

APPENDIX 3D

KLAMATH RIVER REDBAND/RAINBOW TROUT: LENGTH AND GROWTH STATISTICAL ANALYSES CONDUCTED BY ENTRIX, INC.

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January 12, 2004

Mr. Forrest Olson
CH2M Hill
777 108th Avenue NE
Suite 800
Bellevue, WA 98004-5118

Subject: Klamath Hydroelectric Relicensing – Fish Length and Growth Analysis

Dear Mr. Olson,

This letter summarizes the statistical analyses conducted on Klamath River redband/rainbow trout length and growth. The statistical output is provided in a separate file. The effort is in support of the PacifiCorp Klamath hydroelectric relicensing project. Trout were collected in 2002 from three reaches of the Klamath River between Keno Dam and Copco Reservoir: Keno, J.C. Boyle bypass (Bypass), and J.C. Boyle peaking (Peaking). Fish lengths, weights, and scale radii were measured to estimate length-at-age (at annulus). Only fish ages 1 through 4 were included in the analysis because there were insufficient data for older ages. These data were statistically analyzed to address the following questions:

- Do fish from different reaches differ in length? Do those differences change with their age?
- Do fish from different reaches differ in their growth rate? Do those differences change with their age?
- Do fish from different reaches differ in their condition factor? Do those differences change with season?

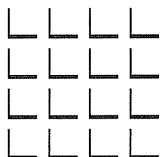
Generalized linear models¹ were used to model the effects of explanatory variables (reach, age, season) on response variables (fish length, growth rate, condition factor).

The analyses for each of these questions are summarized below. The full statistical analyses are provided in a separate attachment. SYSTAT Version 10 was used for all analyses. For a discussion of generalized linear models, see Neter, Wasserman, and Kutner (1990)², Steel and Torrie (1980)³.

¹ Analysis of variance (ANOVA) and linear regression are examples of general linear models.

² Neter, J., W. Wasserman, and M. Kutner. Applied Linear Statistical models, 3rd ed. Irwin: Homewood, IL.

³ Steele, R. and J. Torrie. 1980. Principles and Procedures of Statistics: A Biometrical Approach, 2nd ed. McGraw-Hill: New York.



Fish Length

A regression equation was developed by Jones & Stokes to estimate the length of a given fish at each annulus read from scale samples. These estimated lengths were compared between locations and ages of fish in the following model:

$$\text{Lengthout} = \text{Constant} + \text{Keno} + \text{Bypass} + \text{Estage} + \text{Keno*Estage} + \text{Bypass*Estage},$$

where⁴:

- Lengthout = estimated length of fish
- Constant = intercept of model
- Keno = difference in length at Keno
- Bypass = difference in length at Bypass
- Estage = estimated age of the fish
- Keno*Estage = interaction term measuring the difference in effect of age for Keno
- Bypass*Estage = interaction term measuring the difference in effect of age for Bypass

The Peaking reach is estimated by the base model:

$$\text{Lengthout} = \text{Constant} + \text{Estage}$$

The length of fish from the Bypass and Peaking reaches were not significantly different, either on average or by age class. On average, Keno-reach fish were significantly smaller than those in the other two reaches ($p < .001$). However, a comparison by age indicates a shift in length difference as fish get older. Keno-reach fish are significantly smaller at ages 1 and 2 compared to those in the other two reaches, not significantly different at age 3, and then become significantly larger at age 4 ($p < .001$).

Growth Rate

Growth rates for individual fish were estimated by taking the difference of length estimates for the last complete year (at annulus) of age. These values – by year within each fish – were compared between the three reaches and by age class in the following model:

$$\text{Growthout} = \text{Constant} + \text{Keno} + \text{Bypass} + \text{Yr} + \text{Keno*Yr} + \text{Bypass*Yr}$$

Where:

- Growthout = estimated growth of fish in most recent year
- Constant = intercept of model
- Keno = difference in growth at Keno
- Bypass = difference in growth at Bypass
- Yr = age of fish at end of year's growth
- Keno*Yr = interaction term measuring the difference in effect of age for Keno
- Bypass*Yr = interaction term measuring the difference in effect of age for Bypass

The Peaking reach is estimated by the base model:

$$\text{Growthout} = \text{Constant} + \text{Yr}.$$

⁴ The variable names match the SYSTAT output in the attachment.

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As with the length analysis, only fish from ages 1 through 4 were included in the analysis. The growth was estimated from the most recent age determination on the scale, i.e., growth for 4-year-old fish was estimated by the difference in estimated length between age 4 and age 3.

Growth rates (mm per year) for fish from the Bypass and Peaking reaches were not significantly different, either on average or by age. Keno-reach fish were significantly different ($p < .001$) from the other reaches on average and by age class. Fish from the Keno reach grew more slowly, on average. However, fish from the Bypass and Peaking reaches grew significantly slower after age 3 compared to fish from the Keno reach. This pattern of Keno-reach fish (compared to the other reaches) growing slower at age 1 and 2, catching up by age 3, and then growing faster by age 4 is consistent with the pattern seen with the length-at-age data presented above. The annual growth increment of Keno-reach fish is nearly constant after age 1, whereas it tends to decline with age for fish from the Bypass and Peaking reaches.

Condition Factor

Fish condition factor (K) values were compared between seasons (spring, summer, and fall) and location in the following model:

$$K = \text{Constant} + \text{Loc} + \text{Season} + \text{Loc} * \text{Season}$$

Where:

K = condition factor

Constant = intercept of model

Loc = location of collection (Keno, Bypass, or Peaking)

Season = season of collection (Spring, Summer, or Fall)

Loc*Season = interaction term measuring the difference in K between locations by season

K values did not differ significantly between seasons. There were no significant differences in condition between fish from different locations or seasons, with a single exception. Fish from the Bypass reach in spring had higher condition values than fish from any other location or time of year; on average, their K values were 0.24 higher than those for other fish. Their differences from fish collected at other locations and times were all significant ($p < 0.05$, adjusted for multiple comparisons) except for those fish collected from the Peaking reach in summer.

Sincerely,
ENTRIX, Inc.



Matt Butcher

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.....DIFFERENCES IN LENGTH (BACK-CALCD) BETWEEN REACHES, BY AGE

SYSTAT Rectangular file C:\Project\Klamath\scalein.SYD,
 created Mon Dec 08, 2003 at 11:00:44, contains variables:

IDNO\$	SAMPLELOC\$	LOC\$	DATE	TIME\$	FISHSP\$
FISHID	ESTAGE	LENGTH	SCALERAD	ANNULUS1	ANNULUS2
ANNULUS3	ANNULUS4	ANNULUS5	LENGTHAVE	CORRECTION	ESTYR1
ESTYR2	ESTYR3	ESTYR4	ESTYR5	VAR(24)	LNLENGTH
INT1	INT2	INT3	INT4	INT5	LENGTHOUT
AGE	KENO	BYPASS	PEAKING		

Data for the following results were selected according to:
 (AGE<>0) and (AGE<>5)
 1 case(s) deleted due to missing data.

Eigenvalues of unit scaled X'X

1	2	3	4	5
488	931	361	132	072

6
015

Condition indices

1	2	3	4	5
000	344	107	140	960

6
111

Variance proportions

	1	2	3	4	5
CONSTANT	04	00	35	06	00
KENO	03	10	28	78	60
BYPASS	03	09	24	55	55
ESTAGE	04	00	40	03	00
KENO	03	09	25	65	48
BYPASS	03	10	27	80	82

	6
CONSTANT	0.8
KENO	0.6
BYPASS	0.6
ESTAGE	0.8
KENO	0.6
BYPASS	0.5
	98

Dep Var: LENGTHOUT N: 233 Multiple R: 0.838 Squared multiple R: 0.702

Adjusted squared multiple R: 0.696 Standard error of estimate: 38.094

Effect	Coefficient	Std Error	Std Coef	Tolerance	t
CONSTANT	87.	10.	0.0	.	35
KENO	213	854	00	0.1	4
BYPASS	-	16.	-	0.1	0
ESTAGE	73.077	256	0.488	11	66
KENO*ESTAGE	-	15.	-	0.3	14
BYPASS*ESTAGE	1.190	584	0.008	11	1
	53.	4.5	0.7	0.0	
	319	70	02	62	
	27.	6.5	0.4	98	
	758	87	87	98	
	-	7.0	-	0.1	
	8.348	36	0.126	16	

Effect	Coefficient	Lower 95%	Upper 95%
CONSTANT	87.	65.	108
KENO	213	825	.600
BYPASS	-	-	-
ESTAGE	73.077	105.109	41.045
KENO*ESTAGE	-	-	29.
BYPASS*ESTAGE	1.190	31.898	517
	53.	44.	62.
	319	314	324
	27.	14.	40.
	758	778	737
	-	-	5.5
	8.348	22.213	16

Correlation matrix of regression coefficients

	CONSTANT	KENO	BYPASS	ESTAGE
CONSTANT	1.000			
KENO	-0.668	1.000		
BYPASS	-0.696	0.465	1.000	
ESTAGE	-0.918	0.613	0.639	1.000
KENO	0.637	-0.922	-0.443	-0.694
BYPASS	0.596	-0.398	-0.922	-0.650

BYPASS	
BYPASS	1.000

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio
Regression	776971.074	5	155394.215	107.081
Residual	329419.266	227	1451.186	

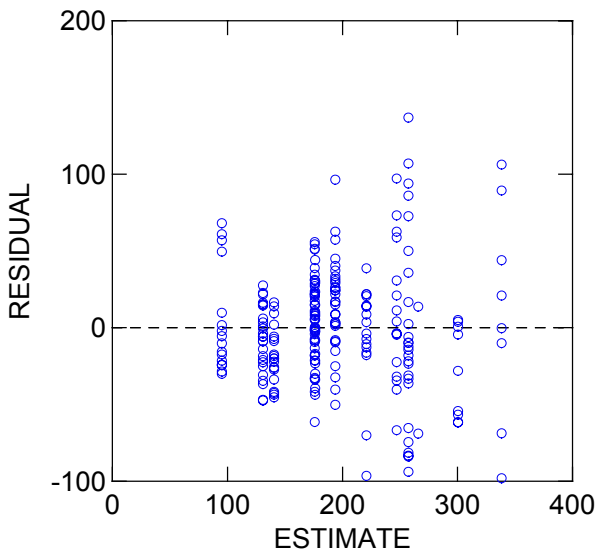
*** WARNING ***

Case 134 is an outlier (Studentized Residual = 3.731)

Durbin-Watson D Statistic 1.694
 First Order Autocorrelation 0.153

Residuals and data have been saved.

Plot of Residuals against Predicted Values



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.....DIFFERENCES IN GROWTH RATE (BY YEAR WITHIN FISH) BETWEEN REACHES

SYSTAT Rectangular file C:\Project\Klamath\in3.SYD,
 created Mon Dec 08, 2003 at 10:38:16, contains variables:

IDNO\$	SAMPLELOC\$	LOC\$	TIME\$	FISHSP\$	FISHID
ESTAGE	LENGTH	SCALERAD	ANNULUS1	ANNULUS2	ANNULUS3
ANNULUS4	ANNULUS5	LENGTHAVE	CORRECTION	ESTYR1	ESTYR2
ESTYR3	ESTYR4	ESTYR5	GROWTH01	GROWTH12	GROWTH23
GROWTH34	GROWTH45	INT1	INT2	INT3	INT4
INT5	GROWTHOUT	YR	KENO	BYPASS	PEAKING

Eigenvalues of unit scaled X'X

	1	2	3	4	5
	491	928	339	149	077

6
015

Condition indices

	1	2	3	4	5
	000	345	210	839	719

6
077

Variance proportions

	1	2	3	4	5
CONSTANT	04	00	43	89	04
KENO	03	10	35	23	86
BYPASS	02	10	23	27	03
YR	04	00	37	90	06
KENO	03	08	28	79	69
BYPASS	03	12	29	40	38

	6
CONSTANT	60
KENO	43
BYPASS	34
YR	64
KENO	13
BYPASS	79

Dep Var: GROWTHOUT N: 240 Multiple R: 0.587 Squared multiple R: 0.344

Adjusted squared multiple R: 0.330 Standard error of estimate: 22.129

Effect	Coefficient	Std Error	Std Coef	Tolerance	t
CONSTANT	122 .871	6.0 78	0.0 00	0.0 .	20. 217
KENO	- 45.637	8.6 47	- 0.789	0.1 25	- 5.278
BYPASS	- 7.268	8.8 96	- 0.128	0.1 13	- 0.817
YR	- 20.162	2.5 46	- 0.755	0.3 08	- 7.918
KENO*YR	16. 035	3.3 53	0.8 12	0.0 97	4.7 82
BYPASS*YR	- 0.331	4.0 18	- 0.013	0.1 18	- 0.082

Effect	Coefficient	Lower 95%	Upper 95%
CONSTANT	122 .871	110 .898	134 .845
KENO	- 45.637	- 62.673	- 28.600
BYPASS	- 7.268	- 24.794	10. 257
YR	- 20.162	- 25.179	- 15.145
KENO*YR	16. 035	9.4 28	22. 641
BYPASS*YR	- 0.331	- 8.247	7.5 85

Correlation matrix of regression coefficients

	CONSTANT	KENO	BYPASS	YR
CONSTANT	1.000			
KENO	-0.703	1.000		
BYPASS	-0.683	0.480	1.000	
YR	-0.912	0.641	0.623	1.000
KENO	0.693	-0.909	-0.473	-0.759
BYPASS	0.578	-0.406	-0.919	-0.634

	BYPASS
BYPASS	1.000

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio
Regression	60171.030	5	12034.206	24.575
Residual	114587.566	234	489.690	

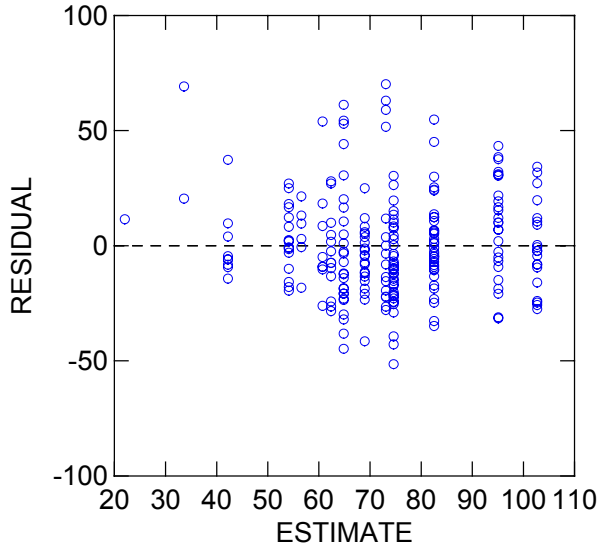
*** WARNING ***

Case 240 has large leverage (Leverage = 0.118)

Durbin-Watson D Statistic 0.621
First Order Autocorrelation 0.685

Residuals and data have been saved.

Plot of Residuals against Predicted Values



SYSTAT Rectangular file C:\Project\Klamath\in3.SYD,
created Mon Dec 08, 2003 at 10:38:16, contains variables:

IDNO\$	SAMPLELOC\$	LOC\$	TIME\$	FISHSP\$	FISHID
ESTAGE	LENGTH	SCALERAD	ANNULUS1	ANNULUS2	ANNULUS3
ANNULUS4	ANNULUS5	LENGTHAVE	CORRECTION	ESTYR1	ESTYR2
ESTYR3	ESTYR4	ESTYR5	GROWTH01	GROWTH12	GROWTH23
GROWTH34	GROWTH45	INT1	INT2	INT3	INT4
INT5	GROWTHOUT	YR	KENO	BYPASS	PEAKING

Data for the following results were selected according to:
loc\$ = 'Keno'

Eigenvalues of unit scaled X'X

1		2	
	1.		0.
912		088	

Condition indices

1		2	
	1.		4.
000		664	

Variance proportions

	1		2	
CONSTANT	44	0.0	56	0.9
YR	44	0.0	56	0.9

Dep Var: GROWTHOUT N: 77 Multiple R: 0.183 Squared multiple R: 0.034

Adjusted squared multiple R: 0.021 Standard error of estimate: 25.951

Effect	Coefficient	Std Error	Std Coef	Tolerance	t
CONSTANT	77. 235	14	0.0		10. 706
YR	- 4.127	2.5 59	- 0.183	1.0 00	- 1.613

Effect	Coefficient	Lower 95%	Upper 95%
CONSTANT	77. 235	62. 864	91. 606
YR	- 4.127	- 9.225	0.9 70

Correlation matrix of regression coefficients

	CONSTANT	YR
CONSTANT	1.000	
YR	-0.912	1.000

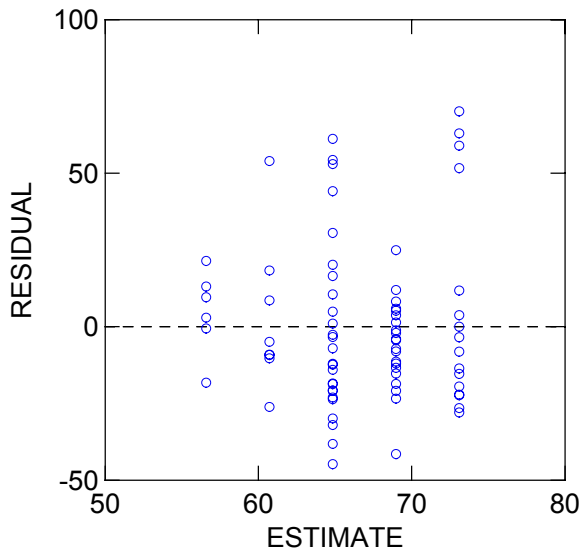
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio
Regression	1751.994	1	1751.994	2.601
Residual	50510.944	75	673.479	

Durbin-Watson D Statistic 0.739
 First Order Autocorrelation 0.626

Residuals and data have been saved.

Plot of Residuals against Predicted Values



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.....DIFFERENCES IN GROWTH RATE (BY YEAR WITHIN FISH) BETWEEN REACHES

SYSTAT Rectangular file C:\Project\Klamath\in3.SYD,
created Mon Dec 08, 2003 at 10:38:16, contains variables:

IDNO\$	SAMPLELOC\$	LOC\$	TIME\$	FISHSP\$	FISHID
ESTAGE	LENGTH	SCALERAD	ANNULUS1	ANNULUS2	ANNULUS3
ANNULUS4	ANNULUS5	LENGTHAVE	CORRECTION	ESTYR1	ESTYR2
ESTYR3	ESTYR4	ESTYR5	GROWTH01	GROWTH12	GROWTH23
GROWTH34	GROWTH45	INT1	INT2	INT3	INT4
INT5	GROWTHOUT	YR	KENO	BYPASS	PEAKING

Eigenvalues of unit scaled X'X

1	2	3	4
659	007	259	076

Condition indices

1	2	3	4
000	1.625	1.206	3.905

Variance proportions

	1	2	3	4
CONSTANT	0.0	0.0	0.0	0.9
KENO	0.0	0.2	0.7	0.0
BYPASS	0.0	0.2	0.5	0.1
YR	0.0	0.0	0.1	0.8

Dep Var: GROWTHOUT N: 240 Multiple R: 0.509 Squared multiple R: 0.260

Adjusted squared multiple R: 0.250 Standard error of estimate: 23.416

Effect	Coefficient	Std Error	Std Coef	Tolerance	t
CONSTANT	107	4.2	0.0		25.
	.356	76	00		104
KENO	-	3.7	-	0.7	-
	7.214	99	0.125	26	1.899
BYPASS	-	3.6	-	0.7	-
	6.224	88	0.110	38	1.687
YR	-	1.5	-	0.9	-
	13.035	47	0.488	34	8.426

Effect	Coefficient	Lower 95%	Upper 95%
CONSTANT	107.356	98.931	115.780
KENO	7.214	14.699	71.0
BYPASS	6.224	13.489	42.0
YR	13.035	16.083	9.987

Correlation matrix of regression coefficients

	CONSTANT	KENO	BYPASS	YR
CONSTANT	1.000			
KENO	-0.301	1.000		
BYPASS	-0.518	0.479	1.000	
YR	-0.788	-0.161	0.099	1.000

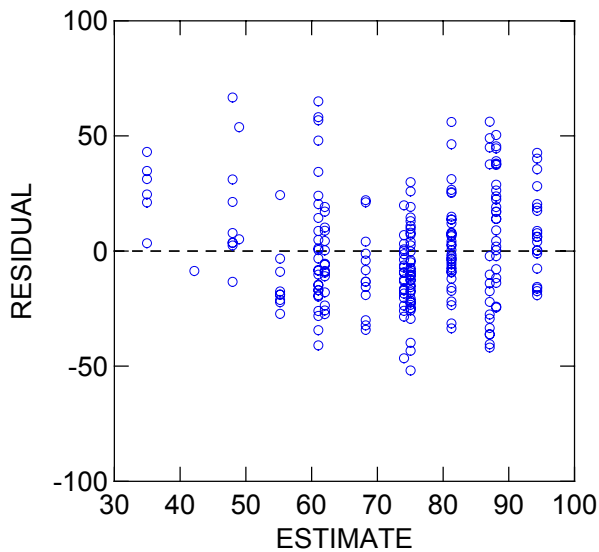
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio
Regression	45353.691	3	15117.897	27.571
Residual	129404.905	236	548.326	

Durbin-Watson D Statistic 0.555
 First Order Autocorrelation 0.717

Residuals and data have been saved.

Plot of Residuals against Predicted Values



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DIFFERENCES IN CONDITION FACTOR BETWEEN REACHES AND SEASONS

SYSTAT Rectangular file C:\Project\Klamath\condition.SYD,
 created Mon Jan 12, 2004 at 16:22:45, contains variables:

REACH\$	STATION\$	LOC\$	SEASON\$	DATE
SPECIES\$	LENGTH	WEIGHT	K	LNLENGTH
LNK	SPRING	SUMMER	FALL	KENO
PEAKING				

Eigenvalues of unit scaled X'X

1	2	3	4	5
3.	1.	1.	1.	0.
552	954	734	000	312

6	7	8	9
0.	0.	0.	0.
187	160	087	014

Condition indices

1	2	3	4	5
1.	1.	1.	1.	3.
000	348	431	885	374

6	7	8	9
4.3	4.7	6.3	16.
59	10	78	113

Variance proportions

	1	2	3	4	5
CONSTANT	03	00	00	00	29
KENO	02	13	03	00	20
BYPASS	03	04	01	00	20
SPRING	02	09	37	00	53
FALL	03	00	02	00	09
KENO	01	23	15	32	21
KENO	02	08	10	11	04
BYPASS	01	01	48	24	57
BYPASS	03	06	00	03	10

	6	7	8	9
CONSTANT	16	80	01	70
KENO	10	59	30	64
BYPASS	26	53	31	60
SPRING	89	66	03	42
FALL	76	66	00	43
KENO	29	29	22	28
KENO	49	61	98	54
BYPASS	87	22	62	98
BYPASS	40	55	32	51

Dep Var: K N: 629 Multiple R: 0.222 Squared multiple R: 0.049

Adjusted squared multiple R: 0.037 Standard error of estimate: 0.270

Effect	Coefficient	Std Error	Std Coef	Tolerance	t
CONSTANT	1.2	0.0	0.0	.	090
KENO	0.131	0.0	0.207	22	1
BYPASS	0.085	0.0	0.155	20	1
SPRING	0.073	0.0	0.094	20	1
FALL	0.117	0.0	0.197	75	2
KENO*SPRING	0.1	0.0	0.0	09	34
KENO*FALL	0.2	0.0	0.3	29	65
BYPASS*SPRING	0.3	0.0	0.2	27	15
BYPASS*FALL	0.1	0.0	0.3	03	80

Effect	Coefficient	Lower 95%	Upper 95%
CONSTANT	1.2	1.1	1.3
KENO	0.131	0.271	0.0
BYPASS	0.085	0.207	0.0
SPRING	0.073	0.200	0.0
FALL	0.117	0.225	0.008
KENO*SPRING	0.1	0.092	0.2
KENO*FALL	0.2	0.0	0.3
BYPASS*SPRING	0.3	0.1	0.5
BYPASS*FALL	0.1	0.0	0.3

Correlation matrix of regression coefficients

	CONSTANT	KENO	BYPASS	SPRING
CONSTANT	1.000			
KENO	-0.682	1.000		
BYPASS	-0.779	0.532	1.000	
SPRING	-0.746	0.509	0.582	1.000
FALL	-0.875	0.597	0.682	0.653
KENO	0.489	-0.717	-0.381	-0.655
KENO	0.603	-0.884	-0.470	-0.450
BYPASS	0.531	-0.362	-0.681	-0.711
BYPASS	0.692	-0.472	-0.887	-0.516

	KENO	KENO	BYPASS	BYPASS
KENO	1.000			
KENO	0.633	1.000		
BYPASS	0.466	0.320	1.000	
BYPASS	0.338	0.545	0.604	1.000

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio
Regression	2.339	8	0.292	4.024
Residual	45.049	620	0.073	

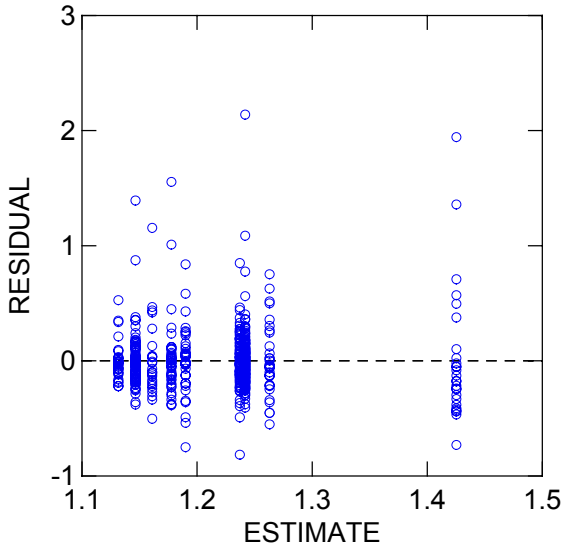
*** WARNING ***

Case 3 is an outlier (Studentized Residual = 4.434)
Case 158 is an outlier (Studentized Residual = 7.676)
Case 165 is an outlier (Studentized Residual = 5.236)
Case 194 is an outlier (Studentized Residual = 5.984)
Case 287 is an outlier (Studentized Residual = 8.381)
Case 312 is an outlier (Studentized Residual = 4.088)
Case 532 is an outlier (Studentized Residual = 5.302)

Durbin-Watson D Statistic 1.795
First Order Autocorrelation 0.102

Residuals and data have been saved.

Plot of Residuals against Predicted Values



SYSTAT Rectangular file C:\Project\Klamath\condition.SYD,
 created Mon Jan 12, 2004 at 16:22:45, contains variables:

REACH\$	STATION\$	LOC\$	SEASON\$	DATE
SPECIES\$	LENGTH	WEIGHT	K	LNLENGTH
LNK	SPRING	SUMMER	FALL	KENO
PEAKING				

Effects coding used for categorical variables in model.

Categorical values encountered during processing are:

LOC\$ (3 levels)
 Bypass, Keno, Peaking
 SEASON\$ (3 levels)
 Fall, Spring, Summer

Dep Var: K N: 629 Multiple R: 0.222 Squared multiple R: 0.049

-1

Estimates of effects $B = (X'X)^{-1} X'Y$

			K
CONSTANT			1.219
LOC\$	Bypass		0.062
LOC\$	Keno		-0.043
SEASON\$	Fall		-0.011
SEASON\$	Spring		0.039
LOC\$	Bypass		
SEASON\$	Fall		-0.029
LOC\$	Bypass		
SEASON\$	Spring		0.104
LOC\$	Keno		
SEASON\$	Fall		0.071
LOC\$	Keno		
SEASON\$	Spring		-0.055

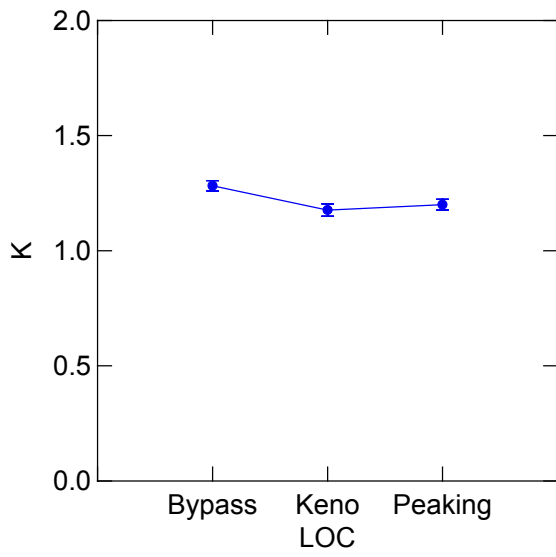
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio
LOC\$	0.801	2	0.400	5.509
SEASON\$	0.243	2	0.122	1.673
LOC\$*SEASON\$	1.475	4	0.369	5.073
Error	45.049	620	0.073	

Least squares means

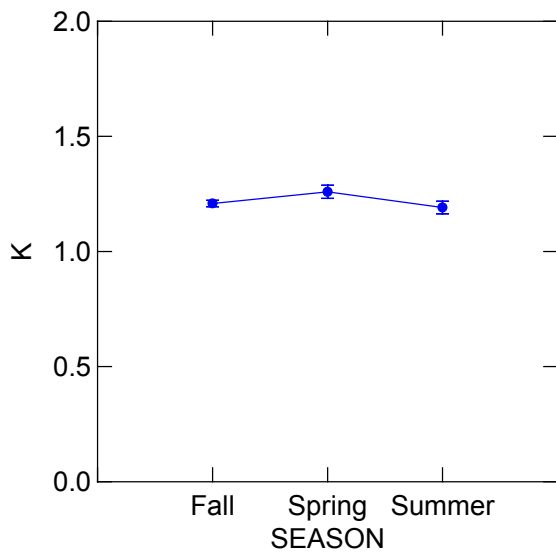
		LS Mean	SE	N
LOC\$	Bypass	1.282	0.022	301
LOC\$	Keno	1.177	0.026	157
LOC\$	Peaking	1.200	0.023	171

Least Squares Means



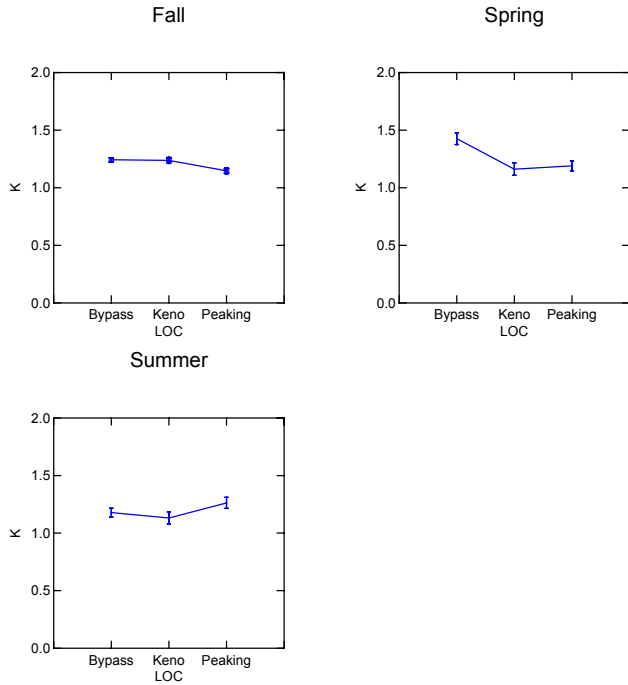
SEASON\$	Fall	1.209	0.014	431
SEASON\$	Spring	1.259	0.029	92
SEASON\$	Summer	1.191	0.027	106

Least Squares Means



LOC\$	Bypass			
SEASON\$	Fall	1.242	0.018	225
LOC\$	Bypass			
SEASON\$	Spring	1.425	0.051	28
LOC\$	Bypass			
SEASON\$	Summer	1.178	0.039	48
LOC\$	Keno			
SEASON\$	Fall	1.237	0.026	105
LOC\$	Keno			
SEASON\$	Spring	1.161	0.054	25
LOC\$	Keno			
SEASON\$	Summer	1.132	0.052	27
LOC\$	Peaking			
SEASON\$	Fall	1.147	0.027	101
LOC\$	Peaking			
SEASON\$	Spring	1.190	0.043	39
LOC\$	Peaking			
SEASON\$	Summer	1.263	0.048	31

Least Squares Means



*** WARNING ***

Case	3 is an outlier	(Studentized Residual =	4.434)
Case	158 is an outlier	(Studentized Residual =	7.676)
Case	165 is an outlier	(Studentized Residual =	5.236)
Case	194 is an outlier	(Studentized Residual =	5.984)
Case	287 is an outlier	(Studentized Residual =	8.381)
Case	312 is an outlier	(Studentized Residual =	4.088)
Case	532 is an outlier	(Studentized Residual =	5.302)

Durbin-Watson D Statistic 1.795
 First Order Autocorrelation 0.102

Residuals and data have been saved.

COL/

ROW	LOC\$	SEASON\$
1	Bypass	Fall
2	Bypass	Spring
3	Bypass	Summer
4	Keno	Fall
5	Keno	Spring
6	Keno	Summer
7	Peaking	Fall
8	Peaking	Spring
9	Peaking	Summer

Using least squares means.
 Post Hoc test of K

Using model MSE of 0.073 with 620 df.

Matrix of pairwise mean differences:

	1	2	3	4	5
1	00	0.1			
2	84	00	0.0		
3	0.064	0.248	00	0.0	
4	0.005	0.188	59	00	0.0
5	0.081	0.264	0.017	0.076	00
6	0.110	0.294	0.046	0.106	0.029
7	0.095	0.279	0.031	0.091	0.015
8	0.052	0.235	12	0.047	29
9	21	0.162	85	26	02

	6	7	8	9
6	000	0.		
7	015	000	0.	
8	058	044	000	0.
9	131	117	073	000

Tukey HSD Multiple Comparisons.

Matrix of pairwise comparison probabilities:

	1	2	3	4	5
1	000	1.			
2	020	000	1.		
3	858	004	000	1.	
4	000	029	941	000	1.
5	890	011	000	940	000
6	538	002	999	673	000
7	077	000	999	277	000
8	973	013	000	991	000
9	000	336	908	000	895

	6	7	8	9
	1.			
6	000			
	1.	1.		
7	000	000		
	0.	0.	1.	
8	995	995	000	
	0.	0.	0.	1.
9	647	470	971	000

SYSTAT Rectangular file C:\Project\Klamath\condition.SYD,
 created Mon Jan 12, 2004 at 16:22:45, contains variables:

REACH\$	STATION\$	LOC\$	SEASON\$	DATE
SPECIES\$	LENGTH	WEIGHT	K	LNLENGTH
LNK	SPRING	SUMMER	FALL	KENO
PEAKING				

Effects coding used for categorical variables in model.

Categorical values encountered during processing are:

LOC\$ (3 levels)
 Bypass, Keno, Peaking
 SEASON\$ (3 levels)
 Fall, Spring, Summer

Dep Var: K N: 629 Multiple R: 0.170 Squared multiple R: 0.029

Estimates of effects $B = (X'X)^{-1} X'Y$

		K
CONSTANT		1.219
LOC\$	Bypass	
SEASON\$	Fall	0.015
LOC\$	Bypass	
SEASON\$	Spring	0.071
LOC\$	Keno	
SEASON\$	Fall	0.041
LOC\$	Keno	
SEASON\$	Spring	-0.036

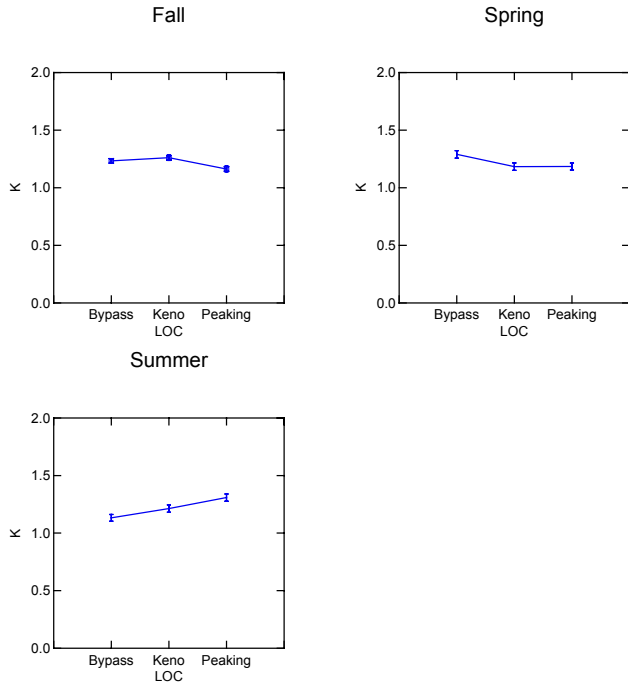
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio
LOC\$*SEASON\$	1.369	4	0.342	4.641
Error	46.018	624	0.074	

Least squares means

		LS Mean	SE	N
LOC\$	Bypass			
SEASON\$	Fall	1.233	0.017	225
LOC\$	Bypass			
SEASON\$	Spring	1.289	0.032	28
LOC\$	Bypass			
SEASON\$	Summer	1.133	0.029	48
LOC\$	Keno			
SEASON\$	Fall	1.260	0.023	105
LOC\$	Keno			
SEASON\$	Spring	1.182	0.032	25
LOC\$	Keno			
SEASON\$	Summer	1.213	0.032	27
LOC\$	Peaking			
SEASON\$	Fall	1.163	0.024	101
LOC\$	Peaking			
SEASON\$	Spring	1.184	0.030	39
LOC\$	Peaking			
SEASON\$	Summer	1.309	0.031	31

Least Squares Means



*** WARNING ***

Case	3 is an outlier	(Studentized Residual =	4.256)
Case	158 is an outlier	(Studentized Residual =	8.101)
Case	165 is an outlier	(Studentized Residual =	5.675)
Case	194 is an outlier	(Studentized Residual =	6.087)
Case	287 is an outlier	(Studentized Residual =	8.345)
Case	312 is an outlier	(Studentized Residual =	4.089)
Case	532 is an outlier	(Studentized Residual =	5.191)

Durbin-Watson D Statistic 1.770
 First Order Autocorrelation 0.114

Residuals and data have been saved.

COL/

ROW	LOC\$	SEASON\$
1	Bypass	Fall
2	Bypass	Spring
3	Bypass	Summer
4	Keno	Fall
5	Keno	Spring
6	Keno	Summer
7	Peaking	Fall
8	Peaking	Spring
9	Peaking	Summer

Using least squares means.
 Post Hoc test of K

Using model MSE of 0.074 with 624 df.

Matrix of pairwise mean differences:

	1	2	3	4	5
	0.0				
1	00				
	0.0	0.0			
2	56	00			
	-	-	0.0		
3	0.100	0.156	00		
	0.0	-	0.1	0.0	
4	27	0.029	27	00	
	-	-	0.0	-	0.0
5	0.051	0.107	49	0.078	00
	-	-	0.0	-	0.0
6	0.020	0.076	80	0.047	31
	-	-	0.0	-	-
7	0.071	0.127	29	0.097	0.020
	-	-	0.0	-	0.0
8	0.049	0.105	51	0.076	02
	0.0	0.0	0.1	0.0	0.1
9	76	20	76	49	27

	6	7	8	9
	0.0			
6	00			
	-	0.0		
7	0.051	00		
	-	0.0	0.0	
8	0.029	21	00	
	0.0	0.1	0.1	0.0
9	96	47	25	00

Tukey HSD Multiple Comparisons.

Matrix of pairwise comparison probabilities:

	1	2	3	4	5
	1.				
1	000				
	0.	1.			
2	856	000			
	0.	0.	1.		
3	091	080	000		
	0.	0.	0.	1.	
4	993	992	003	000	
	0.	0.	0.	0.	1.
5	814	492	798	628	000
	1.	0.	0.	0.	1.
6	000	275	803	967	000
	0.	0.	0.	0.	1.
7	317	003	992	129	000
	0.	0.	0.	0.	1.
8	798	418	814	275	000
	0.	1.	0.	0.	0.
9	275	000	006	798	003

	6	7	8	9
	1.			
6	000			
	0.	1.		
7	814	000		
	0.	1.	1.	
8	992	000	000	
	0.	0.	0.	1.
9	669	008	337	000

ERROR

End of line not expected.

.....

.....REVISION TO APPROACH DROPS THE BYPASS REACH:.....

.....DIFFERENCES IN LENGTH (BACK-CALCD) BETWEEN REACHES, BY AGE

SYSTAT Rectangular file C:\Project\Klamath\scalein.SYD,
 created Mon Dec 08, 2003 at 11:00:44, contains variables:

IDNO\$	SAMPLELOC\$	LOC\$	DATE	TIME\$	FISHSP\$
FISHID	ESTAGE	LENGTH	SCALERAD	ANNULUS1	ANNULUS2
ANNULUS3	ANNULUS4	ANNULUS5	LENGTHAVE	CORRECTION	ESTYR1
ESTYR2	ESTYR3	ESTYR4	ESTYR5	VAR(24)	LNLENGTH
INT1	INT2	INT3	INT4	INT5	LENGTHOUT
AGE	KENO	BYPASS	PEAKING		

Data for the following results were selected according to:
 (estAGE>0) AND (estAGE<5) AND loc\$ <> 'Bypass'

Effects coding used for categorical variables in model.

Categorical values encountered during processing are:

LOC\$ (2 levels)
 Keno, Peaking
 ESTAGE (4 levels)
 1, 2, 3, 4

Dep Var: LENGTHOUT N: 149 Multiple R: 0.854 Squared multiple R: 0.730

-1

Estimates of effects B = (X'X)⁻¹ X'Y

LENGTHOUT		
CONSTANT		216.805
ESTAGE	1	-106.002
ESTAGE	2	-25.749
ESTAGE	3	38.237
LOC\$	Keno	2.097
ESTAGE	1	
LOC\$	Keno	-13.543
ESTAGE	2	
LOC\$	Keno	-19.240
ESTAGE	3	
LOC\$	Keno	-3.594

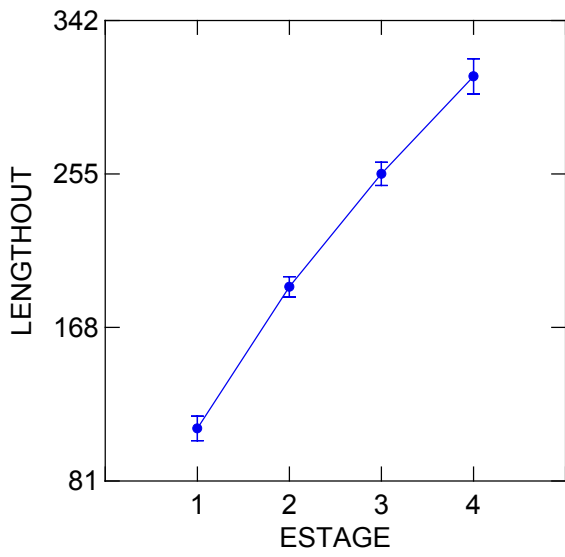
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio
ESTAGE	611971.921	3	203990.640	120.527
LOC\$	533.751	1	533.751	0.315
ESTAGE*LOC\$	41547.018	3	13849.006	8.183
Error	238640.929	141	1692.489	

Least squares means

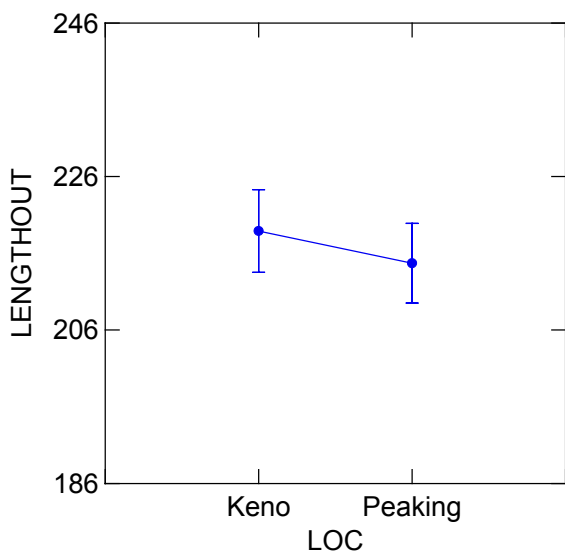
		LS Mean	SE	N
ESTAGE	1	110.803	6.899	36
ESTAGE	2	191.057	5.742	54
ESTAGE	3	255.042	6.536	42
ESTAGE	4	310.319	9.995	17

Least Squares Means



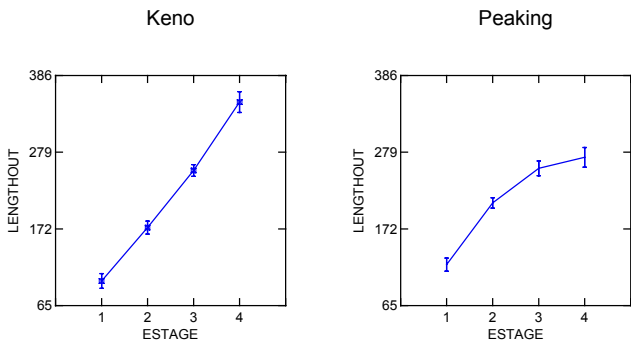
LOC\$	Keno	218.903	5.380	71
LOC\$	Peaking	214.708	5.183	78

Least Squares Means



ESTAGE		1			
LOC\$	Keno		99.358	10.285	16
ESTAGE		1			
LOC\$	Peaking		122.249	9.199	20
ESTAGE		2			
LOC\$	Keno		173.914	8.977	21
ESTAGE		2			
LOC\$	Peaking		208.199	7.162	33
ESTAGE		3			
LOC\$	Keno		253.545	8.068	26
ESTAGE		3			
LOC\$	Peaking		256.538	10.285	16
ESTAGE		4			
LOC\$	Keno		348.793	14.545	8
ESTAGE		4			
LOC\$	Peaking		271.845	13.713	9

Least Squares Means



*** WARNING ***
 Case 134 is an outlier (Studentized Residual = 3.635)

Durbin-Watson D Statistic 1.866
 First Order Autocorrelation 0.065

Residuals and data have been saved.

COL/
 ROW ESTAGE LOC\$
 1 1 Keno
 2 1 Peaking
 3 2 Keno
 4 2 Peaking
 5 3 Keno
 6 3 Peaking
 7 4 Keno
 8 4 Peaking
 Using least squares means.
 Post Hoc test of LENGTHOUT

Using model MSE of 1692.489 with 141 df.

Matrix of pairwise mean differences:

	1	2	3	4	5
1	0.000				
2	22.891	0.000			
3	74.556	51.665	0.000		
4	108.841	85.950	34.285	0.000	
5	154.188	131.297	79.631	45.346	0.000
6	157.180	134.289	82.624	48.339	2.993
7	249.435	226.544	174.879	140.594	95.248
8	172.487	149.596	97.931	63.646	18.300

	6	7	8
6	0.000		
7	92.255	0.000	
8	15.307	-76.948	0.000

Tukey HSD Multiple Comparisons.

Matrix of pairwise comparison probabilities:

	1	2	3	4	5
		1.			
1 000		0.	1.		
2 714		0.	0.	1.	
3 000		002	000	0.	1.
4 000		000	057	000	
5 000		0.	0.	0.	000
6 000		000	000	003	000
7 000		000	000	000	000
8 000		000	000	001	946

	6	7	8
	1.		
6 000	0.	1.	
7 000	000	0.	1.
8 987	003	000	

SYSTAT Rectangular file C:\Project\Klamath\scalein.SYD,
 created Mon Dec 08, 2003 at 11:00:44, contains variables:

IDNO\$	SAMPLELOC\$	LOC\$	DATE	TIME\$	FISHSP\$
FISHID	ESTAGE	LENGTH	SCALERAD	ANNULUS1	ANNULUS2
ANNULUS3	ANNULUS4	ANNULUS5	LENGTHAVE	CORRECTION	ESTYR1
ESTYR2	ESTYR3	ESTYR4	ESTYR5	VAR(24)	LNLENGTH
INT1	INT2	INT3	INT4	INT5	LENGTHOUT
AGE	KENO	BYPASS	PEAKING		

Data for the following results were selected according to:
 (estAGE>0) AND (estAGE<5)

Effects coding used for categorical variables in model.

Categorical values encountered during processing are:

LOC\$ (3 levels)

Bypass, Keno, Peaking

ESTAGE (4 levels)

1, 2, 3, 4

Dep Var: LENGTHOUT N: 233 Multiple R: 0.854 Squared multiple R: 0.729

-1

Estimates of effects B = (X'X)⁻¹ X'Y

LENGTHOUT		
CONSTANT		208.076
ESTAGE	1	-92.978
ESTAGE	2	-19.276
ESTAGE	3	34.043
LOC\$	Bypass	-17.459
LOC\$	Keno	10.827
ESTAGE	1	
LOC\$	Bypass	26.048
ESTAGE	1	
LOC\$	Keno	-26.567
ESTAGE	2	
LOC\$	Bypass	12.945
ESTAGE	2	
LOC\$	Keno	-25.712
ESTAGE	3	
LOC\$	Bypass	-8.387
ESTAGE	3	
LOC\$	Keno	0.600

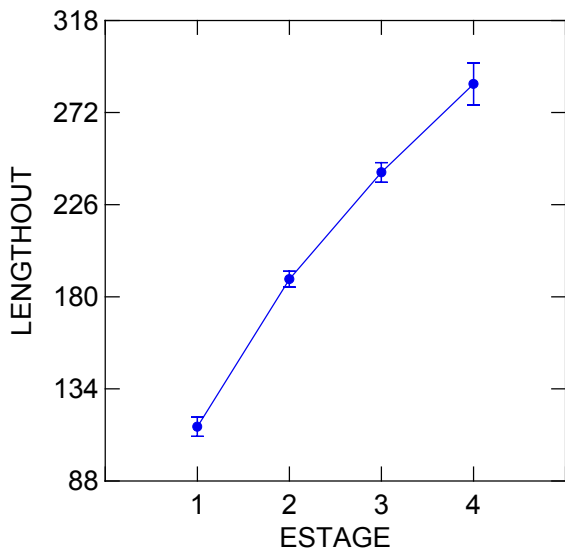
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio
ESTAGE	599985.204	3	199995.068	147.561
LOC\$	14988.942	2	7494.471	5.530
ESTAGE*LOC\$	65497.537	6	10916.256	8.054
Error	299530.210	221	1355.340	

Least squares means

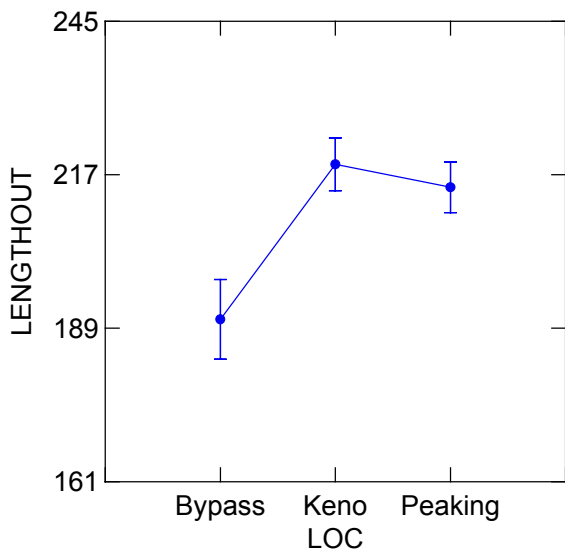
		LS Mean	SE	N
ESTAGE	1	115.098	4.768	62
ESTAGE	2	188.800	3.949	93
ESTAGE	3	242.119	4.905	59
ESTAGE	4	286.287	10.529	19

Least Squares Means



LOC\$	Bypass	190.617	7.264	84
LOC\$	Keno	218.903	4.814	71
LOC\$	Peaking	214.708	4.638	78

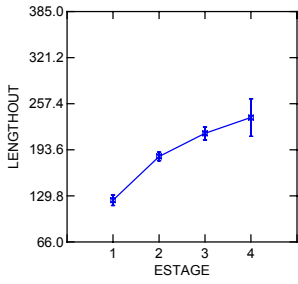
Least Squares Means



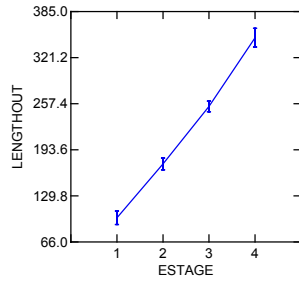
ESTAGE		1			
LOC\$	Bypass		123.686	7.220	26
ESTAGE		1			
LOC\$	Keno		99.358	9.204	16
ESTAGE		1			
LOC\$	Peaking		122.249	8.232	20
ESTAGE		2			
LOC\$	Bypass		184.286	5.895	39
ESTAGE		2			
LOC\$	Keno		173.914	8.034	21
ESTAGE		2			
LOC\$	Peaking		208.199	6.409	33
ESTAGE		3			
LOC\$	Bypass		216.272	8.929	17
ESTAGE		3			
LOC\$	Keno		253.545	7.220	26
ESTAGE		3			
LOC\$	Peaking		256.538	9.204	16
ESTAGE		4			
LOC\$	Bypass		238.222	26.032	2
ESTAGE		4			
LOC\$	Keno		348.793	13.016	8
ESTAGE		4			
LOC\$	Peaking		271.845	12.272	9

Least Squares Means

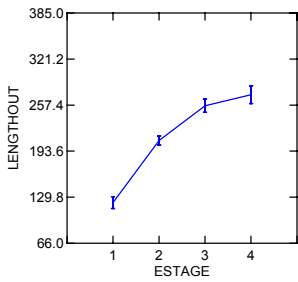
Bypass



Keno



Peaking



*** WARNING ***

Case 134 is an outlier (Studentized Residual = 4.028)

Durbin-Watson D Statistic 1.847

First Order Autocorrelation 0.075

Residuals and data have been saved.

COL/

ROW	ESTAGE	LOC\$
1	1	Bypass
2	1	Keno
3	1	Peaking
4	2	Bypass
5	2	Keno
6	2	Peaking
7	3	Bypass
8	3	Keno
9	3	Peaking
10	4	Bypass
11	4	Keno
12	4	Peaking

Using least squares means.

Post Hoc test of LENGTHOUT

Using model MSE of 1355.340 with 221 df.

Matrix of pairwise mean differences:

	1	2	3	4	5
1	0.000				
2	-24.328	0.000			
3	-1.437	22.891	0.000		
4	60.600	84.928	62.037	0.000	
5	50.228	74.556	51.665	-10.372	0.000
6	84.513	108.841	85.950	23.913	34.285
7	92.586	116.915	94.024	31.986	42.358
8	129.859	154.188	131.297	69.259	79.631
9	132.852	157.180	134.289	72.252	82.624
10	114.536	138.864	115.973	53.936	64.307
11	225.107	249.435	226.544	164.507	174.879
12	148.159	172.487	149.596	87.559	97.931

	6	7	8	9	10
6	0.000				
7	8.073	0.000			
8	45.346	37.273	0.000		
9	48.339	40.266	2.993	0.000	
10	30.023	21.949	-15.324	-18.317	0.000
11	140.594	132.521	95.248	92.255	110.571
12	63.646	55.573	18.300	15.307	33.623

	11	12
11	0.000	
12	-76.948	0.000

Tukey HSD Multiple Comparisons.

Matrix of pairwise comparison probabilities:

	1	2	3	4	5
	1.				
1 000	0.	1.			
2 637	1.	000	0.	1.	
3 000	0.	788	000	0.	1.
4 000	0.	000	000	000	0.
5 000	0.	000	000	997	000
6 000	0.	000	000	204	040
7 000	0.	000	000	111	022
8 000	0.	000	000	000	000
9 000	0.	000	000	000	000
10 001	0.	000	001	679	433
11 000	0.	000	000	000	000
12 000	0.	000	000	000	000

	6	7	8	9	10
6 000	1.				
7 000	1.	1.			
8 000	0.053	0.000	1.		
9 001	0.073	0.000	1.	1.	
10 994	0.000	1.000	1.000	1.000	1.
11 000	0.000	0.000	0.000	0.008	0.
12 000	0.013	0.981	0.998	0.991	0.

	11	12
11 000	1.	
12 001	0.000	1.

.....
 :::::DIFFERENCES IN GROWTH RATE (BY YEAR WITHIN FISH) BETWEEN REACHES :::::

SYSTAT Rectangular file C:\Project\Klamath\in3.SYD,
 created Mon Dec 08, 2003 at 10:38:16, contains variables:

IDNO\$	SAMPLELOC\$	LOC\$	TIME\$	FISHSP\$	FISHID
ESTAGE	LENGTH	SCALERAD	ANNULUS1	ANNULUS2	ANNULUS3
ANNULUS4	ANNULUS5	LENGTHAVE	CORRECTION	ESTYR1	ESTYR2
ESTYR3	ESTYR4	ESTYR5	GROWTH01	GROWTH12	GROWTH23
GROWTH34	GROWTH45	INT1	INT2	INT3	INT4
INT5	GROWTHOUT	YR	KENO	BYPASS	PEAKING

Data for the following results were selected according to:
(yr>0)

Effects coding used for categorical variables in model.

Categorical values encountered during processing are:

LOC\$ (3 levels)

Bypass, Keno, Peaking

YR (5 levels)

1, 2, 3, 4, 5

The following effects have lost degrees of freedom.

Effect	Initial df	Lost df	Final df
YR*LOC\$	8	1	7

Dep Var: GROWTHOUT N: 240 Multiple R: 0.639 Squared multiple R: 0.409

-1

Estimates of effects $B = (X'X)^{-1} X'Y$

GROWTHOUT			
CONSTANT			62.085
YR		1	33.013
YR		2	8.706
YR		3	-2.348
YR		4	-0.669
LOC\$	Bypass		-6.157
LOC\$	Keno		4.107
YR		1	
LOC\$	Bypass		14.745
YR		1	
LOC\$	Keno		-19.847
YR		2	
LOC\$	Bypass		0.845
YR		2	
LOC\$	Keno		-11.768
YR		3	
LOC\$	Bypass		3.126
YR		3	
LOC\$	Keno		23.145
YR		4	
LOC\$	Bypass		-2.176
YR		4	
LOC\$	Keno		-2.176

Analysis of Variance

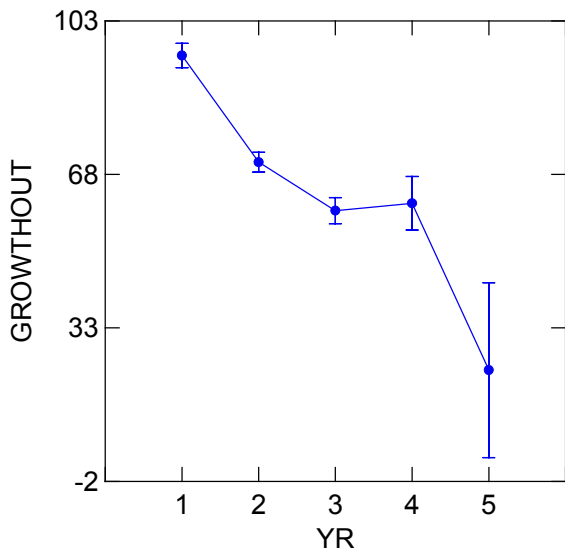
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Model	71389.050	13	5491.465	12.006	0.00
Error	103369.546	226	457.387		

Least squares means

		LS Mean	SE	N
YR	1	95.098	2.770	62
YR	2	70.791	2.266	96

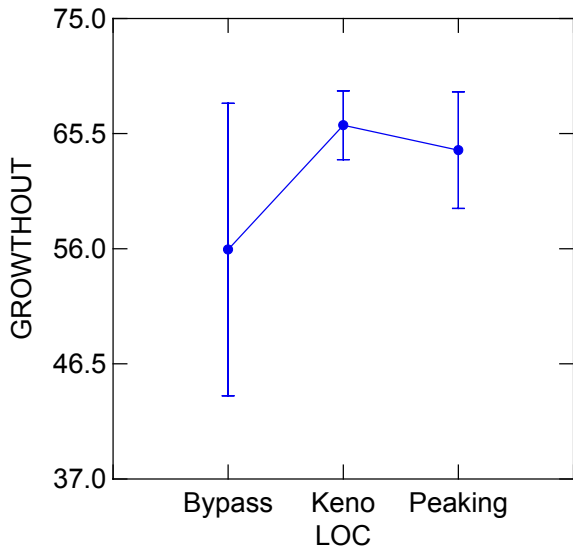
YR	3	59.737	2.975	56
YR	4	61.416	6.116	19
YR	5	23.384	19.944	7

Least Squares Means



LOC\$	Bypass	55.928	12.067	84
LOC\$	Keno	66.192	2.838	77
LOC\$	Peaking	64.134	4.812	79

Least Squares Means

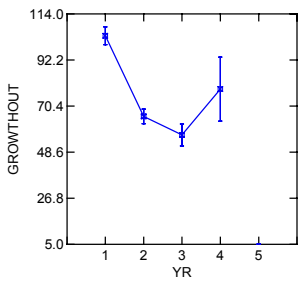


YR		1			
LOC\$	Bypass		103.686	4.194	26
YR		1			
LOC\$	Keno		79.358	5.347	16
YR		1			
LOC\$	Peaking		102.249	4.782	20
YR		2			
LOC\$	Bypass		65.478	3.425	39
YR		2			
LOC\$	Keno		63.130	4.667	21
YR		2			
LOC\$	Peaking		83.763	3.564	36
YR		3			
LOC\$	Bypass		56.706	5.187	17

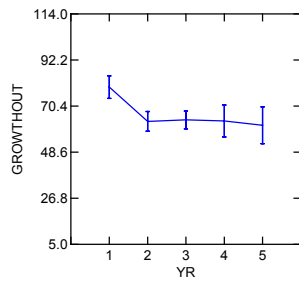
YR		3			
LOC\$	Keno		63.845	4.194	26
YR		3			
LOC\$	Peaking		58.661	5.932	13
YR		4			
LOC\$	Bypass		78.404	15.123	2
YR		4			
LOC\$	Keno		63.347	7.561	8
YR		4			
LOC\$	Peaking		42.496	7.129	9
YR		5			
LOC\$	Keno		61.282	8.731	6
YR		5			
LOC\$	Peaking		33.504	21.387	1

Least Squares Means

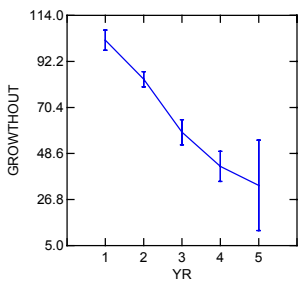
Bypass



Keno



Peaking



Durbin-Watson D Statistic 0.621
 First Order Autocorrelation 0.687

Residuals and data have been saved.

COL/

ROW	YR	LOC\$
1	1	Bypass
2	1	Keno
3	1	Peaking
4	2	Bypass
5	2	Keno
6	2	Peaking
7	3	Bypass
8	3	Keno
9	3	Peaking
10	4	Bypass
11	4	Keno
12	4	Peaking
13	5	Keno
14	5	Peaking

Using least squares means.

Post Hoc test of GROWTHOUT

Using model MSE of 457.387 with 226 df.

Matrix of pairwise mean differences:

	1	2	3	4	5
1	0.000				
2	-24.328	0.000			
3	-1.437	22.891	0.000		
4	-38.208	-13.879	-36.770	0.000	
5	-40.556	-16.227	-39.118	-2.348	0.000
6	-19.923	4.405	-18.486	18.284	20.632
7	-46.980	-22.651	-45.542	-8.772	-6.424
8	-39.842	-15.513	-38.404	-1.634	0.714
9	-45.026	-20.697	-43.588	-6.818	-4.470
10	-25.282	-0.954	-23.845	12.926	15.274
11	-40.339	-16.011	-38.902	-2.131	0.217
12	-61.190	-36.862	-59.753	-22.983	-20.635
13	-42.404	-18.076	-40.967	-4.197	-1.849
14	-70.182	-45.854	-68.745	-31.975	-29.627

	6	7	8	9	10
6	0.000				
7	-27.057	0.000			
8	-19.918	7.138	0.000		
9	-25.102	1.954	-5.184	0.000	
10	-5.359	21.698	14.559	19.743	0.000
11	-20.416	6.641	-0.497	4.687	-15.057
12	-41.267	-14.210	-21.349	-16.165	-35.908
13	-22.481	4.576	-2.563	2.621	-17.122
14	-50.259	-23.203	-30.341	-25.157	-44.900

	11	12	13	14
11	0.000			
12	-20.851	0.000		
13	-2.065	18.786	0.000	
14	-29.843	-8.992	-27.778	0.000

Tukey HSD Multiple Comparisons.

Matrix of pairwise comparison probabilities:

	1	2	3	4	5
		1.			
1	000	0.	1.		
2	024	000			
		1.	0.	1.	
3	000	082	000		
		0.	0.	0.	1.
4	000	640	000	000	
		0.	0.	0.	1.
5	000	565	000	000	000
		0.	1.	0.	0.
6	021	000	106	016	030
		0.	0.	0.	0.
7	000	124	000	981	000
		0.	0.	0.	1.
8	000	568	000	000	000
		0.	0.	0.	0.
9	000	345	000	999	000
		0.	1.	0.	1.
10	944	000	967	000	000
		0.	0.	0.	1.
11	000	906	001	000	000
		0.	0.	0.	0.
12	000	003	000	175	464
		0.	0.	0.	1.
13	001	892	003	000	000
		0.	0.	0.	0.
14	075	715	095	972	987

	6	7	8	9	10
	1.				
6	000				
	0.	1.			
7	001	000			
	0.	0.	1.		
8	021	999	000		
	0.	1.	1.	1.	
9	020	000	000	000	
	1.	0.	1.	0.	1.
10	000	986	000	995	000
	0.	1.	1.	1.	1.
11	449	000	000	000	000
	0.	0.	0.	0.	0.
12	000	944	352	901	668
	0.	1.	1.	1.	0.
13	492	000	000	000	999
	0.	0.	0.	0.	0.
14	541	999	983	998	911

		11		12		13		14
		1.						
11	000	0.		1.				
12	764	1.	000	0.		1.		
13	000	0.	928	1.	000	0.		1.
14	990		000		996		000	

.....
 :::::DIFFERENCES IN CONDITION FACTOR BETWEEN REACHES AND SEASONS

SYSTAT Rectangular file C:\Project\Klamath\condition.SYD,
 created Mon Jan 12, 2004 at 16:22:45, contains variables:

REACH\$	STATION\$	LOC\$	SEASON\$	DATE
SPECIES\$	LENGTH	WEIGHT	K	LNLENGTH
LNK	SPRING	SUMMER	FALL	KENO
PEAKING				

Data for the following results were selected according to:
 loc\$ <> 'Bypass'

Effects coding used for categorical variables in model.

Categorical values encountered during processing are:

LOC\$ (2 levels)
 Keno, Peaking
 SEASON\$ (3 levels)
 Fall, Spring, Summer

Dep Var: K N: 328 Multiple R: 0.186 Squared multiple R: 0.035

-1

Estimates of effects B = (X'X)⁻¹ X'Y

		K
CONSTANT		1.188
SEASON\$	Fall	0.004
SEASON\$	Spring	-0.013
LOC\$	Keno	-0.012
SEASON\$	Fall	
LOC\$	Keno	0.057
SEASON\$	Spring	
LOC\$	Keno	-0.003

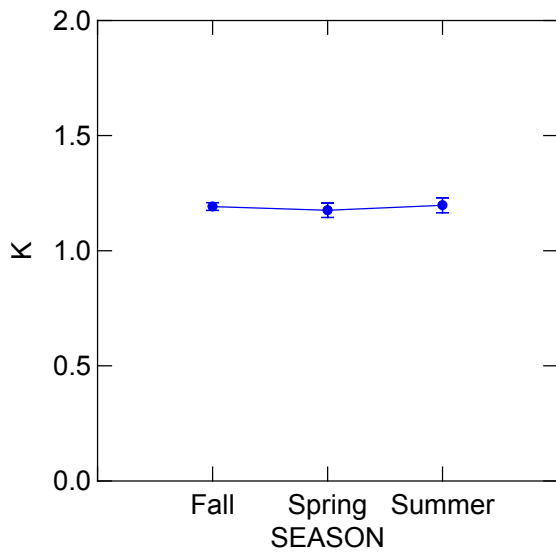
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio
SEASON\$	0.017	2	0.008	0.136
LOC\$	0.032	1	0.032	0.520
SEASON\$*LOC\$	0.618	2	0.309	5.094
Error	19.536	322	0.061	

Least squares means

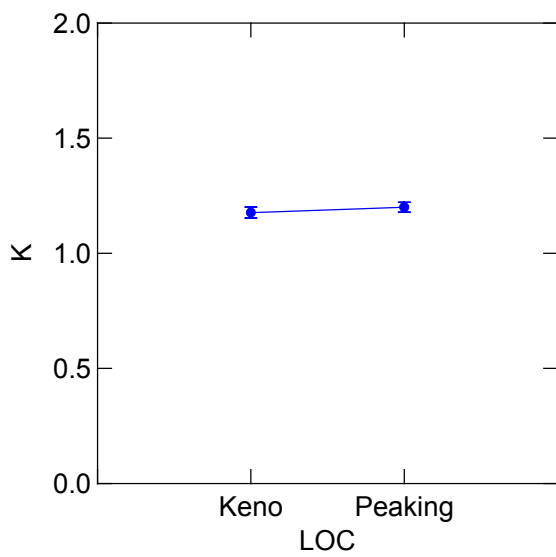
		LS Mean	SE	N
SEASON\$	Fall	1.192	0.017	206
SEASON\$	Spring	1.176	0.032	64
SEASON\$	Summer	1.197	0.032	58

Least Squares Means



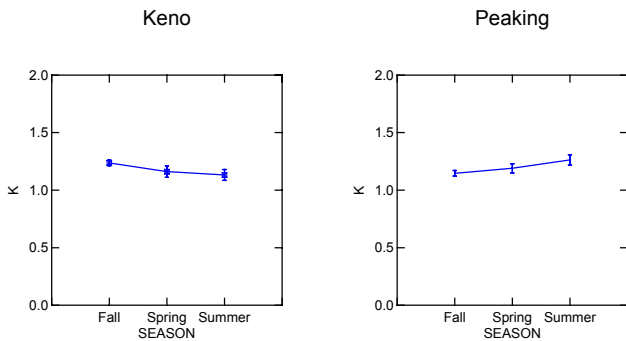
LOC\$	Keno	1.177	0.024	157
LOC\$	Peaking	1.200	0.021	171

Least Squares Means



SEASON\$	Fall			
LOC\$	Keno	1.237	0.024	105
SEASON\$	Fall			
LOC\$	Peaking	1.147	0.025	101
SEASON\$	Spring			
LOC\$	Keno	1.161	0.049	25
SEASON\$	Spring			
LOC\$	Peaking	1.190	0.039	39
SEASON\$	Summer			
LOC\$	Keno	1.132	0.047	27
SEASON\$	Summer			
LOC\$	Peaking	1.263	0.044	31

Least Squares Means



*** WARNING ***

Case 3 is an outlier (Studentized Residual = 4.952)
 Case 532 is an outlier (Studentized Residual = 5.977)

Durbin-Watson D Statistic 1.857
 First Order Autocorrelation 0.070

Residuals and data have been saved.

COL/

ROW LOC\$

1 Keno

2 Peaking

Using least squares means.

Post Hoc test of K

Using model MSE of 0.061 with 322 df.

Matrix of pairwise mean differences:

	1	2
1	000	0.
2	023	000

Bonferroni Adjustment.

Matrix of pairwise comparison probabilities:

	1	2
1	000	1.
2	471	000

