

THE HARRISON BAR GRAVEL REMOVAL EXPERIMENT: FINAL REPORT

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Appendix A. Photographic history of bar scalping at Harrison Bar.



Aerial view of scalping operation at Harrison Bar. Photograph taken March 7, 2000 (courtesy of Dr. V. Galay).



Ground view of scalping operation at Harrison Bar. Photograph taken March 7, 2000.



Stockpile area and conveyor belt used to transport gravel from Minto Island to Steelhead Aggregates Ltd. yard. Photograph taken March 6, 2000 (courtesy of Dr. V. Galay).



Gravel stockpile and conveyor belt across Minto Channel (March 7, 2000).



Lower Harrison Bar pre-scalping (August 17, 1999) looking east toward Mt. Cheam.



Lower Harrison Bar post-scalping (March 26, 2000) looking west toward Harrison Knob.



Lower Harrison Bar post-scalping as flood water inundated the site (May 9, 2000). View is east toward Mt. Cheam.



Lower Harrison Bar post-scalping and on the declining limb of the discharge hydrograph (August 17, 2000). View is east toward Mt. Cheam.

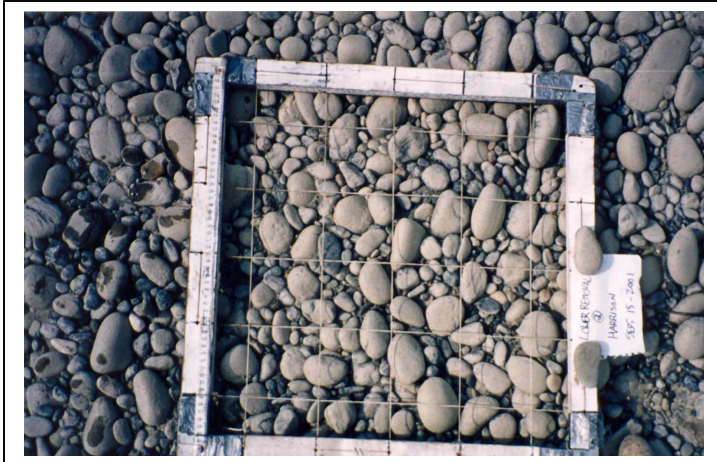
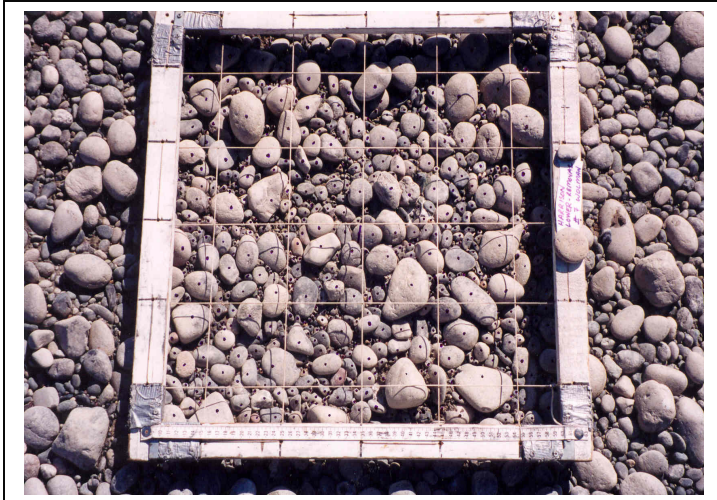
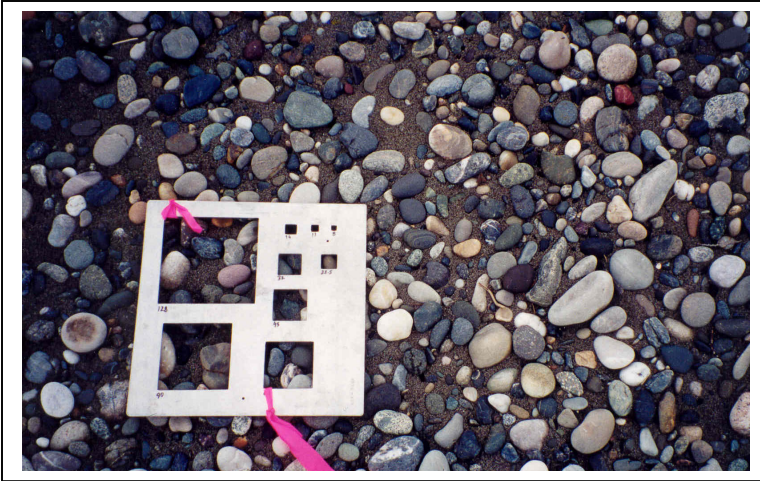


Summer channel intersecting across the scalped area of lower Harrison Bar, November 15, 2000. View is east toward Mt. Cheam.

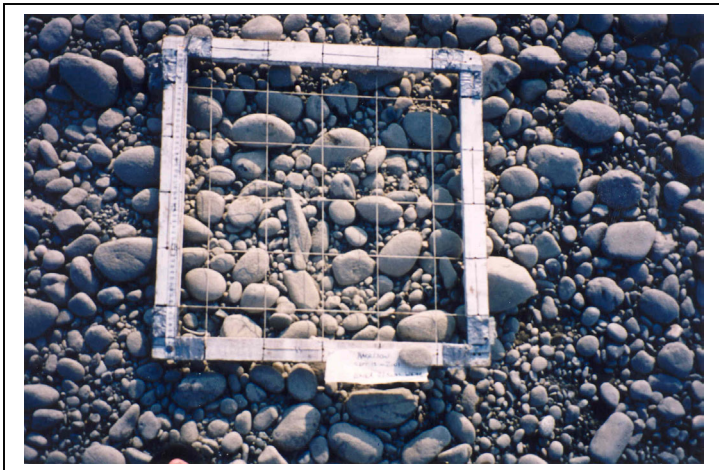
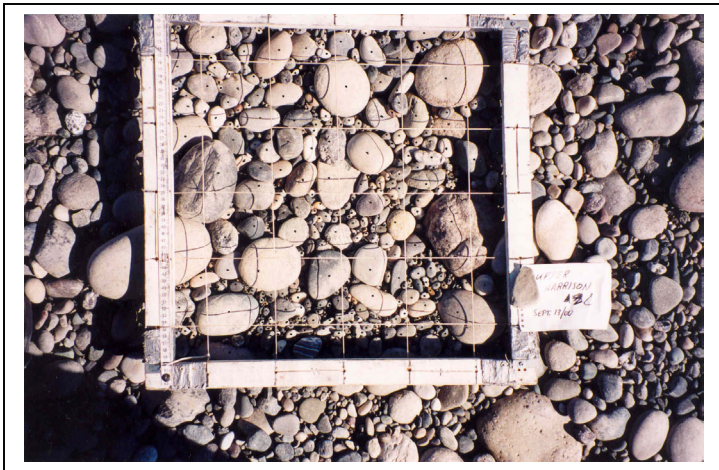


Lower Harrison Bar post-scalping and after one freshet event (March 7, 2001). View is east toward Mt. Cheam.

Sediment photos page 1



Sediment photos page 2



Sediment photos page 3



Appendix B. Record of scalping at Foster Bar (1995).



Bar scalping at Foster Bar. Photo taken March 2, 1995 (courtesy of Dr. V. Galay). Scalping took place in February/March 1995. Approximately 300,000 tonnes of gravel was removed.

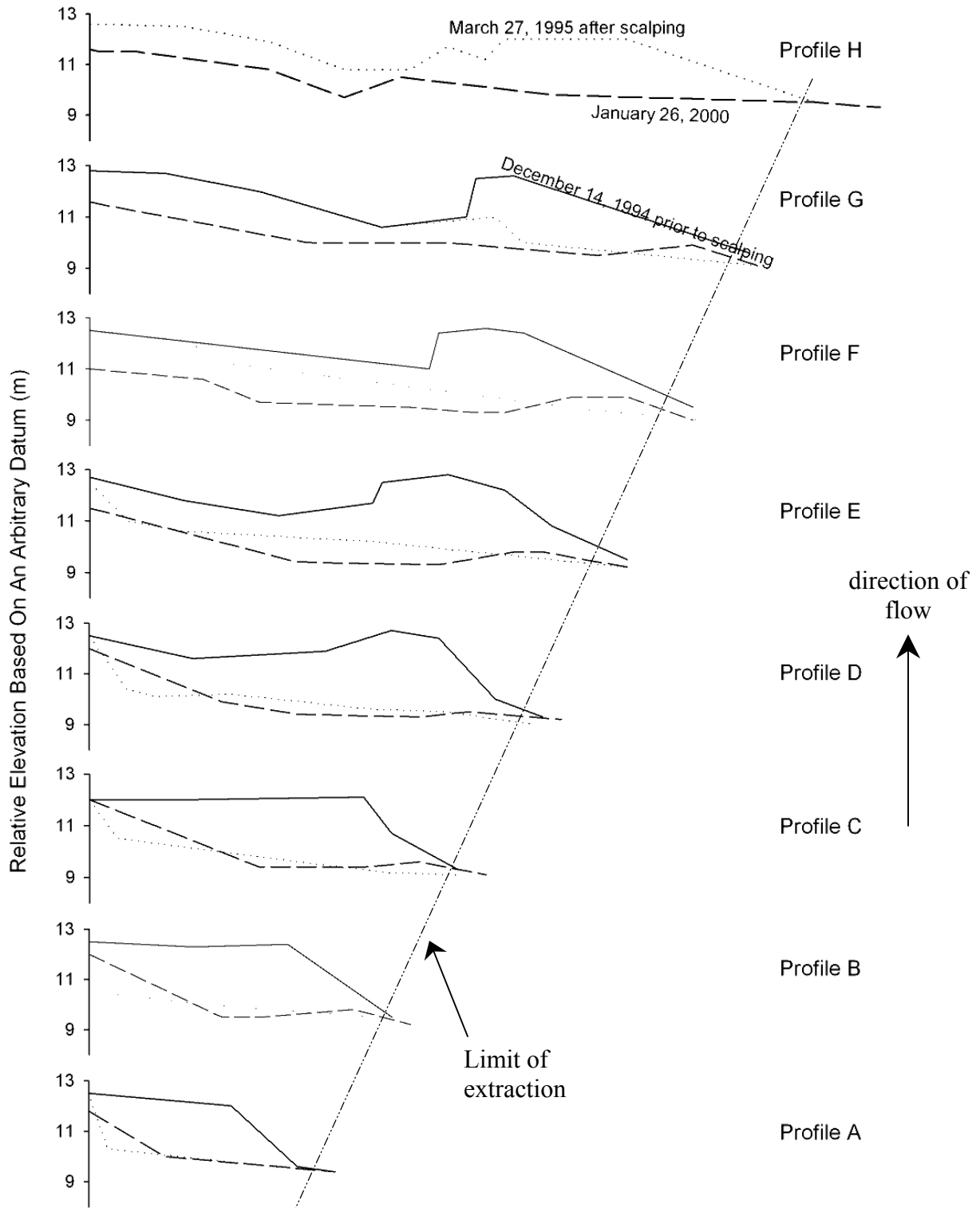
A.



B.



Foster Bar (A) August 30, 1995 (photo courtesy of Dr. V. Galay) with scalped area inundated and (B) September 20, 2002, showing no sediment replenishment.



Planform view of cross-sections at Foster Bar (Tunbridge & Tunbridge Ltd) before, immediately after, and 5 years following bar scalping. Approximate horizontal scale 1:2500.

Appendix C. Twenty-five fish species collected in the gravel reach of Fraser River.

Family	Species	Common Name	3-Letter Code
<i>Petromyzonidae</i>	<i>Lampetra species</i>	Lamprey (species unknown)	LAM
<i>Acipenseridae</i>	<i>Acipenser transmontanus</i>	White sturgeon ^R	WST
<i>Salmonidae</i>	<i>Prosopium williamsoni</i>	Mountain whitefish	MWF
	<i>Salvelinus confluentus</i>	Bull char ^B	BUL
	<i>S. malma</i>	Dolly Varden ^B	DOV
	<i>Oncorhynchus clarki</i>	Cutthroat trout ^B	CUT
	<i>O. mykiss</i>	Rainbow trout	RBT
	<i>O. gorbuscha</i>	Pink salmon	PIN
	<i>O. keta</i>	Chum salmon	CHU
	<i>O. kisutch</i>	Coho salmon	COH
	<i>O. nerka</i>	Sockeye salmon	SOC
	<i>O. tshawytscha</i>	Chinook salmon	CHI
<i>Cyprinidae</i>	<i>Hybognathus hankinsoni</i>	Brassy minnow ^B	BRA
	<i>Mylocheilus caurinus</i>	Peamouth	PEA
	<i>Ptychocheilus oregonensis</i>	Northern pikeminnow	NPM
	<i>Rhinichthys cataractae</i>	Longnose dace	LND
	<i>R. falcatus</i>	Leopard dace	LED
	<i>Richardsonius balteatus</i>	Redside shiner	RSS
<i>Catostomidae</i>	<i>Catostomus columbianus</i>	Bridgelip sucker	BLS
	<i>C. macrocheilus</i>	Largescale sucker	LGS
	<i>C. platyrhynchus</i>	Mountain sucker ^B	MTS
<i>Gasterosteidae</i>	<i>Gasterosteus aculeatus</i>	Threespine stickleback	TSS
	<i>G. aculeatus trachurus</i>	Marine stickleback	MSB
<i>Cottidae</i>	<i>Cottus aleuticus</i>	Coastrange sculpin	CRS
	<i>C. asper</i>	Prickly sculpin	PRS

B: blue-listed

R: red-listed

Appendix D. Benthic invertebrate taxa collected in the gravel reach of Fraser River.

Invertebrates were identified to the lowest-possible taxonomic level, dependent on size and maturity of the individual and preserved condition. FFG refers to the functional feeding group classification based on Merritt and Cummins (1996). CG: collector-gatherer; SC: scraper; SH: shredder; PR: predator; CF: collector-filterer; PA: parasite. * identifies groups representing >1% of the total abundance of invertebrates collected; ° identifies groups representing 0.5-1% of the total abundance of invertebrates collected; ‘ identifies groups representing 0.1-0.5% of the total abundance of invertebrates collected.

ORDER	FAMILY	SUB-FAMILY	GENUS	FFG
O. Ephemeroptera	*F. Baetidae		<i>Baetis sp.</i>	CG/SC
	*F. Heptageniidae		<i>Cinygmula sp.</i>	SC
			<i>Epeorus sp.</i>	SC
			<i>Heptagenia sp.</i>	CG/SC
			<i>Rhithrogena sp.</i>	CG/SC
	*F. Ephemerellidae		<i>Drunella sp.</i>	SC
			<i>Ephemerella sp.</i>	CG
	°F. Ameletidae		<i>Ameletus sp.</i>	SC
	F. Leptophlebiidae		<i>Paraleptophlebiidae sp.</i>	CG
	O. Plecoptera	*F. Capniidae		<i>Capnia sp.</i>
			<i>Utacapnia sp.</i>	SH
F. Chloroperlidae			<i>Plumiperla sp.</i>	PR
			<i>Sweltsa sp.</i>	PR
‘F. Nemouridae			<i>Ostrocera sp.</i>	SH
			<i>Podmosta sp.</i>	SH
			<i>Zapada sp.</i>	SH
F. Perlidae			<i>Agnatina sp.</i>	PR
			<i>Claassenia sp.</i>	PR
			<i>Hesperoperla sp.</i>	PR
‘F. Perlodidae			<i>Isogenoides sp.</i>	PR
			<i>Isoperla sp.</i>	PR
			<i>Skwala sp.</i>	PR
F. Leuctridae			<i>Despaxia sp.</i>	SH
F. Pteronarcyidae			<i>Pteronarcella sp.</i>	SH
°F. Taeniopterygidae			<i>Taenionema sp.</i>	SH
O. Trichoptera		F. Brachycentridae		<i>Brachycentrus sp.</i>
	F. Glossomatidae		<i>Glossosoma sp.</i>	SC

ORDER	FAMILY	SUB-FAMILY	GENUS	FFG
	F. Hydroptilidae		<i>Hydroptila sp.</i>	SC
	F. Limnephilidae		<i>Onocosmoecus sp.</i>	SH
O. Trichoptera	F. Lepidostomatidae		<i>Lepidostoma sp.</i>	SH
	°F. Hydropsychidae		<i>Hydropsyche sp.</i>	CF
	F. Polycentropodidae		<i>Polycentropus sp.</i>	PR
	F. Rhyacophilidae		<i>Rhyacophila sp.</i>	PR
O. Diptera	F. Athericidae		<i>Atherix sp.</i>	PR
	F. Blephariceridae		<i>Bibiocephala sp.</i>	SC
	*F. Chironomidae	s.f. Orthoclaadiinae		CG
		s.f. Tanypodinae		PR
		s.f. Chironominae	<i>Tanytarsini</i>	CF
			<i>Chironomoni</i>	CG
		s.f. Diamesinae		CG
	‘F. Ceratopogoniidae	s.f. Ceratopogoninae.		PR
	°F. Empididae		<i>Chelifera sp.</i>	PR
			<i>Hemerodromia sp.</i>	PR
	‘F. Simuliidae		<i>Simulium sp.</i>	CF
	F. Tipulidae		<i>Antocha sp.</i>	CG
			<i>Dicranota sp.</i>	PR
			<i>Erioptera sp.</i>	CG
			<i>Hesperconopa sp.</i>	CG
			<i>Limnophilia sp.</i>	PR
			<i>Ormosia sp.</i>	CG
O. Coleoptera	F. Dytiscida		<i>Brachyvatus sp.</i>	PR
	Fam. Elmidae		<i>Heterolimnius sp.</i>	SC
	Fam. Gyrinidae			PR
	Fam. Hydrochidae		<i>Hydrochus sp.</i>	SH
	Fam. Hydrophilidae			PR
	F. Corixidae		<i>Corisella sp.</i>	PR
O. Homoptera			<i>Tricorixa sp.</i>	PR
O. Lepidoptera				SH
*Nematoda				PA
*Oligochaeta	Fam. Naididae			SC
	Fam. Tubificidae			SC
‘Acarina				PA

Appendix E. Asymmetrical ANOVA – Mechanics and Power Calculation

Mechanics

Underwood (1993) describes in thorough detail the mechanics of asymmetrical ANOVA, which is carried out by running four separate ANOVA procedures using any common statistical software. The procedure is described briefly below. Refer to appendices F through K to examine its application.

Three independent variables are involved in the analysis:

1. Before/After (B) – fixed categorical variable
2. Times – random categorical variable
3. Locations – fixed or random categorical variable

First (Table A in appendices), analyze all data as a fully orthogonal analysis of Before/After, Locations, and Times nested within Before/After [T(B)]. This analysis does not differentiate between the impacted and reference sites.

Second (Table B in appendices), analyze data as a three-factor analysis of all data from the reference locations only. The identical model as for analysis #1 is used, only selecting for reference sites.

Third (Table C in appendices), analyze data from all sites as a two-factor analysis and exclude sampling periods after the impact. Factor B (Before/After) is not included and Times is included as a non-nested factor.

Fourth (Table D in appendices), repeat analysis #3 but include only the reference sites.

From these four analyses, the entire asymmetrical ANOVA can be calculated by subtractions and additions of the component terms. The algebra is indicated in the appendices. Once the Source of Variation table is completed, use the flow chart below and proceed through a set of questions and statistical tests to address whether or not an impact has occurred. The answer to the question at each branch of the flowchart determines the sources of variation and degrees of freedom used to calculate an F-value. Refer to **Section 2.6** for further details.

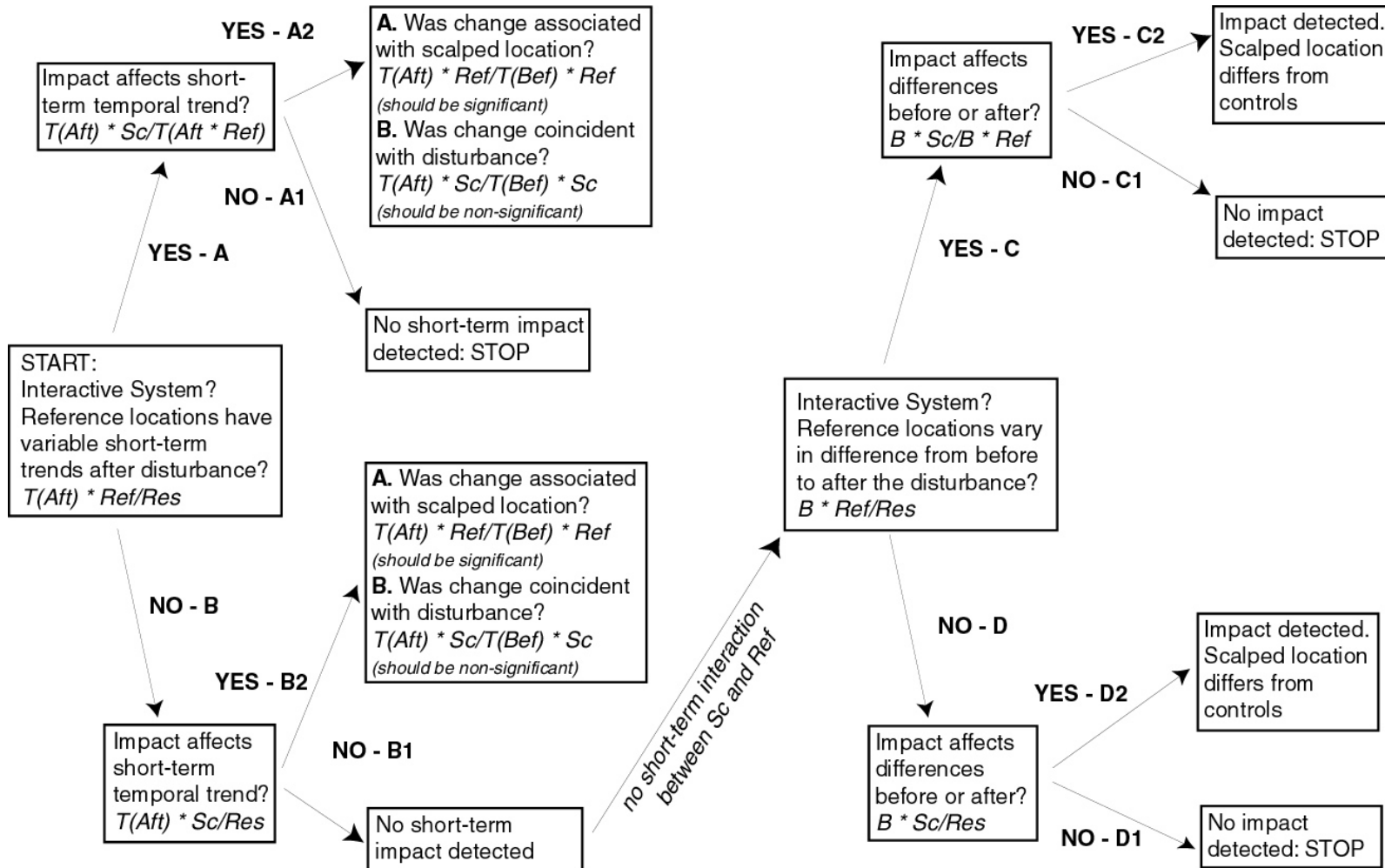
Power Calculation

The power of a statistical analysis is its capacity to detect a difference between groups when a difference actually exists. The calculation of power for asymmetrical ANOVA is straightforward, using values derived from the Source of Variation table and from the central distribution of F that is in common use.

First, determine $1+n\eta^2 = \text{Mean Square [T(Aft) x Sc]} / \text{Mean Square [Residual]}$

Second, calculate $F_{\text{alt}} = F_{\text{crit}} / (1+n\eta^2)$. F_{crit} is based on the degrees of freedom of $(1+n\eta^2)$. df_1 for MS [T(Aft) x Sc]; df_2 for MS [Residual].

Third, estimate power based on F_{alt} using the distribution function of F : $[(F_{\text{alt}}), df_1, df_2]$.



Sequence of questions and statistical tests of Underwood's asymmetrical ANOVA to detect an impact at a site with several reference locations (from Underwood 1993, Table 6). Sc: Scalp site. Ref: Reference sites. Res: Residual. B: Before. Aft: After. T: Time.

Appendix F. ANOVA results of Habitat Characteristics – Bar Edge Units

PC AXIS 1 (Hydraulic Gradient)

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	0.109	1	0.109	a1
Times(B)	10.180	9	1.131	a2
Locations	2.980	3	0.993	a3
B * L	2.400	3	0.800	a4
T(B) * L	43.725	27	1.619	a5
Residual	42.029	80	0.525	a6
Total	101.423	123		a7

B. Reference Locations on All Dates

Bef/Aft - B	0.928	1	0.928	
Times(B)	7.272	9	0.808	
Locations	2.954	2	1.477	b1
B * L	0.044	2	0.022	b2
T(B) * L	11.900	18	0.661	b3
Residual	29.221	53	0.551	
Total	52.319	85		

C. All Locations Before Impact

Times(B)	7.240	2	3.620	
Locations	2.106	3	0.702	
B * L	6.296	6	1.049	c1
Residual	2.332	13	0.179	
Total	17.974	24		

D. Reference Locations Before Impact

Times(B)	2.053	2	1.027	
Locations	1.149	2	0.575	
B * L	1.685	4	0.421	d1
Residual	1.472	6	0.245	
Total	6.359	14		

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	0.109	1	0.109
T(B)	a2	10.180	9	1.131
Location	a3	2.980	3	0.993
Impact vs Ref	a3-b1	0.026	1	0.026
Among Refs	b1	2.954	2	1.477
B * Location	a4	2.400	3	0.800
B * Impact	a4-b2	2.356	1	2.356
B * Ref	b2	0.044	2	0.022
T(B) * L	a5	43.725	27	1.619
T(Bef) * Location	c1	6.296	6	1.049
T(Bef) * Impact	c1-d1	4.611	2	2.306
T(Bef) * Ref	d1	1.685	4	0.421
T(Aft) * Location	a5-c1	37.429	21	1.782
T(Aft) * Impact	a5-c1-b3+d1	27.214	7	3.888
T(Aft) * Ref	b3-d1	10.215	14	0.730
Residual	a6	42.029	74	0.568
Total	a7	101.423	123	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,74	1.285	1.83	0.24
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NO...

2. Does scalping affect short-term temporal trend?

T(Aft) * Imp / Residual	7,74	6.845	2.14	p<0.0005
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YES... short-term impact detected

3A. Was change observed at reference sites?

T(Aft) * Ref / T(Bef) * Ref	14,4	1.732	5.87	0.32
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NO... change was associated with Impact site

3B. Was timing of change coincident with impact?

T(Aft) * Imp / T(Bef) * Imp	7,2	1.686	39.4	0.42
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NO... change was not coincident with impact

PC AXIS 2 (Coarse Sediment Gradient)

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	5.024	1	5.024	a1
Times(B)	30.489	9	3.388	a2
Locations	8.621	3	2.874	a3
B * L	3.399	3	1.133	a4
T(B) * L	13.377	27	0.495	a5
Residual	44.880	80	0.561	a6
Total	105.790	123		a7

B. Reference Locations on All Dates

Bef/Aft - B	4.390	1	4.390	
Times(B)	23.538	9	2.615	
Locations	4.701	2	2.351	b1
B * L	2.930	2	1.465	b2
T(B) * L	10.484	18	0.582	b3
Residual	35.061	53	0.662	
Total	81.104	85		

C. All Locations Before Impact

Times(B)	25.072	2	12.536	
Locations	6.567	3	2.189	
B * L	5.157	6	0.860	c1
Residual	8.742	13	0.672	
Total	45.538	24		

D. Reference Locations Before Impact

Times(B)	19.136	2	9.568	
Locations	4.273	2	2.137	
B * L	5.006	4	1.252	d1
Residual	4.583	6	0.764	
Total	32.998	14		

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	5.024	1	5.024
T(B)	a2	30.489	9	3.388
Location	a3	8.621	3	2.874
Impact vs Ref	a3-b1	3.920	1	3.920
Among Refs	b1	4.701	2	2.351
B * Location	a4	3.399	3	1.133
B * Impact	a4-b2	0.469	1	0.469
B * Ref	b2	2.930	2	1.465
T(B) * L	a5	13.377	27	0.495
T(Bef) * Location	c1	5.157	6	0.860
T(Bef) * Impact	c1-d1	0.151	2	0.075
T(Bef) * Ref	d1	5.006	4	1.252
T(Aft) * Location	a5-c1	8.220	21	0.391
T(Aft) * Impact	a5-c1-b3+d1	2.742	7	0.392
T(Aft) * Ref	b3-d1	5.478	14	0.391
Residual	a6	44.880	74	0.606
Total	a7	105.790	123	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,74	0.645	1.83	0.82
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NO...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / Residual	7,74	0.646	2.14	0.72
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NO... no short-term impact detected

3. Do reference sites vary in the difference from before to after?

B * Ref / Residual	2,74	2.416	3.11	0.1
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NO...

4. Does impact affect difference from before to after impact?

B * Imp / Residual	1,74	0.773	3.96	0.38
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NO...no impact detected

Power Analysis

$1+n0 = MS[T(Aft) * Impact] / MS[Residual]$

Degrees of Freedom

$Falt = Fcrit / (1+n0) = 2.14 / (1+n0)$

Power (based on F-distribution)

0.646
7,74
3.310
0.004

PC AXIS 3 (Fine Sediment Gradient)

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	0.194	1	0.194	a1
Times(B)	13.764	9	1.529	a2
Locations	1.803	3	0.601	a3
B * L	0.230	3	0.077	a4
T(B) * L	21.796	27	0.807	a5
Residual	76.002	80	0.950	a6
Total	113.789	123		a7

B. Reference Locations on All Dates

Bef/Aft - B	0.126	1	0.126	
Times(B)	13.386	9	1.487	
Locations	1.623	2	0.812	b1
B * L	0.222	2	0.111	b2
T(B) * L	10.366	18	0.576	b3
Residual	29.022	53	0.548	
Total	54.745	85		

C. All Locations Before Impact

Times(B)	8.056	2	4.028	
Locations	1.023	3	0.341	
B * L	6.617	6	1.103	c1
Residual	2.404	13	0.185	
Total	18.100	24		

D. Reference Locations Before Impact

Times(B)	10.357	2	5.179	
Locations	0.940	2	0.470	
B * L	1.938	4	0.485	d1
Residual	1.117	6	0.186	
Total	14.352	14		

Power Analysis

$1+n0 = MS[T(Aft) * Impact] / MS[Residual]$
 Degrees of Freedom
 $Falt = Fcrit / (1+n0) = 2.14 / (1+n0)$
 Power (based on F-distribution)

0.939
7,74
2.277
0.034

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	0.194	1	0.194
T(B)	a2	13.764	9	1.529
Location	a3	1.803	3	0.601
Impact vs Ref	a3-b1	0.180	1	0.180
Among Refs	b1	1.623	2	0.812
B * Location	a4	0.230	3	0.077
B * Impact	a4-b2	0.008	1	0.008
B * Ref	b2	0.222	2	0.111
T(B) * L	a5	21.796	27	0.807
T(Bef) * Location	c1	6.617	6	1.103
T(Bef) * Impact	c1-d1	4.679	2	2.340
T(Bef) * Ref	d1	1.938	4	0.485
T(Aft) * Location	a5-c1	15.179	21	0.723
T(Aft) * Impact	a5-c1-b3+d1	6.751	7	0.964
T(Aft) * Ref	b3-d1	8.428	14	0.602
Residual	a6	76.002	74	1.027
Total	a7	113.789	123	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,74	0.586	1.82	0.87
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NO...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / Residual	7,74	0.939	2.13	0.48
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NO... no short-term impact detected

3. Do reference sites vary in the difference from before to after?

B * Ref / Residual	2,74	0.108	3.11	0.9
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NO...

4. Does impact affect difference from before to after impact?

B * Imp / Residual	1,74	0.008	3.96	0.93
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NO...no impact detected

Appendix G. Fish ANOVA results – Whole Bar Unit

FISH DENSITY

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	0.019	1	0.019	a1
Times(B)	0.884	9	0.098	a2
Locations	0.184	3	0.061	a3
B * L	0.113	3	0.038	a4
T(B) * L	1.231	27	0.046	a5
Residual	14.965	198	0.076	a6
Total	17.396	241		a7

B. Exclude Impact Site

Bef/Aft - B	0.056	1	0.056	
Times(B)	0.732	9	0.081	
Locations	0.171	2	0.086	b1
B * L	0.050	2	0.025	b2
T(B) * L	0.464	18	0.026	b3
Residual	9.304	139	0.067	
Total	10.777	171		

C. All Locations Before Impact

Times(B)	0.292	2	0.146	
Locations	0.158	3	0.053	
B * L	0.121	6	0.020	c1
Residual	1.359	33	0.041	
Total	1.930	44		

D. Reference Locations Before Impact

Times(B)	0.251	2	0.126	
Locations	0.118	2	0.059	
B * L	0.101	4	0.025	d1
Residual	1.311	22	0.060	
Total	1.781	30		

Power Analysis

$1+n0 = MS[T(Aft) * Impact] / MS[Residual]$	1.391
Degrees of Freedom	7,195
$F_{alt} = F_{crit} / (1+n0) = 2.06 / (1+n0)$	1.481
Power (based on F-distribution)	0.176

PERCENT REPRESENTATION BY SALMON

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	0.610	1	0.610	a1
Times(B)	5.758	9	0.640	a2
Locations	0.713	3	0.238	a3
B * L	0.327	3	0.109	a4
T(B) * L	3.661	27	0.136	a5
Residual	25.510	198	0.129	a6
Total	36.579	241		a7

B. Exclude Impact Site

Bef/Aft - B	0.234	1	0.234	
Times(B)	3.268	9	0.363	
Locations	0.077	2	0.039	b1
B * L	0.166	2	0.083	b2
T(B) * L	2.630	18	0.146	b3
Residual	20.304	139	0.146	
Total	26.679	171		

C. All Locations Before Impact

Times(B)	0.032	2	0.016	
Locations	0.511	3	0.170	
B * L	0.115	6	0.019	c1
Residual	4.709	33	0.143	
Total	5.367	44		

D. Reference Locations Before Impact

Times(B)	0.075	2	0.038	
Locations	0.023	2	0.012	
B * L	0.101	4	0.025	d1
Residual	4.668	22	0.212	
Total	4.867	30		

Power Analysis

$1+n0 = MS[T(Aft) * Impact] / MS[Residual]$	1.111
Degrees of Freedom	7,195
$F_{alt} = F_{crit} / (1+n0) = 2.06 / (1+n0)$	1.855
Power (based on F-distribution)	0.079

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	0.019	1	0.019
T(B)	a2	0.884	9	0.098
Location	a3	0.184	3	0.061
Impact vs Ref	a3-b1	0.013	1	0.013
Among Refs	b1	0.171	2	0.086
B * Location	a4	0.113	3	0.038
B * Impact	a4-b2	0.063	1	0.063
B * Ref	b2	0.050	2	0.025
T(B) * L	a5	1.231	27	0.046
T(Bef) * Location	c1	0.121	6	0.020
T(Bef) * Impact	c1-d1	0.020	2	0.010
T(Bef) * Ref	d1	0.101	4	0.025
T(Aft) * Location	a5-c1	1.110	21	0.053
T(Aft) * Impact	a5-c1-b3+d1	0.747	7	0.107
T(Aft) * Ref	b3-d1	0.363	14	0.026
Residual	a6	14.965	195	0.077
Total	a7	17.396	241	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,195	0.338	1.93	0.98
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NO...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / Residual	7,195	1.391	2.35	0.21
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NO... no short-term impact detected

3. Do reference sites vary in difference from before to after impact?

B * Ref / Residual	2,195	0.326	3.76	0.72
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NO...

4. Does impact affect differences from before to after?

B * Imp / Residual	1,195	0.821	5.1	0.37
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NO...no impact detected

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	0.610	1	0.610
T(B)	a2	5.758	9	0.640
Location	a3	0.713	3	0.238
Impact vs Ref	a3-b1	0.636	1	0.636
Among Refs	b1	0.077	2	0.039
B * Location	a4	0.327	3	0.109
B * Impact	a4-b2	0.161	1	0.161
B * Ref	b2	0.166	2	0.083
T(B) * L	a5	3.661	27	0.136
T(Bef) * Location	c1	0.115	6	0.019
T(Bef) * Impact	c1-d1	0.014	2	0.007
T(Bef) * Ref	d1	0.101	4	0.025
T(Aft) * Location	a5-c1	3.546	21	0.169
T(Aft) * Impact	a5-c1-b3+d1	1.017	7	0.145
T(Aft) * Ref	b3-d1	2.529	14	0.181
Residual	a6	25.510	195	0.131
Total	a7	36.579	241	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,195	1.381	1.93	0.16
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NO...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / Residual	7,195	1.111	2.35	0.35
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NO... no short-term impact detected

3. Do reference sites vary in difference from before to after impact?

B * Ref / Residual	2,195	0.634	3.76	0.53
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NO...

4. Does impact affect differences from before to after?

B * Imp / Residual	1,195	1.231	5.1	0.27
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NO...no impact detected

SPECIES RICHNESS

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	12.077	1	12.077	a1
Times(B)	393.173	9	43.686	a2
Locations	2.368	3	0.789	a3
B * L	5.316	3	1.772	a4
T(B) * L	154.425	27	5.719	a5
Residual	733.625	198	3.705	a6
Total	1300.984	241		a7

B. Exclude Impact Site

Bef/Aft - B	10.637	1	10.637	
Times(B)	323.943	9	35.994	
Locations	0.84	2	0.420	b1
B * L	4.693	2	2.347	b2
T(B) * L	92.76	18	5.153	b3
Residual	536.806	139	3.862	
Total	969.679	171		

C. All Locations Before Impact

Times(B)	141.771	2	70.886	
Locations	0.682	3	0.227	
B * L	13.004	6	2.167	c1
Residual	68.433	33	2.074	
Total	223.89	44		

D. Reference Locations Before Impact

Times(B)	92.801	2	46.401	
Locations	0.629	2	0.315	
B * L	1.101	4	0.275	d1
Residual	49.6	22	2.255	
Total	144.131	30		

Power Analysis

1+n0 = MS[T(Aft) * Impact] / MS[Residual]	1.890
Degrees of Freedom	7,195
Falt = Fcrit / (1+n0) = 2.06 / (1+n0)	1.090
Power (based on F-distribution)	0.371

SIMPSON'S DIVERSITY

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	0.065	1	0.065	a1
Times(B)	1.122	9	0.125	a2
Locations	0.042	3	0.014	a3
B * L	0.032	3	0.011	a4
T(B) * L	1.894	27	0.070	a5
Residual	9.826	198	0.050	a6
Total	12.981	241		a7

B. Exclude Impact Site

Bef/Aft - B	0.020	1	0.020	
Times(B)	0.690	9	0.077	
Locations	0.018	2	0.009	b1
B * L	0.008	2	0.004	b2
T(B) * L	1.143	18	0.064	b3
Residual	6.963	139	0.050	
Total	8.842	171		

C. All Locations Before Impact

Times(B)	0.497	2	0.249	
Locations	0.003	3	0.001	
B * L	0.219	6	0.037	c1
Residual	1.819	33	0.055	
Total	2.538	44		

D. Reference Locations Before Impact

Times(B)	0.197	2	0.099	
Locations	0.003	2	0.002	
B * L	0.035	4	0.009	d1
Residual	1.464	22	0.067	
Total	1.699	30		

Power Analysis

1+n0 = MS[T(Aft) * Impact] / MS[Residual]	1.607
Degrees of Freedom	7,195
Falt = Fcrit / (1+n0) = 2.06 / (1+n0)	1.282
Power (based on F-distribution)	0.261

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	12.077	1	12.077
T(B)	a2	393.173	9	43.686
Location	a3	2.368	3	0.789
Impact vs Ref	a3-b1	1.528	1	1.528
Among Refs	b1	0.840	2	0.420
B * Location	a4	5.316	3	1.772
B * Impact	a4-b2	0.623	1	0.623
B * Ref	b2	4.693	2	2.347
T(B) * L	a5	154.425	27	5.719
T(Bef) * Location	c1	13.004	6	2.167
T(Bef) * Impact	c1-d1	11.903	2	5.952
T(Bef) * Ref	d1	1.101	4	0.275
T(Aft) * Location	a5-c1	141.421	21	6.734
T(Aft) * Impact	a5-c1-b3+d1	49.762	7	7.109
T(Aft) * Ref	b3-d1	91.659	14	6.547
Residual	a6	733.625	195	3.762
Total	a7	1300.984	241	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,195	1.740	1.93	0.06
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NO...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / Residual	7,195	1.890	2.35	0.07
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NO... no short-term impact detected

3. Do reference sites vary in difference from before to after impact?

B * Ref / Residual	2,195	0.624	3.76	0.53
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NO...

4. Does impact affect differences from before to after?

B * Imp / Residual	1,195	0.166	5.1	0.68
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NO...no impact detected

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	0.065	1	0.065
T(B)	a2	1.122	9	0.125
Location	a3	0.042	3	0.014
Impact vs Ref	a3-b1	0.024	1	0.024
Among Refs	b1	0.018	2	0.009
B * Location	a4	0.032	3	0.011
B * Impact	a4-b2	0.024	1	0.024
B * Ref	b2	0.008	2	0.004
T(B) * L	a5	1.894	27	0.070
T(Bef) * Location	c1	0.219	6	0.037
T(Bef) * Impact	c1-d1	0.184	2	0.092
T(Bef) * Ref	d1	0.035	4	0.009
T(Aft) * Location	a5-c1	1.675	21	0.080
T(Aft) * Impact	a5-c1-b3+d1	0.567	7	0.081
T(Aft) * Ref	b3-d1	1.108	14	0.079
Residual	a6	9.826	195	0.050
Total	a7	12.981	241	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,195	1.571	1.93	0.08
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NO...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / Residual	7,195	1.607	2.35	0.13
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NO... no short-term impact detected

3. Do reference sites vary in difference from before to after impact?

B * Ref / Residual	2,195	0.079	3.76	0.92
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NO...

4. Does impact affect differences from before to after?

B * Imp / Residual	1,195	0.476	5.1	0.49
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NO...no impact detected

SIMPSON'S EVENNESS

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	0.117	1	0.117	a1
Times(B)	0.126	9	0.014	a2
Locations	0.006	3	0.002	a3
B * L	0.007	3	0.002	a4
T(B) * L	0.255	27	0.009	a5
Residual	1.042	198	0.005	a6
Total	1.553	241		a7

B. Exclude Impact Site

Source of Variance	SS	df	MS	Term
Bef/Aft - B	0.077	1	0.077	
Times(B)	0.045	9	0.005	
Locations	0.000	2	0.000	b1
B * L	0.006	2	0.003	b2
T(B) * L	0.083	18	0.005	b3
Residual	0.755	139	0.005	
Total	0.966	171		

C. All Locations Before Impact

Source of Variance	SS	df	MS	Term
Times(B)	0.088	2	0.044	
Locations	0.005	3	0.002	
B * L	0.043	6	0.007	c1
Residual	0.138	33	0.004	
Total	0.274	44		

D. Reference Locations Before Impact

Source of Variance	SS	df	MS	Term
Times(B)	0.037	2	0.019	
Locations	0.002	2	0.001	
B * L	0.014	4	0.004	d1
Residual	0.117	22	0.005	
Total	0.170	30		

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	0.117	1	0.117
T(B)	a2	0.126	9	0.014
Location	a3	0.006	3	0.002
Impact vs Ref	a3-b1	0.006	1	0.006
Among Refs	b1	0.000	2	0.000
B * Location	a4	0.007	3	0.002
B * Impact	a4-b2	0.001	1	0.001
B * Ref	b2	0.006	2	0.003
T(B) * L	a5	0.255	27	0.009
T(Bef) * Location	c1	0.043	6	0.007
T(Bef) * Impact	c1-d1	0.029	2	0.015
T(Bef) * Ref	d1	0.014	4	0.004
T(Aft) * Location	a5-c1	0.212	21	0.010
T(Aft) * Impact	a5-c1-b3+d1	0.143	7	0.020
T(Aft) * Ref	b3-d1	0.069	14	0.005
Residual	a6	1.042	195	0.005
Total	a7	1.553	241	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,195	0.922	1.93	0.52
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NO...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / Residual	7,195	3.823	2.075	<0.001
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YES... short-term impact detected

3A. Are changes associated with impact site?

T(Aft) * Ref / T(Bef) * Ref	14,4	1.408	39.4	0.40
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YES... changes are associated with scalped site

3B. Timing of change was coincident with impact?

T(Aft) * Imp / T(Bef) * Imp	7,2	1.409	948	0.48
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NO... timing of change was not coincident with impact

Appendix H. Fish ANOVA results – Bar Edge Unit

FISH DENSITY

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	0.070	1	0.070	a1
Times(B)	0.297	9	0.033	a2
Locations	0.008	3	0.003	a3
B * L	0.013	3	0.004	a4
T(B) * L	0.137	27	0.005	a5
Residual	0.779	80	0.010	a6
Total	1.304	123		a7

B. Exclude Impact Site

Bef/Aft - B	0.060	1	0.060	
Times(B)	0.202	9	0.022	
Locations	0.008	2	0.004	b1
B * L	0.011	2	0.006	b2
T(B) * L	0.066	18	0.004	b3
Residual	0.428	53	0.008	
Total	0.775	85		

C. All Locations Before Impact

Times(B)	0.172	2	0.086	
Locations	0.012	3	0.004	
B * L	0.054	6	0.009	c1
Residual	0.040	13	0.003	
Total	0.278	24		

D. Reference Locations Before Impact

Times(B)	0.116	2	0.058	
Locations	0.012	2	0.006	
B * L	0.054	4	0.014	d1
Residual	0.025	6	0.004	
Total	0.207	14		

Power Analysis

$1+n0 = MS[T(Aft) * Impact] / MS[Residual]$

Degrees of Freedom

$Falt = Fcrit / (1+n0) = 2.14 / (1+n0)$

Power (based on F-distribution)

0.964
7.74
2.219
0.042

PROPORTION REPRESENTED BY SALMON

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	0.808	1	0.808	a1
Times(B)	1.289	9	0.143	a2
Locations	0.173	3	0.058	a3
B * L	0.488	3	0.163	a4
T(B) * L	5.306	27	0.197	a5
Residual	12.981	80	0.162	a6
Total	21.045	123		a7

B. Exclude Impact Site

Bef/Aft - B	1.109	1	1.109	
Times(B)	1.335	9	0.148	
Locations	0.081	2	0.041	b1
B * L	0.049	2	0.025	b2
T(B) * L	1.699	18	0.094	b3
Residual	10.32	53	0.195	
Total	14.593	85		

C. All Locations Before Impact

Times(B)	0.202	2	0.101	
Locations	0.364	3	0.121	
B * L	0.302	6	0.050	c1
Residual	2.165	13	0.167	
Total	3.033	24		

D. Reference Locations Before Impact

Times(B)	0.275	2	0.138	
Locations	0.061	2	0.031	
B * L	0.071	4	0.018	d1
Residual	1.44	6	0.240	
Total	1.847	14		

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	0.070	1	0.070
T(B)	a2	0.297	9	0.033
Location	a3	0.008	3	0.003
Impact vs Ref	a3-b1	0.000	1	0.000
Among Refs	b1	0.008	2	0.004
B * Location	a4	0.013	3	0.004
B * Impact	a4-b2	0.002	1	0.002
B * Ref	b2	0.011	2	0.006
T(B) * L	a5	0.137	27	0.005
T(Bef) * Location	c1	0.054	6	0.009
T(Bef) * Impact	c1-d1	0.000	2	0.000
T(Bef) * Ref	d1	0.054	4	0.014
T(Aft) * Location	a5-c1	0.083	21	0.004
T(Aft) * Impact	a5-c1-b3+d1	0.071	7	0.010
T(Aft) * Ref	b3-d1	0.012	14	0.001
Residual	a6	0.779	74	0.011
Total	a7	1.304	123	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,74	0.081	1.93	0.99
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NO...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / Residual	7,74	0.964	2.35	0.46
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NO... no short-term impact detected

3. Do reference sites vary in difference from before to after impact?

B * Ref / Residual	2,74	0.522	3.76	0.60
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NO...

4. Does scalping affect differences from before to after?

B * Imp / Residual	1,74	0.190	5.1	0.66
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NO...no impact detected

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	0.808	1	0.808
T(B)	a2	1.289	9	0.143
Location	a3	0.173	3	0.058
Impact vs Ref	a3-b1	0.092	1	0.092
Among Refs	b1	0.081	2	0.041
B * Location	a4	0.488	3	0.163
B * Impact	a4-b2	0.439	1	0.439
B * Ref	b2	0.049	2	0.025
T(B) * L	a5	5.306	27	0.197
T(Bef) * Location	c1	0.302	6	0.050
T(Bef) * Impact	c1-d1	0.231	2	0.116
T(Bef) * Ref	d1	0.071	4	0.018
T(Aft) * Location	a5-c1	5.004	21	0.238
T(Aft) * Impact	a5-c1-b3+d1	3.376	7	0.482
T(Aft) * Ref	b3-d1	1.628	14	0.116
Residual	a6	12.981	74	0.175
Total	a7	21.045	123	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after scalping?

T(Aft) * Ref / Residual	14,74	0.663	1.93	0.80
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NO...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / Residual	7,74	2.749	2.35	0.01
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YES... short-term impact detected

3A. Was change observed at reference sites?

T(Aft) * Ref / T(Bef) * Ref	14,4	6.551	39.4	0.04
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YES... changes are associated with scalped site

3B. Was timing of change coincident with scalping?

T(Aft) * Imp / T(Bef) * Imp	7,2	4.176	948	0.21
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NO... change was not coincident with scalping

SPECIES RICHNESS

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	2.089	1	2.089	a1
Times(B)	291.578	9	32.398	a2
Locations	4.31	3	1.437	a3
B * L	1.124	3	0.375	a4
T(B) * L	62.743	27	2.324	a5
Residual	223.395	80	2.792	a6
Total	585.239	123		a7

B. Exclude Impact Site

Bef/Aft - B	2.474	1	2.474	
Times(B)	219.268	9	24.363	
Locations	2.713	2	1.357	b1
B * L	0.561	2	0.281	b2
T(B) * L	36.63	18	2.035	b3
Residual	137.895	53	2.602	
Total	399.541	85		

C. All Locations Before Impact

Times(B)	132.235	2	66.118	
Locations	0.334	3	0.111	
B * L	1.954	6	0.326	c1
Residual	6.3	13	0.485	
Total	140.823	24		

D. Reference Locations Before Impact

Times(B)	85.253	2	42.627	
Locations	0.249	2	0.125	
B * L	0.473	4	0.118	d1
Residual	1.8	6	0.300	
Total	87.775	14		

Power Analysis

1+n0 = MS[T(Aft) * Impact] / MS[Residual]	1.166
Degrees of Freedom	7,74
Falt = Fcrit / (1+n0) = 2.14 / (1+n0)	1.834
Power (based on F-distribution)	0.093

SIMPSON'S DIVERSITY

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	0.356	1	0.356	a1
Times(B)	3.253	9	0.361	a2
Locations	0.179	3	0.060	a3
B * L	0.021	3	0.007	a4
T(B) * L	0.513	27	0.019	a5
Residual	2.8	80	0.035	a6
Total	7.122	123		a7

B. Exclude Impact Site

Bef/Aft - B	0.234	1	0.234	
Times(B)	2.37	9	0.263	
Locations	0.032	2	0.016	b1
B * L	0.02	2	0.010	b2
T(B) * L	0.3	18	0.017	b3
Residual	1.692	53	0.032	
Total	4.648	85		

C. All Locations Before Impact

Times(B)	1.346	2	0.673	
Locations	0.073	3	0.024	
B * L	0.064	6	0.011	c1
Residual	0.004	13	0.000	
Total	1.487	24		

D. Reference Locations Before Impact

Times(B)	1.021	2	0.511	
Locations	0.018	2	0.009	
B * L	0.022	4	0.006	d1
Residual	0.002	6	0.000	
Total	1.063	14		

Power Analysis

1+n0 = MS[T(Aft) * Impact] / MS[Residual]	0.646
Degrees of Freedom	7,74
Falt = Fcrit / (1+n0) = 2.14 / (1+n0)	3.312
Power (based on F-distribution)	0.004

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	2.089	1	2.089
T(B)	a2	291.578	9	32.398
Location	a3	4.310	3	1.437
Impact vs Ref	a3-b1	1.597	1	1.597
Among Refs	b1	2.713	2	1.357
B * Location	a4	1.124	3	0.375
B * Impact	a4-b2	0.563	1	0.563
B * Ref	b2	0.561	2	0.281
T(B) * L	a5	62.743	27	2.324
T(Bef) * Location	c1	1.954	6	0.326
T(Bef) * Impact	c1-d1	1.481	2	0.741
T(Bef) * Ref	d1	0.473	4	0.118
T(Aft) * Location	a5-c1	60.789	21	2.895
T(Aft) * Impact	a5-c1-b3+d1	24.632	7	3.519
T(Aft) * Ref	b3-d1	36.157	14	2.583
Residual	a6	223.395	74	3.019
Total	a7	585.239	123	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,74	0.856	1.93	0.61
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NO...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / Residual	7,74	1.166	2.35	0.33
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NO... no short-term impact detected

3. Do reference sites vary in difference from before to after impact?

B * Ref / Residual	2,74	0.093	3.76	0.91
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NO...

4. Does impact affect differences from before to after?

B * Imp / Residual	1,74	0.186	5.1	0.67
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NO...no impact detected

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	0.356	1	0.356
T(B)	a2	3.253	9	0.361
Location	a3	0.179	3	0.060
Impact vs Ref	a3-b1	0.147	1	0.147
Among Refs	b1	0.032	2	0.016
B * Location	a4	0.021	3	0.007
B * Impact	a4-b2	0.001	1	0.001
B * Ref	b2	0.020	2	0.010
T(B) * L	a5	0.513	27	0.019
T(Bef) * Location	c1	0.064	6	0.011
T(Bef) * Impact	c1-d1	0.042	2	0.021
T(Bef) * Ref	d1	0.022	4	0.006
T(Aft) * Location	a5-c1	0.449	21	0.021
T(Aft) * Impact	a5-c1-b3+d1	0.171	7	0.024
T(Aft) * Ref	b3-d1	0.278	14	0.020
Residual	a6	2.800	74	0.038
Total	a7	7.122	123	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,74	0.525	1.93	0.91
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NO...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / Residual	7,74	0.646	2.35	0.72
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NO... no short-term impact detected

3. Do reference sites vary in difference from before to after impact?

B * Ref / Residual	2,74	0.264	3.76	0.77
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NO...

4. Does impact affect differences from before to after?

B * Imp / Residual	1,74	0.026	5.1	0.87
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NO...no impact detected

SIMPSON'S EVENNESS

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	0.000	1	0.000	a1
Times(B)	0.070	9	0.008	a2
Locations	0.010	3	0.003	a3
B * L	0.005	3	0.002	a4
T(B) * L	0.214	27	0.008	a5
Residual	0.464	80	0.006	a6
Total	0.763	123		a7

B. Exclude Impact Site

Source of Variance	SS	df	MS	Term
Bef/Aft - B	0.000	1	0.000	
Times(B)	0.079	9	0.009	
Locations	0.010	2	0.005	b1
B * L	0.005	2	0.003	b2
T(B) * L	0.160	18	0.009	b3
Residual	0.346	53	0.007	
Total	0.600	85		

C. All Locations Before Impact

Source of Variance	SS	df	MS	Term
Times(B)	0.001	2	0.001	
Locations	0.001	3	0.000	
B * L	0.015	6	0.003	c1
Residual	0.042	13	0.003	
Total	0.059	24		

D. Reference Locations Before Impact

Source of Variance	SS	df	MS	Term
Times(B)	0.001	2	0.001	
Locations	0.001	2	0.001	
B * L	0.009	4	0.002	d1
Residual	0.010	6	0.002	
Total	0.021	14		

Power Analysis

$1+n0 = MS[T(Aft) * Impact] / MS[Residual]$

Degrees of Freedom

$Falt = Fcrit / (1+n0) = 2.14 / (1+n0)$

Power (based on F-distribution)

1.094

7,74

1.955

0.073

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	0.000	1	0.000
T(B)	a2	0.070	9	0.008
Location	a3	0.010	3	0.003
Impact vs Ref	a3-b1	0.000	1	0.000
Among Refs	b1	0.010	2	0.005
B * Location	a4	0.005	3	0.002
B * Impact	a4-b2	0.000	1	0.000
B * Ref	b2	0.005	2	0.003
T(B) * L	a5	0.214	27	0.008
T(Bef) * Location	c1	0.015	6	0.003
T(Bef) * Impact	c1-d1	0.006	2	0.003
T(Bef) * Ref	d1	0.009	4	0.002
T(Aft) * Location	a5-c1	0.199	21	0.009
T(Aft) * Impact	a5-c1-b3+d1	0.048	7	0.007
T(Aft) * Ref	b3-d1	0.151	14	0.011
Residual	a6	0.464	74	0.006
Total	a7	0.763	123	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,74	1.720	1.93	0.07
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NO...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / Residual	7,74	1.094	2.35	0.38
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NO... no short-term impact detected

3. Do reference sites vary in difference from before to after impact?

B * Ref / Residual	2,74	0.399	3.76	0.67
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NO...

4. Does impact affect differences from before to after?

B * Imp / Residual	1,74	0.000	5.1	1.00
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NO...no impact detected

Appendix I. Benthic ANOVA results – Whole Bar Unit

INVERTEBRATE DENSITY

A. All Data

Source	SS	df	MS	Term
Bef/Aft - B	4.391	1	4.391	a1
Times(B)	79.129	8	9.891	a2
Locations	0.301	3	0.100	a3
B * L	0.469	3	0.156	a4
T(B) * L	3.798	24	0.158	a5
Residual	8.346	157	0.053	a6
Total	96.434	196		a7

B. Exclude Impact Site

Bef/Aft - B	3.816	1	3.816	
Times(B)	50.615	8	6.327	
Locations	0.258	2	0.129	b1
B * L	0.404	2	0.202	b2
T(B) * L	1.713	16	0.107	b3
Residual	5.828	105	0.056	
Total	62.634	134		

C. All Locations Before Impact

Times(B)	10.507	1	10.507	
Locations	0.391	3	0.130	
B * L	1.033	3	0.344	c1
Residual	2.253	34	0.066	
Total	14.184	41		

D. Reference Locations Before Impact

Times(B)	6.915	1	6.915	
Locations	0.391	2	0.196	
B * L	0.979	2	0.490	d1
Residual	1.954	27	0.072	
Total	10.239	32		

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	4.391	1	4.391
T(B)	a2	79.129	8	9.891
Location	a3	0.301	3	0.100
Impact vs Ref	a3-b1	0.043	1	0.043
Among Refs	b1	0.258	2	0.129
B * Location	a4	0.469	3	0.156
B * Impact	a4-b2	0.065	1	0.065
B * Ref	b2	0.404	2	0.202
T(B) * L	a5	3.798	24	0.158
T(Bef) * Location	c1	1.033	3	0.344
T(Bef) * Impact	c1-d1	0.054	1	0.054
T(Bef) * Ref	d1	0.979	2	0.490
T(Aft) * Location	a5-c1	2.765	21	0.132
T(Aft) * Impact	a5-c1-b3+d	2.031	7	0.290
T(Aft) * Ref	b3-d1	0.734	14	0.052
Residual	a6	8.346	156	0.054
Total	a7	96.434	196	

df	F	Fcrit	p
14,156	0.980	1.75	0.48

1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,156	0.980	1.75	0.48
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NO...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / Residual	7,156	5.423	2.075	<0.00001
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YES... short-term impact detected

3A. Was change observed at reference sites?

T(Aft) * Ref / T(Bef) * Ref	14,2	0.107	39.4	0.99
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NO... change was associated with Impact site

3B. Was timing of change coincident with impact?

T(Aft) * Imp / T(Bef) * Imp	7,1	5.373	948	0.32
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NO... change was not coincident with impact

PROPORTION REPRESENTED BY EPHEMEROPTERA, PLECOPTERA, TRICOPTERA

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	1.035	1	1.035	a1
Times(B)	3.515	8	0.439	a2
Locations	0.558	3	0.186	a3
B * L	0.306	3	0.102	a4
T(B) * L	1.834	24	0.076	a5
Residual	6.355	157	0.040	a6
Total	13.603	196		a7

B. Exclude Impact Site

Bef/Aft - B	0.387	1	0.387	
Times(B)	1.899	8	0.237	
Locations	0.193	2	0.097	b1
B * L	0.065	2	0.033	b2
T(B) * L	0.695	16	0.043	b3
Residual	3.587	105	0.034	
Total	6.826	134		

C. All Locations Before Impact

Times(B)	1.013	1	1.013	
Locations	0.473	3	0.158	
B * L	0.127	3	0.042	c1
Residual	0.720	34	0.021	
Total	2.333	41		

D. Reference Locations Before Impact

Times(B)	0.528	1	0.528	
Locations	0.110	2	0.055	
B * L	0.016	2	0.008	d1
Residual	0.625	27	0.023	
Total	1.279	32		

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	1.035	1	1.035
T(B)	a2	3.515	8	0.439
Location	a3	0.558	3	0.186
Impact vs Ref	a3-b1	0.365	1	0.365
Among Refs	b1	0.193	2	0.097
B * Location	a4	0.306	3	0.102
B * Impact	a4-b2	0.241	1	0.241
B * Ref	b2	0.065	2	0.033
T(B) * L	a5	1.834	24	0.076
T(Bef) * Location	c1	0.127	3	0.042
T(Bef) * Impact	c1-d1	0.111	1	0.111
T(Bef) * Ref	d1	0.016	2	0.008
T(Aft) * Location	a5-c1	1.707	21	0.081
T(Aft) * Impact	a5-c1-b3+d	1.028	7	0.147
T(Aft) * Ref	b3-d1	0.679	14	0.049
Residual	a6	6.355	156	0.041
Total	a7	13.603	196	

df	F	Fcrit	p
14,156	1.191	1.75	0.29

1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,156	1.191	1.75	0.29
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NO...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / Residual	7,156	3.605	2.075	0.001
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YES... short-term impact detected

3A. Was change observed at reference sites?

T(Aft) * Ref / T(Bef) * Ref	14,2	6.063	39.4	0.150
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NO... change was associated with Impact site

3B. Was timing of change coincident with impact?

T(Aft) * Imp / T(Bef) * Imp	7,1	1.323	948	0.59
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NO... change was not coincident with impact

TAXON RICHNESS

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	234.244	1	234.244	a1
Times(B)	1637.361	8	204.670	a2
Locations	26.372	3	8.791	a3
B * L	13.871	3	4.624	a4
T(B) * L	133.918	24	5.580	a5
Residual	481.823	157	3.069	a6
Total	2527.589	196		a7

B. Exclude Impact Site

Bef/Aft - B	138.747	1	138.747	
Times(B)	1044.639	8	130.580	
Locations	15.640	2	7.820	b1
B * L	7.077	2	3.539	b2
T(B) * L	100.763	16	6.298	b3
Residual	375.056	105	3.572	
Total	1681.922	134		

C. All Locations Before Impact

Times(B)	185.570	1	185.570	
Locations	12.841	3	4.280	
B * L	19.885	3	6.628	c1
Residual	223.056	34	6.560	
Total	441.352	41		

D. Reference Locations Before Impact

Times(B)	132.302	1	132.302	
Locations	2.589	2	1.295	
B * L	19.881	2	9.941	d1
Residual	207.556	27	7.687	
Total	362.328	32		

Power Analysis

1+n0 = MS[T(Aft) * Impact] / MS[Residual]
 Degrees of Freedom
 Falt = Fcrit / (1+n0) = 2.07 / (1+n0)
 Power (based on F-distribution)

1.533
7,156
1.350
0.23

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	234.244	1	234.244
T(B)	a2	1637.361	8	204.670
Location	a3	26.372	3	8.791
Impact vs Ref	a3-b1	10.732	1	10.732
Among Refs	b1	15.640	2	7.820
B * Location	a4	13.871	3	4.624
B * Impact	a4-b2	6.794	1	6.794
B * Ref	b2	7.077	2	3.539
T(B) * L	a5	133.918	24	5.580
T(Bef) * Location	c1	19.885	3	6.628
T(Bef) * Impact	c1-d1	0.004	1	0.004
T(Bef) * Ref	d1	19.881	2	9.941
T(Aft) * Location	a5-c1	114.033	21	5.430
T(Aft) * Impact	a5-c1-b3+d	33.151	7	4.736
T(Aft) * Ref	b3-d1	80.882	14	5.777
Residual	a6	481.823	156	3.089
Total	a7	2527.589	196	

df	F	Fcrit	p
14,156	1.871	1.75	0.033

1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual
 YES...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / T(Aft) * Ref	7,14	0.820	2.76	
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NO... no short-term impact detected

NUMBER OF TAXA REPRESENTED BY EPHEMEROPTERA, PLECOPTERA, TRICOPTERA

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	174.386	1	174.386	a1
Times(B)	899.942	8	112.493	a2
Locations	22.739	3	7.580	a3
B * L	8.000	3	2.667	a4
T(B) * L	92.102	24	3.838	a5
Residual	298.449	157	1.901	a6
Total	1495.618	196		a7

B. Exclude Impact Site

Bef/Aft - B	102.327	1	102.327	
Times(B)	585.328	8	73.166	
Locations	16.499	2	8.250	b1
B * L	2.174	2	1.087	b2
T(B) * L	67.694	16	4.231	b3
Residual	236.333	105	2.251	
Total	1010.355	134		

C. All Locations Before Impact

Times(B)	58.368	1	58.368	
Locations	11.785	3	3.928	
B * L	12.485	3	4.162	c1
Residual	133.167	34	3.917	
Total	215.805	41		

D. Reference Locations Before Impact

Times(B)	44.180	1	44.180	
Locations	4.346	2	2.173	
B * L	12.221	2	6.111	d1
Residual	121.833	27	4.512	
Total	182.580	32		

Power Analysis

1+n0 = MS[T(Aft) * Impact] / MS[Residual]
 Degrees of Freedom
 Falt = Fcrit / (1+n0) = 2.07 / (1+n0)
 Power (based on F-distribution)

1.803
7,156
1.148
0.336

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	174.386	1	174.386
T(B)	a2	899.942	8	112.493
Location	a3	22.739	3	7.580
Impact vs Ref	a3-b1	6.240	1	6.240
Among Refs	b1	16.499	2	8.250
B * Location	a4	8.000	3	2.667
B * Impact	a4-b2	5.826	1	5.826
B * Ref	b2	2.174	2	1.087
T(B) * L	a5	92.102	24	3.838
T(Bef) * Location	c1	12.485	3	4.162
T(Bef) * Impact	c1-d1	0.264	1	0.264
T(Bef) * Ref	d1	12.221	2	6.111
T(Aft) * Location	a5-c1	79.617	21	3.791
T(Aft) * Impact	a5-c1-b3+d	24.144	7	3.449
T(Aft) * Ref	b3-d1	55.473	14	3.962
Residual	a6	298.449	156	1.913
Total	a7	1495.618	196	

df	F	Fcrit	p
14,156	2.071	1.75	0.016

1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual
 YES...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / T(Aft) * Ref	7,14	0.870	2.76	0.55
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NO... no short-term impact detected

SIMPSON'S DIVERSITY

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	0.121	1	0.121	a1
Times(B)	3.353	8	0.419	a2
Locations	0.383	3	0.128	a3
B * L	0.209	3	0.070	a4
T(B) * L	1.170	24	0.049	a5
Residual	3.749	157	0.024	a6
Total	8.985	196		a7

B. Exclude Impact Site

Bef/Aft - B	0.020	1	0.020	
Times(B)	2.725	8	0.341	
Locations	0.313	2	0.157	b1
B * L	0.137	2	0.069	b2
T(B) * L	0.793	16	0.050	b3
Residual	2.145	105	0.020	
Total	6.133	134		

C. All Locations Before Impact

Times(B)	0.834	1	0.834	
Locations	0.209	3	0.070	
B * L	0.011	3	0.004	c1
Residual	0.660	34	0.019	
Total	1.714	41		

D. Reference Locations Before Impact

Times(B)	0.621	1	0.621	
Locations	0.126	2	0.063	
B * L	0.009	2	0.005	d1
Residual	0.595	27	0.022	
Total	1.351	32		

Power Analysis

1+n0 = MS[T(Aft) * Impact] / MS[Residual]	2.229
Degrees of Freedom	7,156
Falt = Fcrit / (1+n0) = 2.07 / (1+n0)	0.929
Power (based on F-distribution)	0.486

SIMPSON'S EVENNESS

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	0.489	1	0.489	a1
Times(B)	14.441	8	1.805	a2
Locations	0.098	3	0.033	a3
B * L	0.059	3	0.020	a4
T(B) * L	0.770	24	0.032	a5
Residual	2.393	157	0.015	a6
Total	18.250	196		a7

B. Exclude Impact Site

Bef/Aft - B	0.429	1	0.429	
Times(B)	9.509	8	1.189	
Locations	0.089	2	0.045	b1
B * L	0.054	2	0.027	b2
T(B) * L	0.274	16	0.017	b3
Residual	1.640	105	0.016	
Total	11.995	134		

C. All Locations Before Impact

Times(B)	1.874	1	1.874	
Locations	0.077	3	0.026	
B * L	0.068	3	0.023	c1
Residual	0.406	34	0.012	
Total	2.425	41		

D. Reference Locations Before Impact

Times(B)	1.276	1	1.276	
Locations	0.070	2	0.035	
B * L	0.060	2	0.030	d1
Residual	0.372	27	0.014	
Total	1.778	32		

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	0.121	1	0.121
T(B)	a2	3.353	8	0.419
Location	a3	0.383	3	0.128
Impact vs Ref	a3-b1	0.070	1	0.070
Among Refs	b1	0.313	2	0.157
B * Location	a4	0.209	3	0.070
B * Impact	a4-b2	0.072	1	0.072
B * Ref	b2	0.137	2	0.069
T(B) * L	a5	1.170	24	0.049
T(Bef) * Location	c1	0.011	3	0.004
T(Bef) * Impact	c1-d1	0.002	1	0.002
T(Bef) * Ref	d1	0.009	2	0.005
T(Aft) * Location	a5-c1	1.159	21	0.055
T(Aft) * Impact	a5-c1-b3+d	0.375	7	0.054
T(Aft) * Ref	b3-d1	0.784	14	0.056
Residual	a6	3.749	156	0.024
Total	a7	8.985	196	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,156	2.330	1.75	0.006
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YES...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / T(Aft) * Ref	7,14	0.957	2.76	0.5
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NO... no short-term impact detected

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	0.489	1	0.489
T(B)	a2	14.441	8	1.805
Location	a3	0.098	3	0.033
Impact vs Ref	a3-b1	0.009	1	0.009
Among Refs	b1	0.089	2	0.045
B * Location	a4	0.059	3	0.020
B * Impact	a4-b2	0.005	1	0.005
B * Ref	b2	0.054	2	0.027
T(B) * L	a5	0.770	24	0.032
T(Bef) * Location	c1	0.068	3	0.023
T(Bef) * Impact	c1-d1	0.008	1	0.008
T(Bef) * Ref	d1	0.060	2	0.030
T(Aft) * Location	a5-c1	0.702	21	0.033
T(Aft) * Impact	a5-c1-b3+d	0.488	7	0.070
T(Aft) * Ref	b3-d1	0.214	14	0.015
Residual	a6	2.393	156	0.015
Total	a7	18.250	196	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,156	0.996	1.83	0.46
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NO...

2. Does scalping affect short-term temporal trend?

T(Aft) * Imp / Residual	7,156	4.545	2.14	0.008
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YES... short-term impact detected

3A. Was change observed at reference sites?

T(Aft) * Ref / T(Bef) * Ref	14,2	0.510	39.4	0.82
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NO... change was associated with Impact site

3B. Was timing of change coincident with impact?

T(Aft) * Imp / T(Bef) * Imp	7,1	8.714	948	0.26
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NO... change was not coincident with impact

Appendix J. Benthic ANOVA results – Bar Edge Unit

INVERTEBRATE DENSITY

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	2.647	1	2.647	a1
Times(B)	71.848	8	8.981	a2
Locations	0.693	3	0.231	a3
B * L	0.512	3	0.171	a4
T(B) * L	3.766	24	0.157	a5
Residual	4.756	115	0.041	a6
Total	84.222	154		a7

B. Exclude Impact Site

Bef/Aft - B	1.962	1	1.962	
Times(B)	45.796	8	5.725	
Locations	0.603	2	0.302	b1
B * L	0.509	2	0.255	b2
T(B) * L	1.979	16	0.124	b3
Residual	2.447	66	0.037	
Total	53.296	95		

C. All Locations Before Impact

Times(B)	9.738	1	9.738	
Locations	0.690	3	0.230	
B * L	1.252	3	0.417	c1
Residual	1.118	22	0.051	
Total	12.798	29		

D. Reference Locations Before Impact

Times(B)	6.346	1	6.346	
Locations	0.671	2	0.336	
B * L	1.193	2	0.597	d1
Residual	0.819	15	0.055	
Total	9.029	20		

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	2.647	1	2.647
T(B)	a2	71.848	8	8.981
Location	a3	0.693	3	0.231
Impact vs Ref	a3-b1	0.090	1	0.090
Among Refs	b1	0.603	2	0.302
B * Location	a4	0.512	3	0.171
B * Impact	a4-b2	0.003	1	0.003
B * Ref	b2	0.509	2	0.255
T(B) * L	a5	3.766	24	0.157
T(Bef) * Location	c1	1.252	3	0.417
T(Bef) * Impact	c1-d1	0.059	1	0.059
T(Bef) * Ref	d1	1.193	2	0.597
T(Aft) * Location	a5-c1	2.514	21	0.120
T(Aft) * Impact	a5-c1-b3+d1	1.728	7	0.247
T(Aft) * Ref	b3-d1	0.786	14	0.056
Residual	a6	4.756	113	0.042
Total	a7	84.222	154	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,113	1.334	1.75	0.20
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NO...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / Residual	7,113	5.865	2.075	<0.00001
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YES... short-term impact detected

3A. Was change observed at reference sites?

T(Aft) * Ref / T(Bef) * Ref	14,2	0.094	39.4	0.99
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NO... change was associated with Impact site

3B. Was timing of change coincident with impact?

T(Aft) * Imp / T(Bef) * Imp	7,1	4.184	948	0.36
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NO... change was not coincident with impact

PROPORTION REPRESENTED BY EPHEMEROPTERA, PLECOPTERA, TRICOPTERA

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	0.997	1	0.997	a1
Times(B)	2.594	8	0.324	a2
Locations	0.826	3	0.275	a3
B * L	0.270	3	0.090	a4
T(B) * L	1.710	24	0.071	a5
Residual	3.760	115	0.033	a6
Total	10.157	154		a7

B. Exclude Impact Site

Bef/Aft - B	0.381	1	0.381	
Times(B)	1.221	8	0.153	
Locations	0.297	2	0.149	b1
B * L	0.043	2	0.022	b2
T(B) * L	0.483	16	0.030	b3
Residual	1.221	66	0.019	
Total	3.646	95		

C. All Locations Before Impact

Times(B)	0.701	1	0.701	
Locations	0.609	3	0.203	
B * L	0.146	3	0.049	c1
Residual	0.421	22	0.019	
Total	1.877	29		

D. Reference Locations Before Impact

Times(B)	0.308	1	0.308	
Locations	0.181	2	0.091	
B * L	0.040	2	0.020	d1
Residual	0.325	15	0.022	
Total	0.854	20		

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	0.997	1	0.997
T(B)	a2	2.594	8	0.324
Location	a3	0.826	3	0.275
Impact vs Ref	a3-b1	0.529	1	0.529
Among Refs	b1	0.297	2	0.149
B * Location	a4	0.270	3	0.090
B * Impact	a4-b2	0.227	1	0.227
B * Ref	b2	0.043	2	0.022
T(B) * L	a5	1.710	24	0.071
T(Bef) * Location	c1	0.146	3	0.049
T(Bef) * Impact	c1-d1	0.106	1	0.106
T(Bef) * Ref	d1	0.040	2	0.020
T(Aft) * Location	a5-c1	1.564	21	0.074
T(Aft) * Impact	a5-c1-b3+d1	1.121	7	0.160
T(Aft) * Ref	b3-d1	0.443	14	0.032
Residual	a6	3.760	113	0.033
Total	a7	10.157	154	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,113	0.951	1.75	0.510
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NO...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / Residual	7,113	4.813	2.075	<0.00001
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YES... short-term impact detected

3A. Was change observed at reference sites?

T(Aft) * Ref / T(Bef) * Ref	14,2	1.582	39.4	0.45
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NO... change was associated with Impact site

3B. Was timing of change coincident with impact?

T(Aft) * Imp / T(Bef) * Imp	7,1	1.511	948	0.56
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NO... change was not coincident with impact

TAXON RICHNESS

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	120.293	1	120.293	a1
Times(B)	1336.507	8	167.063	a2
Locations	68.836	3	22.945	a3
B * L	32.078	3	10.693	a4
T(B) * L	126.535	24	5.272	a5
Residual	267.379	115	2.325	a6
Total	1951.628	154		a7

B. Exclude Impact Site

Bef/Aft - B	50.135	1	50.135	
Times(B)	820.065	8	102.508	
Locations	46.310	2	23.155	b1
B * L	10.698	2	5.349	b2
T(B) * L	85.735	16	5.358	b3
Residual	168.000	66	2.545	
Total	1180.943	95		

C. All Locations Before Impact

Times(B)	141.440	1	141.440	
Locations	55.699	3	18.566	
B * L	15.930	3	5.310	c1
Residual	110.833	22	5.038	
Total	323.902	29		

D. Reference Locations Before Impact

Times(B)	92.182	1	92.182	
Locations	29.896	2	14.948	
B * L	15.263	2	7.632	d1
Residual	95.333	15	6.356	
Total	232.674	20		

Power Analysis

$1+n_0 = MS[T(Aft) * Impact] / MS[Residual]$	2.423
Degrees of Freedom	7,113
$F_{alt} = F_{crit} / (1+n_0) = 2.09 / (1+n_0)$	0.863
Power (based on F-distribution)	0.538

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	120.293	1	120.293
T(B)	a2	1336.507	8	167.063
Location	a3	68.836	3	22.945
Impact vs Ref	a3-b1	22.526	1	22.526
Among Refs	b1	46.310	2	23.155
B * Location	a4	32.078	3	10.693
B * Impact	a4-b2	21.380	1	21.380
B * Ref	b2	10.698	2	5.349
T(B) * L	a5	126.535	24	5.272
T(Bef) * Location	c1	15.930	3	5.310
T(Bef) * Impact	c1-d1	0.667	1	0.667
T(Bef) * Ref	d1	15.263	2	7.632
T(Aft) * Location	a5-c1	110.605	21	5.267
T(Aft) * Impact	a5-c1-b3+d1	40.133	7	5.733
T(Aft) * Ref	b3-d1	70.472	14	5.034
Residual	a6	267.379	113	2.366
Total	a7	1951.628	154	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,113	2.127	1.782	0.015
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YES...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / T(Aft) * Ref	7,14	1.139	2.76	0.39
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NO... no short-term impact detected

NUMBER OF TAXA REPRESENTED BY EPHEMEROPTERA, PLECOPTERA, TRICOPTERA

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	109.014	1	109.014	a1
Times(B)	771.526	8	96.441	a2
Locations	45.659	3	15.220	a3
B * L	18.461	3	6.154	a4
T(B) * L	81.805	24	3.409	a5
Residual	168.061	115	1.461	a6
Total	1194.526	154		a7

B. Exclude Impact Site

Bef/Aft - B	50.653	1	50.653	
Times(B)	488.736	8	61.092	
Locations	33.915	2	16.958	b1
B * L	5.869	2	2.935	b2
T(B) * L	50.551	16	3.159	b3
Residual	114.667	66	1.737	
Total	744.391	95		

C. All Locations Before Impact

Times(B)	50.298	1	50.298	
Locations	35.604	3	11.868	
B * L	11.628	3	3.876	c1
Residual	70.500	22	3.205	
Total	168.030	29		

D. Reference Locations Before Impact

Times(B)	36.379	1	36.379	
Locations	21.429	2	10.715	
B * L	11.596	2	5.798	d1
Residual	59.167	15	3.944	
Total	128.571	20		

Power Analysis

$1+n_0 = MS[T(Aft) * Impact] / MS[Residual]$	2.999
Degrees of Freedom	7,113
$F_{alt} = F_{crit} / (1+n_0) = 2.09 / (1+n_0)$	0.697
Power (based on F-distribution)	0.674

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	109.014	1	109.014
T(B)	a2	771.526	8	96.441
Location	a3	45.659	3	15.220
Impact vs Ref	a3-b1	11.744	1	11.744
Among Refs	b1	33.915	2	16.958
B * Location	a4	18.461	3	6.154
B * Impact	a4-b2	12.592	1	12.592
B * Ref	b2	5.869	2	2.935
T(B) * L	a5	81.805	24	3.409
T(Bef) * Location	c1	11.628	3	3.876
T(Bef) * Impact	c1-d1	0.032	1	0.032
T(Bef) * Ref	d1	11.596	2	5.798
T(Aft) * Location	a5-c1	70.177	21	3.342
T(Aft) * Impact	a5-c1-b3+d1	31.222	7	4.460
T(Aft) * Ref	b3-d1	38.955	14	2.783
Residual	a6	168.061	113	1.487
Total	a7	1194.526	154	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,113	1.871	1.782	0.037
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YES...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / T(Aft) * Ref	7,14	1.603	2.76	0.21
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NO... no short-term impact detected

SIMPSON'S DIVERSITY

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	0.075	1	0.075	a1
Times(B)	2.863	8	0.358	a2
Locations	0.502	3	0.167	a3
B * L	0.137	3	0.046	a4
T(B) * L	1.198	24	0.050	a5
Residual	2.633	115	0.023	a6
Total	7.408	154		a7

B. Exclude Impact Site

Bef/Aft - B	0.005	1	0.005	
Times(B)	2.318	8	0.290	
Locations	0.379	2	0.190	b1
B * L	0.020	2	0.010	b2
T(B) * L	0.747	16	0.047	b3
Residual	1.060	66	0.016	
Total	4.529	95		

C. All Locations Before Impact

Times(B)	0.638	1	0.638	
Locations	0.318	3	0.106	
B * L	0.013	3	0.004	c1
Residual	0.427	22	0.019	
Total	1.396	29		

D. Reference Locations Before Impact

Times(B)	0.436	1	0.436	
Locations	0.179	2	0.090	
B * L	0.012	2	0.006	d1
Residual	0.362	15	0.024	
Total	0.989	20		

Power Analysis

$1+n_0 = MS[T(Aft) * Impact] / MS[Residual]$

Degrees of Freedom

$F_{alt} = F_{crit} / (1+n_0) = 2.09 / (1+n_0)$

Power (based on F-distribution)

2.759
7,113
0.758
0.624

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	0.075	1	0.075
T(B)	a2	2.863	8	0.358
Location	a3	0.502	3	0.167
Impact vs Ref	a3-b1	0.123	1	0.123
Among Refs	b1	0.379	2	0.190
B * Location	a4	0.137	3	0.046
B * Impact	a4-b2	0.117	1	0.117
B * Ref	b2	0.020	2	0.010
T(B) * L	a5	1.198	24	0.050
T(Bef) * Location	c1	0.013	3	0.004
T(Bef) * Impact	c1-d1	0.001	1	0.001
T(Bef) * Ref	d1	0.012	2	0.006
T(Aft) * Location	a5-c1	1.185	21	0.056
T(Aft) * Impact	a5-c1-b3+d1	0.450	7	0.064
T(Aft) * Ref	b3-d1	0.735	14	0.053
Residual	a6	2.633	113	0.023
Total	a7	7.408	154	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,113	2.253	1.782	0.008
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YES...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / T(Aft) * Ref	7,14	1.224	2.76	0.35
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NO... no short-term impact detected

SIMPSON'S EVENNESS

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	0.248	1	0.248	a1
Times(B)	12.449	8	1.556	a2
Locations	0.112	3	0.037	a3
B * L	0.066	3	0.022	a4
T(B) * L	0.767	24	0.032	a5
Residual	1.314	115	0.011	a6
Total	14.956	154		a7

B. Exclude Impact Site

Bef/Aft - B	0.178	1	0.178	
Times(B)	8.052	8	1.007	
Locations	0.106	2	0.053	b1
B * L	0.066	2	0.033	b2
T(B) * L	0.334	16	0.021	b3
Residual	0.586	66	0.009	
Total	9.322	95		

C. All Locations Before Impact

Times(B)	1.533	1	1.533	
Locations	0.097	3	0.032	
B * L	0.066	3	0.022	c1
Residual	0.254	22	0.012	
Total	1.950	29		

D. Reference Locations Before Impact

Times(B)	0.981	1	0.981	
Locations	0.095	2	0.048	
B * L	0.053	2	0.027	d1
Residual	0.220	15	0.015	
Total	1.349	20		

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	0.248	1	0.248
T(B)	a2	12.449	8	1.556
Location	a3	0.112	3	0.037
Impact vs Ref	a3-b1	0.006	1	0.006
Among Refs	b1	0.106	2	0.053
B * Location	a4	0.066	3	0.022
B * Impact	a4-b2	0.000	1	0.000
B * Ref	b2	0.066	2	0.033
T(B) * L	a5	0.767	24	0.032
T(Bef) * Location	c1	0.066	3	0.022
T(Bef) * Impact	c1-d1	0.013	1	0.013
T(Bef) * Ref	d1	0.053	2	0.027
T(Aft) * Location	a5-c1	0.701	21	0.033
T(Aft) * Impact	a5-c1-b3+d1	0.420	7	0.060
T(Aft) * Ref	b3-d1	0.281	14	0.020
Residual	a6	1.314	113	0.012
Total	a7	14.956	154	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,113	1.726	1.75	0.06
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NO...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / Residual	7,113	5.160	2.075	<0.00001
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YES... short-term impact detected

3A. Was change observed at reference sites?

T(Aft) * Ref / T(Bef) * Ref	14,2	0.757	39.4	0.70
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NO... change was associated with Impact site

3B. Was timing of change coincident with impact?

T(Aft) * Imp / T(Bef) * Imp	7,1	4.615	948	0.34
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NO... change was not coincident with impact

Appendix K. Benthic ANOVA results – Common Family Groups

BAETIDAE ABUNDANCE

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	0.489	1	0.489	a1
Times(B)	46.166	8	5.771	a2
Locations	2.090	3	0.697	a3
B * L	0.245	3	0.082	a4
T(B) * L	4.552	24	0.190	a5
Residual	13.144	157	0.084	a6
Total	66.686	196		a7

B. Exclude Impact Site

Bef/Aft - B	0.195	1	0.195	
Times(B)	26.888	8	3.361	
Locations	0.126	2	0.063	b1
B * L	0.137	2	0.069	b2
T(B) * L	2.111	16	0.132	b3
Residual	8.631	105	0.082	
Total	38.088	134		

C. All Locations Before Impact

Times(B)	6.889	1	6.889	
Locations	1.000	3	0.333	
B * L	1.218	3	0.406	c1
Residual	5.185	34	0.153	
Total	14.292	41		

D. Reference Locations Before Impact

Times(B)	3.024	1	3.024	
Locations	0.063	2	0.032	
B * L	0.172	2	0.086	d1
Residual	4.905	27	0.182	
Total	8.164	32		

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	0.489	1	0.489
T(B)	a2	46.166	8	5.771
Location	a3	2.090	3	0.697
Impact vs Ref	a3-b1	1.964	1	1.964
Among Refs	b1	0.126	2	0.063
B * Location	a4	0.245	3	0.082
B * Impact	a4-b2	0.108	1	0.108
B * Ref	b2	0.137	2	0.069
T(B) * L	a5	4.552	24	0.190
T(Bef) * Location	c1	1.218	3	0.406
T(Bef) * Impact	c1-d1	1.046	1	1.046
T(Bef) * Ref	d1	0.172	2	0.086
T(Aft) * Location	a5-c1	3.334	21	0.159
T(Aft) * Impact	a5-c1-b3+d1	1.395	7	0.199
T(Aft) * Ref	b3-d1	1.939	14	0.139
Residual	a6	13.144	156	0.084
Total	a7	66.686	196	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,156	1.644	1.75	0.073
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NO...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / Residual	7,156	2.365	2.075	0.03
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YES... short-term impact detected

3A. Was change observed at reference sites?

T(Aft) * Ref / T(Bef) * Ref	14,2	1.610	39.4	0.45
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NO... change was associated with Impact site

3B. Was timing of change coincident with impact?

T(Aft) * Imp / T(Bef) * Imp	7,1	0.191	948	0.94
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NO... change was not coincident with impact

HEPTAGENIIDAE ABUNDANCE

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	12.404	1	12.404	a1
Times(B)	31.283	8	3.910	a2
Locations	2.766	3	0.922	a3
B * L	1.363	3	0.454	a4
T(B) * L	8.154	24	0.340	a5
Residual	17.188	157	0.109	a6
Total	73.158	196		a7

B. Exclude Impact Site

Bef/Aft - B	7.300	1	7.300	
Times(B)	16.524	8	2.066	
Locations	0.787	2	0.394	b1
B * L	1.068	2	0.534	b2
T(B) * L	5.191	16	0.324	b3
Residual	12.925	105	0.123	
Total	43.795	134		

C. All Locations Before Impact

Times(B)	1.395	1	1.395	
Locations	1.249	3	0.416	
B * L	1.165	3	0.388	c1
Residual	8.081	34	0.238	
Total	11.89	41		

D. Reference Locations Before Impact

Times(B)	1.208	1	1.208	
Locations	0.122	2	0.061	
B * L	1.051	2	0.526	d1
Residual	7.373	27	0.273	
Total	9.754	32		

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	12.404	1	12.404
T(B)	a2	31.283	8	3.910
Location	a3	2.766	3	0.922
Impact vs Ref	a3-b1	1.979	1	1.979
Among Refs	b1	0.787	2	0.394
B * Location	a4	1.363	3	0.454
B * Impact	a4-b2	0.295	1	0.295
B * Ref	b2	1.068	2	0.534
T(B) * L	a5	8.154	24	0.340
T(Bef) * Location	c1	1.165	3	0.388
T(Bef) * Impact	c1-d1	0.114	1	0.114
T(Bef) * Ref	d1	1.051	2	0.526
T(Aft) * Location	a5-c1	6.989	21	0.333
T(Aft) * Impact	a5-c1-b3+d1	2.849	7	0.407
T(Aft) * Ref	b3-d1	4.140	14	0.296
Residual	a6	17.188	156	0.110
Total	a7	73.158	196	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,156	2.684	1.75	0.002
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YES...

2. Does scalping affect short-term temporal trend?

T(Aft) * Imp / T(Aft) * Ref	7,14	1.376	2.76	0.29
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NO... no short-term impact detected

Power Analysis

$1+n0 = MS[T(Aft) * Impact] / MS[Residual]$

Degrees of Freedom

$Falt = Fcrit / (1+n0) = 2.07 / (1+n0)$

Power (based on F-distribution)

3.694
7.156
0.560
0.787

EPHEMERELLIDAE ABUNDANCE

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	13.772	1	13.772	a1
Times(B)	21.961	8	2.745	a2
Locations	0.679	3	0.226	a3
B * L	0.465	3	0.155	a4
T(B) * L	11.102	24	0.463	a5
Residual	10.758	157	0.069	a6
Total	58.737	196		a7

B. Exclude Impact Site

Bef/Aft - B	10.217	1	10.217	
Times(B)	14.655	8	1.832	
Locations	0.643	2	0.322	b1
B * L	0.464	2	0.232	b2
T(B) * L	9.826	16	0.614	b3
Residual	8.402	105	0.080	
Total	44.207	134		

C. All Locations Before Impact

Times(B)	1.107	1	1.107	
Locations	0.030	3	0.010	
B * L	4.582	3	1.527	c1
Residual	4.110	34	0.121	
Total	9.829	41		

D. Reference Locations Before Impact

Times(B)	0.109	1	0.109	
Locations	0.023	2	0.012	
B * L	3.949	2	1.975	d1
Residual	3.412	27	0.126	
Total	7.493	32		

Power Analysis

$1+n0 = MS[T(Aft) * Impact] / MS[Residual]$

Degrees of Freedom

$Falt = Fcrit / (1+n0) = 2.07 / (1+n0)$

Power (based on F-distribution)

1.332
7,156
1.554
0.153

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	13.772	1	13.772
T(B)	a2	21.961	8	2.745
Location	a3	0.679	3	0.226
Impact vs Ref	a3-b1	0.036	1	0.036
Among Refs	b1	0.643	2	0.322
B * Location	a4	0.465	3	0.155
B * Impact	a4-b2	0.001	1	0.001
B * Ref	b2	0.464	2	0.232
T(B) * L	a5	11.102	24	0.463
T(Bef) * Location	c1	4.582	3	1.527
T(Bef) * Impact	c1-d1	0.633	1	0.633
T(Bef) * Ref	d1	3.949	2	1.975
T(Aft) * Location	a5-c1	6.520	21	0.310
T(Aft) * Impact	a5-c1-b3+d1	0.643	7	0.092
T(Aft) * Ref	b3-d1	5.877	14	0.420
Residual	a6	10.758	156	0.069
Total	a7	58.737	196	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,156	6.087	1.75	<0.0005
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YES...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / T(Aft) * Ref	7,14	0.219	2.76	0.98
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NO... no short-term impact detected

CAPNIIDAE ABUNDANCE

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	5.220	1	5.220	a1
Times(B)	25.844	8	3.231	a2
Locations	0.214	3	0.071	a3
B * L	0.163	3	0.054	a4
T(B) * L	4.031	24	0.168	a5
Residual	12.618	157	0.080	a6
Total	48.090	196		a7

B. Exclude Impact Site

Bef/Aft - B	3.745	1	3.745	
Times(B)	14.685	8	1.836	
Locations	0.029	2	0.015	b1
B * L	0.152	2	0.076	b2
T(B) * L	2.720	16	0.170	b3
Residual	9.955	105	0.095	
Total	31.286	134		

C. All Locations Before Impact

Times(B)	3.504	1	3.504	
Locations	0.177	3	0.059	
B * L	1.583	3	0.528	c1
Residual	5.012	34	0.147	
Total	10.276	41		

D. Reference Locations Before Impact

Times(B)	1.319	1	1.319	
Locations	0.088	2	0.044	
B * L	0.883	2	0.442	d1
Residual	4.396	27	0.163	
Total	6.686	32		

Power Analysis

$1+n0 = MS[T(Aft) * Impact] / MS[Residual]$

Degrees of Freedom

$Falt = Fcrit / (1+n0) = 2.07 / (1+n0)$

Power (based on F-distribution)

1.079
7,156
1.918
0.072

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	5.220	1	5.220
T(B)	a2	25.844	8	3.231
Location	a3	0.214	3	0.071
Impact vs Ref	a3-b1	0.185	1	0.185
Among Refs	b1	0.029	2	0.015
B * Location	a4	0.163	3	0.054
B * Impact	a4-b2	0.011	1	0.011
B * Ref	b2	0.152	2	0.076
T(B) * L	a5	4.031	24	0.168
T(Bef) * Location	c1	1.583	3	0.528
T(Bef) * Impact	c1-d1	0.700	1	0.700
T(Bef) * Ref	d1	0.883	2	0.442
T(Aft) * Location	a5-c1	2.448	21	0.117
T(Aft) * Impact	a5-c1-b3+d1	0.611	7	0.087
T(Aft) * Ref	b3-d1	1.837	14	0.131
Residual	a6	12.618	156	0.081
Total	a7	48.090	196	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,156	1.622	1.75	0.08
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NO...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / Residual	7,156	1.079	2.075	0.43
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NO... no short-term impact detected

3. Do reference sites vary in difference from before to after impact?

B * Ref / Residual	2,156	0.940	3.05	0.39
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NO...

4. Does impact affect differences from before to after?

B * Imp / Residual	1,156	0.136	3.9	0.71
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NO impact detected

CHIRONOMIDAE ABUNDANCE

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	5.440	1	5.440	a1
Times(B)	122.079	8	15.260	a2
Locations	0.897	3	0.299	a3
B * L	1.021	3	0.340	a4
T(B) * L	5.965	24	0.249	a5
Residual	11.040	157	0.070	a6
Total	146.442	196		a7

B. Exclude Impact Site

Bef/Aft - B	5.689	1	5.689	
Times(B)	77.639	8	9.705	
Locations	0.869	2	0.435	b1
B * L	0.474	2	0.237	b2
T(B) * L	2.884	16	0.180	b3
Residual	7.549	105	0.072	
Total	95.104	134		

C. All Locations Before Impact

Times(B)	15.260	1	15.260	
Locations	0.955	3	0.318	
B * L	1.532	3	0.511	c1
Residual	1.711	34	0.050	
Total	19.458	41		

D. Reference Locations Before Impact

Times(B)	9.043	1	9.043	
Locations	0.724	2	0.362	
B * L	1.138	2	0.569	d1
Residual	1.633	27	0.060	
Total	12.538	32		

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	5.440	1	5.440
T(B)	a2	122.079	8	15.260
Location	a3	0.897	3	0.299
Impact vs Ref	a3-b1	0.028	1	0.028
Among Refs	b1	0.869	2	0.435
B * Location	a4	1.021	3	0.340
B * Impact	a4-b2	0.547	1	0.547
B * Ref	b2	0.474	2	0.237
T(B) * L	a5	5.965	24	0.249
T(Bef) * Location	c1	1.532	3	0.511
T(Bef) * Impact	c1-d1	0.394	1	0.394
T(Bef) * Ref	d1	1.138	2	0.569
T(Aft) * Location	a5-c1	4.433	21	0.211
T(Aft) * Impact	a5-c1-b3+d1	2.687	7	0.384
T(Aft) * Ref	b3-d1	1.746	14	0.125
Residual	a6	11.040	156	0.071
Total	a7	146.442	196	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,156	1.762	1.75	0.05
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NO...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / Residual	7,156	5.424	2.075	<0.0001
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YES... short-term impact detected

3A. Was change observed at reference sites?

T(Aft) * Ref / T(Bef) * Ref	14,2	0.219	39.4	0.97
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NO... change was associated with Impact site

3B. Was timing of change coincident with impact?

T(Aft) * Imp / T(Bef) * Imp	7,1	0.974	948	0.660
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NO... change was not coincident with impact

NEMATODA ABUNDANCE

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	0.018	1	0.018	a1
Times(B)	20.527	8	2.566	a2
Locations	0.111	3	0.037	a3
B * L	0.065	3	0.022	a4
T(B) * L	2.187	24	0.091	a5
Residual	8.029	157	0.051	a6
Total	30.937	196		a7

B. Exclude Impact Site

Bef/Aft - B	0.007	1	0.007	
Times(B)	14.821	8	1.853	
Locations	0.089	2	0.045	b1
B * L	0.064	2	0.032	b2
T(B) * L	1.678	16	0.105	b3
Residual	6.434	105	0.061	
Total	23.093	134		

C. All Locations Before Impact

Times(B)	3.444	1	3.444	
Locations	0.017	3	0.006	
B * L	0.018	3	0.006	c1
Residual	4.663	34	0.137	
Total	8.142	41		

D. Reference Locations Before Impact

Times(B)	2.493	1	2.493	
Locations	0.012	2	0.006	
B * L	0.011	2	0.006	d1
Residual	4.254	27	0.158	
Total	6.77	32		

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	0.018	1	0.018
T(B)	a2	20.527	8	2.566
Location	a3	0.111	3	0.037
Impact vs Ref	a3-b1	0.022	1	0.022
Among Refs	b1	0.089	2	0.045
B * Location	a4	0.065	3	0.022
B * Impact	a4-b2	0.001	1	0.001
B * Ref	b2	0.064	2	0.032
T(B) * L	a5	2.187	24	0.091
T(Bef) * Location	c1	0.02	3	0.006
T(Bef) * Impact	c1-d1	0.01	1	0.007
T(Bef) * Ref	d1	0.01	2	0.006
T(Aft) * Location	a5-c1	2.169	21	0.103
T(Aft) * Impact	a5-c1-b3+d1	0.502	7	0.072
T(Aft) * Ref	b3-d1	1.667	14	0.119
Residual	a6	8.029	156	0.051
Total	a7	30.9	196	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,156	2.314	1.75	0.006
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YES...

2. Does scalping affect short-term temporal trend?

T(Aft) * Imp / T(Aft) * Ref	7,14	0.602	2.76	0.74
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NO... no short-term impact detected

Power Analysis

$1+n0 = MS[T(Aft) * Impact] / MS[Residual]$

Degrees of Freedom

$F_{alt} = F_{crit} / (1+n0) = 2.07 / (1+n0)$

Power (based on F-distribution)

1.393

7.156

1.486

0.176

OLIGOCHAETA ABUNDANCE

A. All Data

Source of Variance	SS	df	MS	Term
Bef/Aft - B	1.658	1	1.658	a1
Times(B)	10.970	8	1.371	a2
Locations	0.490	3	0.163	a3
B * L	2.349	3	0.783	a4
T(B) * L	9.474	24	0.395	a5
Residual	16.621	157	0.106	a6
Total	41.562	196		a7

B. Exclude Impact Site

Source of Variance	SS	df	MS	Term
Bef/Aft - B	0.861	1	0.861	
Times(B)	5.667	8	0.708	
Locations	0.324	2	0.162	b1
B * L	2.045	2	1.023	b2
T(B) * L	6.594	16	0.412	b3
Residual	12.109	105	0.115	
Total	27.600	134		

C. All Locations Before Impact

Source of Variance	SS	df	MS	Term
Times(B)	0.305	1	0.305	
Locations	1.371	3	0.457	
B * L	1.481	3	0.494	c1
Residual	5.988	34	0.176	
Total	9.145	41		

D. Reference Locations Before Impact

Source of Variance	SS	df	MS	Term
Times(B)	0.100	1	0.100	
Locations	1.014	2	0.507	
B * L	1.476	2	0.738	d1
Residual	5.140	27	0.190	
Total	7.730	32		

Source of Variation	Term	SS	df	MS
B (bef-aft)	a1	1.658	1	1.658
T(B)	a2	10.970	8	1.371
Location	a3	0.490	3	0.163
Impact vs Ref	a3-b1	0.166	1	0.166
Among Refs	b1	0.324	2	0.162
B * Location	a4	2.349	3	0.783
B * Impact	a4-b2	0.304	1	0.304
B * Ref	b2	2.045	2	1.023
T(B) * L	a5	9.474	24	0.395
T(Bef) * Location	c1	1.481	3	0.494
T(Bef) * Impact	c1-d1	0.005	1	0.005
T(Bef) * Ref	d1	1.476	2	0.738
T(Aft) * Location	a5-c1	7.993	21	0.381
T(Aft) * Impact	a5-c1-b3+d1	2.875	7	0.411
T(Aft) * Ref	b3-d1	5.118	14	0.366
Residual	a6	16.621	156	0.107
Total	a7	41.562	196	

df	F	Fcrit	p
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1. Do reference sites have variable short-term trends after impact?

T(Aft) * Ref / Residual	14,156	3.431	1.75	<0.0005
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YES...

2. Does impact affect short-term temporal trend?

T(Aft) * Imp / T(Aft) * Ref	7,14	1.123	2.76	0.40
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NO... no short-term impact detected

Power Analysis

$1+n0 = MS[T(Aft) * Impact] / MS[Residual]$

Degrees of Freedom

$Falt = Fcrit / (1+n0) = 2.07 / (1+n0)$

Power (based on F-distribution)

3.855
7,156
0.537
0.805