

Article

Supplementary Materials: Physiological Responses of the Submerged Macrophyte *Stuckenia pectinata* to High Salinity and Irradiance Stress to Assess Eutrophication Management and Climatic Effects: An Integrative Approach

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Table S1. Two-way repeated measures of variance of JIP-test in *Stuckenia pectinata*.

Response variable	Effect	df	MS	F	p-Value	Transformations and significance level	Response variable	df	MS	F	p-Value	Transformations and significance level
TR0/RC	Intercept	1	411.901	14944.234	<0.01	Non a= 0.01	RC/ABS	1	5.662	2672.420	<0.01	Non a= 0.01
	Irradiance	1	0.017	0.624	0.439			1	0.124	58.57	<0.01	
	Salinity	1	0.081	2.948	0.101			1	0.000	0.177	0.678	
	Irradiance*Salinity	1	0.029	1.036	0.321			1	0.002	1.011	0.327	
	Error	20	0.028					20	0.002			
	Time	2	0.013	1.501	0.235			2	0.001	1.571	0.220	
	Time*Irradiance	2	0.002	0.221	0.802			2	0.002	3.430	0.042	
	Time*Salinity	2	0.010	1.089	0.346			2	0.003	4.948	0.012	
	Time*Irradiance*Salinity	2	0.005	0.587	0.561			2	0.002	4.347	0.020	
	Error	40	0.009					40	0.001			

Model	Variable	df	ABS/RC			Non a=0.01	Model	Variable	df	DI ₀ /RC			Non a=0.01
			Estimate	SE	p-value					Estimate	SE	p-value	
ABS/RC	Intercept	1	945.161	903.3	<0.01	Non a=0.01	DI ₀ /RC	Intercept	1	132.121	134.6	<0.01	Non a=0.01
	Irradiance	1	30.001	28.67	<0.01			Irradiance	1	26.614	27.12	<0.01	
	Salinity	1	0.086	0.082	0.777			Salinity	1	0.013	0.013	0.911	
	Irradiance*Salinity	1	0.861	0.823	0.375			Irradiance*Salinity	1	0.089	0.091	0.767	
	Error	20	1.046					Error	20	0.981			
	Time	2	0.259	1.474	0.241			Time	2	0.853	2.116	0.134	
	Time*Irradiance	2	0.384	2.186	0.126			Time*Irradiance	2	0.870	2.156	0.129	
	Time*Salinity	2	0.869	4.947	0.012			Time*Salinity	2	1.820	4.513	0.017	
	Time*Irradiance*Salinity	2	0.811	4.614	0.016			Time*Irradiance*Salinity	2	1.674	4.150	0.023	
	Error	40	0.176					Error	40	0.403			
φ _{P0}	Intercept	1	32.194	3613	<0.01	Non a=0.01	φ _{E0}	Intercept	1	2.569	1095.213	<0.01	Non a=0.01
	Irradiance	1	0.622	69.86	<0.01			Irradiance	1	0.407	173.7	<0.01	
	Salinity	1	0.002	0.234	0.634			Salinity	1	0.002	0.665	0.424	
	Irradiance*Salinity	1	0.003	0.294	0.594			Irradiance*Salinity	1	0.000	0.036	0.851	
	Error	20	0.009					Error	20	0.002			
	Time	2	0.009	3.517	0.039			Time	2	0.013	14.48	<0.01	
	Time*Irradiance	2	0.008	3.044	0.059			Time*Irradiance	2	0.004	4.036	0.025	
	Time*Salinity	2	0.019	7.081	<0.01			Time*Salinity	2	0.002	1.914	0.161	

φ_{R0}	Time*Ir-radiance*Salinity Error	2	0.014	5.266	<0.01	Non a= 0.01	ψ_{E0}	2	0.004	4.104	0.024	Non a= 0.01
	Intercept	40	0.003					40	0.001			
	Intercept	1	0.162	543.2	<0.01			1	5.162	1644.27	<0.01	
	Irradiance	1	0.007	24.56	<0.01			1	0.443	141.032	<0.01	
	Salinity	1	0.000	0.106	0.748			1	0.001	0.381	0.544	
	Irradiance*Salinity	1	0.000	0.000	0.988			1	0.000	0.000	0.984	
	Error	20	0.000					20	0.003			
	Time	2	0.001	6.252	<0.01			2	0.024	14.37	<0.01	
	Time*Ir-radiance	2	0.001	5.570	<0.01			2	0.006	3.688	0.034	
	Time*Salinity	2	0.000	0.518	0.599			2	0.002	1.182	0.317	
	Time*Ir-radiance*Salinity	2	0.000	3.093	0.056			2	0.005	3.260	0.049	
	Error	40	0.000					40	0.002			
	Intercept	1	5.788	580.425	<0.01			1	167.167	2383.26	<0.01	
	Irradiance	1	0.334	33.54	<0.01			1	1.565	22.306	<0.01	
δ_{R0}	Salinity	1	0.004	0.447	0.511	Non a= 0.01	M_0'/M_0	1	0.000	0.001	0.971	Non a= 0.01
	Irradiance*Salinity	1	0.004	0.405	0.532			1	0.022	0.320	0.578	
	Error	20	0.010					20	0.070			
	Time	2	0.004	1.070	0.353			2	0.057	4.283	0.021	

Time*Ir-radiance	2	0.002	0.588	0.560		2	0.028	2.066	0.140
Time*Salinity	2	0.018	4.514	0.017		2	0.028	2.127	0.132
Time*Ir-radiance*Salinity	2	0.005	1.240	0.300		2	0.001	0.069	0.934
Error	40	0.004				40	0.013		

Table S2. Duncan's post hoc test for RC/ABS in *Stuckenia pectinata*.

	Condi- tions	TIME	1	2	3	4	5	6	7	8	9	10	11	12
1	C1	RC/ABS 1		0.856	0.439	0.608	0.503	0.500	0.019	0.000	0.002	0.000	0.000	0.001
2	C1	RC/ABS 5	0.856		0.370	0.674	0.565	0.564	0.017	0.000	0.001	0.000	0.000	0.001
3	C1	RC/ABS 8	0.439	0.370		0.326	0.258	0.258	0.051	0.000	0.006	0.000	0.001	0.005
4	C2	RC/ABS 1	0.608	0.674	0.326		0.781	0.770	0.007	0.000	0.000	0.000	0.000	0.000
5	C2	RC/ABS 5	0.503	0.565	0.258	0.781		0.973	0.005	0.000	0.000	0.000	0.000	0.000
6	C2	RC/ABS 8	0.500	0.564	0.258	0.770	0.973		0.005	0.000	0.000	0.000	0.000	0.000
7	C3	RC/ABS 1	0.019	0.017	0.051	0.007	0.005	0.005		0.000	0.146	0.028	0.133	0.279
8	C3	RC/ABS 5	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.005	0.434	0.131	0.056
9	C3	RC/ABS 8	0.002	0.001	0.006	0.000	0.000	0.000	0.146	0.005		0.184	0.550	0.896
10	C4	RC/ABS 1	0.000	0.000	0.000	0.000	0.000	0.000	0.028	0.434	0.184		0.235	0.073

11	C4	RC/ABS 5	0.000	0.000	0.001	0.000	0.000	0.000	0.133	0.131	0.550	0.235	0.468
12	C4	RC/ABS 8	0.001	0.001	0.005	0.000	0.000	0.000	0.279	0.056	0.896	0.073	0.468

Table S3. Duncan's post hoc test for ABS/RC in *Stuckenia pectinata*.

	Condi- tions	TIME	1	2	3	4	5	6	7	8	9	10	11	12
1	C1	ABS/RC 1		0.381	0.591	0.797	0.430	0.421	0.173	0.001	0.065	0.001	0.018	0.022
2	C1	ABS/RC 5	0.381		0.692	0.751	0.765	0.757	0.082	0.000	0.026	0.000	0.006	0.007
3	C1	ABS/RC 8	0.591	0.692		0.924	0.611	0.605	0.119	0.001	0.040	0.000	0.010	0.012
4	C2	ABS/RC 1	0.797	0.751	0.924		0.349	0.337	0.127	0.001	0.044	0.000	0.011	0.014
5	C2	ABS/RC 5	0.430	0.765	0.611	0.349		0.960	0.049	0.000	0.014	0.000	0.003	0.004
6	C2	ABS/RC 8	0.421	0.757	0.605	0.337	0.960		0.049	0.000	0.014	0.000	0.003	0.004
7	C3	ABS/RC 1	0.173	0.082	0.119	0.127	0.049	0.049		0.001	0.324	0.022	0.234	0.269
8	C3	ABS/RC 5	0.001	0.000	0.001	0.001	0.000	0.000	0.001		0.009	0.780	0.288	0.259
9	C3	ABS/RC 8	0.065	0.026	0.040	0.044	0.014	0.014	0.324	0.009		0.070	0.505	0.566
10	C4	ABS/RC 1	0.001	0.000	0.000	0.000	0.000	0.000	0.022	0.780	0.070		0.041	0.029
11	C4	ABS/RC 5	0.018	0.006	0.010	0.011	0.003	0.003	0.234	0.288	0.505	0.041		0.823
12	C4	ABS/RC 8	0.022	0.007	0.012	0.014	0.004	0.004	0.269	0.259	0.566	0.029	0.823	

Table S4. Duncan's post hoc test for DI₀/RC in *Stuckenia pectinata*.

	Condi- tions	TIME	1	2	3	4	5	6	7	8	9	10	11	12
1	C1	DI ₀ /RC 1		0.935	0.889	0.998	0.973	0.956	0.280	0.000	0.110	0.001	0.031	0.059
2	C1	DI ₀ /RC 5	0.935		0.945	0.944	0.927	0.910	0.280	0.000	0.110	0.001	0.032	0.060
3	C1	DI ₀ /RC 8	0.889	0.945		0.906	0.889	0.872	0.274	0.000	0.109	0.002	0.033	0.061
4	C2	DI ₀ /RC 1	0.998	0.944	0.906		0.968	0.948	0.269	0.000	0.104	0.001	0.029	0.056
5	C2	DI ₀ /RC 5	0.973	0.927	0.889	0.968		0.975	0.275	0.000	0.108	0.001	0.030	0.058
6	C2	DI ₀ /RC 8	0.956	0.910	0.872	0.948	0.975		0.272	0.000	0.107	0.001	0.030	0.057
7	C3	DI ₀ /RC 1	0.280	0.280	0.274	0.269	0.275	0.272		0.000	0.456	0.024	0.238	0.362
8	C3	DI ₀ /RC 5	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.002	0.309	0.035	0.019
9	C3	DI ₀ /RC 8	0.110	0.110	0.109	0.104	0.108	0.107	0.456	0.002		0.081	0.517	0.720
10	C4	DI ₀ /RC 1	0.001	0.001	0.002	0.001	0.001	0.001	0.024	0.309	0.081		0.139	0.076
11	C4	DI ₀ /RC 5	0.031	0.032	0.033	0.029	0.030	0.030	0.238	0.035	0.517	0.139		0.685
12	C4	DI ₀ /RC 8	0.059	0.060	0.061	0.056	0.058	0.057	0.362	0.019	0.720	0.076	0.685	

Table S5. Duncan's post hoc test for φ_{P0} in *Stuckenia pectinata*.

	Condi- tions	TIME	1	2	3	4	5	6	7	8	9	10	11	12
1	C1	φ_{P0} 1		0.719	0.720	0.835	0.868	0.910	0.016	0.000	0.001	0.000	0.000	0.000
2	C1	φ_{P0} 5	0.719		0.994	0.941	0.904	0.862	0.020	0.000	0.001	0.000	0.000	0.001
3	C1	φ_{P0} 8	0.720	0.994		0.941	0.905	0.864	0.016	0.000	0.001	0.000	0.000	0.001
4	C2	φ_{P0} 1	0.835	0.941	0.941		0.941	0.882	0.020	0.000	0.001	0.000	0.000	0.001
5	C2	φ_{P0} 5	0.868	0.904	0.905	0.941		0.932	0.020	0.000	0.001	0.000	0.000	0.001
6	C2	φ_{P0} 8	0.910	0.862	0.864	0.882	0.932		0.019	0.000	0.001	0.000	0.000	0.000
7	C3	φ_{P0} 1	0.016	0.020	0.016	0.020	0.020	0.019		0.000	0.137	0.004	0.054	0.181
8	C3	φ_{P0} 5	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.001	0.466	0.077	0.019
9	C3	φ_{P0} 8	0.001	0.001	0.001	0.001	0.001	0.001	0.137	0.001		0.050	0.346	0.765
10	C4	φ_{P0} 1	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.466	0.050		0.126	0.021
11	C4	φ_{P0} 5	0.000	0.000	0.000	0.000	0.000	0.000	0.054	0.077	0.346	0.126		0.349
12	C4	φ_{P0} 8	0.000	0.001	0.001	0.001	0.001	0.000	0.181	0.019	0.765	0.021	0.349	

Table S6. Duncan's post hoc test for ϕ_{E0} in *Stuckenia pectinata*.

	Condi- tions	TIME	1	2	3	4	5	6	7	8	9	10	11	12
1	C1	ϕ_{E0} 1		0.018	0.018	0.929	0.017	0.029	0.000	0.000	0.000	0.000	0.000	0.000
2	C1	ϕ_{E0} 5	0.018		0.909	0.051	0.553	0.724	0.000	0.000	0.000	0.000	0.000	0.000
3	C1	ϕ_{E0} 8	0.018	0.909		0.054	0.513	0.677	0.000	0.000	0.000	0.000	0.000	0.000
4	C2	ϕ_{E0} 1	0.929	0.051	0.054		0.003	0.007	0.000	0.000	0.000	0.000	0.000	0.000
5	C2	ϕ_{E0} 5	0.017	0.553	0.513	0.003		0.729	0.000	0.000	0.000	0.000	0.000	0.000
6	C2	ϕ_{E0} 8	0.029	0.724	0.677	0.007	0.729		0.000	0.000	0.000	0.000	0.000	0.000
7	C3	ϕ_{E0} 1	0.000	0.000	0.000	0.000	0.000	0.000		0.000	0.180	0.026	0.025	0.154
8	C3	ϕ_{E0} 5	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.003	0.194	0.206	0.038
9	C3	ϕ_{E0} 8	0.000	0.000	0.000	0.000	0.000	0.000	0.180	0.003		0.200	0.198	0.668
10	C4	ϕ_{E0} 1	0.000	0.000	0.000	0.000	0.000	0.000	0.026	0.194	0.200		0.958	0.253
11	C4	ϕ_{E0} 5	0.000	0.000	0.000	0.000	0.000	0.000	0.025	0.206	0.198	0.958		0.246
12	C4	ϕ_{E0} 8	0.000	0.000	0.000	0.000	0.000	0.000	0.154	0.038	0.668	0.253	0.246	

Table S7. Duncan's post hoc test for ϕ_{R0} in *Stuckenia pectinata*.

	Condi- tions	TIME	1	2	3	4	5	6	7	8	9	10	11	12
1	C1	ϕ_{R0} 1		0.907	0.172	0.292	0.329	0.109	0.104	0.000	0.078	0.020	0.002	0.015
2	C1	ϕ_{R0} 5	0.907		0.154	0.307	0.313	0.098	0.092	0.000	0.068	0.017	0.002	0.013
3	C1	ϕ_{R0} 8	0.172	0.154		0.035	0.780	0.607	0.584	0.003	0.487	0.204	0.048	0.171
4	C2	ϕ_{R0} 1	0.292	0.307	0.035		0.028	0.004	0.010	0.000	0.007	0.001	0.000	0.001
5	C2	ϕ_{R0} 5	0.329	0.313	0.780	0.028		0.387	0.436	0.001	0.355	0.135	0.028	0.112
6	C2	ϕ_{R0} 8	0.109	0.098	0.607	0.004	0.387		0.943	0.011	0.810	0.402	0.120	0.348
7	C3	ϕ_{R0} 1	0.104	0.092	0.584	0.010	0.436	0.943		0.004	0.829	0.422	0.129	0.370
8	C3	ϕ_{R0} 5	0.000	0.000	0.003	0.000	0.001	0.011	0.004		0.006	0.068	0.251	0.079
9	C3	ϕ_{R0} 8	0.078	0.068	0.487	0.007	0.355	0.810	0.829	0.006		0.502	0.166	0.449
10	C4	ϕ_{R0} 1	0.020	0.017	0.204	0.001	0.135	0.402	0.422	0.068	0.502		0.348	0.873
11	C4	ϕ_{R0} 5	0.002	0.002	0.048	0.000	0.028	0.120	0.129	0.251	0.166	0.348		0.401
12	C4	ϕ_{R0} 8	0.015	0.013	0.171	0.001	0.112	0.348	0.370	0.079	0.449	0.873	0.401	

Table S8. Duncan's post hoc test for ψ_{E0} in *Stuckenia pectinata*.

	Condi- tions	TIME	1	2	3	4	5	6	7	8	9	10	11	12
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1	C1	Ψ_{E0} 1		0.031	0.039	0.761	0.017	0.027	0.000	0.000	0.000	0.000	0.000	0.000
2	C1	Ψ_{E0} 5	0.031		0.837	0.034	0.536	0.687	0.001	0.000	0.000	0.000	0.000	0.000
3	C1	Ψ_{E0} 8	0.039	0.837		0.044	0.448	0.585	0.001	0.000	0.000	0.000	0.000	0.000
4	C2	Ψ_{E0} 1	0.761	0.034	0.044		0.003	0.006	0.000	0.000	0.000	0.000	0.000	0.000
5	C2	Ψ_{E0} 5	0.017	0.536	0.448	0.003		0.769	0.005	0.000	0.001	0.000	0.000	0.000
6	C2	Ψ_{E0} 8	0.027	0.687	0.585	0.006	0.769		0.004	0.000	0.000	0.000	0.000	0.000
7	C3	Ψ_{E0} 1	0.000	0.001	0.001	0.000	0.005	0.004		0.000	0.383	0.085	0.041	0.217
8	C3	Ψ_{E0} 5	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.002	0.064	0.119	0.020
9	C3	Ψ_{E0} 8	0.000	0.000	0.000	0.000	0.001	0.000	0.383	0.002		0.288	0.164	0.581
10	C4	Ψ_{E0} 1	0.000	0.000	0.000	0.000	0.000	0.000	0.085	0.064	0.288		0.643	0.506
11	C4	Ψ_{E0} 5	0.000	0.000	0.000	0.000	0.000	0.000	0.041	0.119	0.164	0.643		0.291
12	C4	Ψ_{E0} 8	0.000	0.000	0.000	0.000	0.000	0.000	0.217	0.020	0.581	0.506	0.291	

Table S9. Duncan's post hoc test for δ_{R0} in *Stuckenia pectinata*.

	Condi- tions	TIME	1	2	3	4	5	6	7	8	9	10	11	12
1	C1	δ_{R0} 1		0.302	0.914	0.531	0.632	0.813	0.048	0.003	0.007	0.000	0.010	0.009
2	C1	δ_{R0} 5	0.302		0.270	0.792	0.671	0.305	0.194	0.023	0.047	0.000	0.061	0.058
3	C1	δ_{R0} 8	0.914	0.270		0.495	0.596	0.869	0.043	0.002	0.006	0.000	0.009	0.008
4	C2	δ_{R0} 1	0.531	0.792	0.495		0.815	0.318	0.142	0.013	0.029	0.000	0.040	0.037
5	C2	δ_{R0} 5	0.632	0.671	0.596	0.815		0.418	0.111	0.009	0.020	0.000	0.030	0.026
6	C2	δ_{R0} 8	0.813	0.305	0.869	0.318	0.418		0.032	0.002	0.004	0.000	0.006	0.005
7	C3	δ_{R0} 1	0.048	0.194	0.043	0.142	0.111	0.032		0.160	0.297	0.015	0.485	0.458
8	C3	δ_{R0} 5	0.003	0.023	0.002	0.013	0.009	0.002	0.160		0.660	0.136	0.588	0.635
9	C3	δ_{R0} 8	0.007	0.047	0.006	0.029	0.020	0.004	0.297	0.660		0.082	0.820	0.882
10	C4	δ_{R0} 1	0.000	0.000	0.000	0.000	0.000	0.000	0.015	0.136	0.082		0.023	0.026
11	C4	δ_{R0} 5	0.010	0.061	0.009	0.040	0.030	0.006	0.485	0.588	0.820	0.023		0.908
12	C4	δ_{R0} 8	0.009	0.058	0.008	0.037	0.026	0.005	0.458	0.635	0.882	0.026	0.908	

Table S10. Duncan's post hoc test for M_0/M_0 in *Stuckenia pectinata*.

	Condi- tions	TIME	1	2	3	4	5	6	7	8	9	10	11	12
1	C1	M_0/M_0 1		0.346	0.156	0.728	0.878	0.912	0.118	0.001	0.005	0.014	0.002	0.005
2	C1	M_0/M_0 5	0.346		0.568	0.763	0.624	0.603	0.285	0.006	0.019	0.047	0.007	0.019
3	C1	M_0/M_0 8	0.156	0.568		0.531	0.422	0.405	0.440	0.014	0.039	0.085	0.016	0.038
4	C2	M_0/M_0 1	0.728	0.763	0.531		0.732	0.690	0.193	0.003	0.010	0.027	0.004	0.010
5	C2	M_0/M_0 5	0.878	0.624	0.422	0.732		0.934	0.143	0.002	0.006	0.018	0.002	0.006
6	C2	M_0/M_0 8	0.912	0.603	0.405	0.690	0.934		0.137	0.002	0.006	0.017	0.002	0.006
7	C3	M_0/M_0 1	0.118	0.285	0.440	0.193	0.143	0.137		0.005	0.027	0.286	0.075	0.150
8	C3	M_0/M_0 5	0.001	0.006	0.014	0.003	0.002	0.002	0.005		0.439	0.360	0.928	0.607
9	C3	M_0/M_0 8	0.005	0.019	0.039	0.010	0.006	0.006	0.027	0.439		0.635	0.659	0.970
10	C4	M_0/M_0 1	0.014	0.047	0.085	0.027	0.018	0.017	0.286	0.360	0.635		0.184	0.468
11	C4	M_0/M_0 5	0.002	0.007	0.016	0.004	0.002	0.002	0.075	0.928	0.659	0.184		0.485
12	C4	M_0/M_0 8	0.005	0.019	0.038	0.010	0.006	0.006	0.150	0.607	0.970	0.468	0.485	

Table S11. Two-way measures of variance of chlorophyll content and ratio in *Stuckenia pectinata*.

Response variable	Effect	df	MS	F	p-Value	Transformations and significance level
Chl α	Intercept	1	199.232	173.648	0.000	Non. a= 0.01
	Irradiance	1	6.622	5.772	0.026	
	Salinity	1	1.344	1.172	0.292	
	Irradiance*Salinity	1	23.114	20.146	<0.01	
	Error	20	1.147			
Chl b	Intercept	1	52.670	136.317	0.000	Non. a=0.01
	Irradiance	1	2.645	6.847	0.017	
	Salinity	1	0.487	1.262	0.275	
	Irradiance*Salinity	1	6.343	16.416	<0.01	
	Error	20	0.386			
Chl α/b	Intercept	1	95.260	1404.985	<0.01	Non. a=0.01
	Irradiance	1	0.274	4.044	0.058	
	Salinity	1	0.000	0.006	0.938	
	Irradiance*Salinity	1	0.018	0.268	0.611	
	Error	20	0.068			

Table S12. Duncan's post hoc test for Chl α in *Stuckenia pectinata*.

	Conditions	1	2	3	4
1	C1		0.032	0.000	0.362
2	C2	0.032		0.023	0.156
3	C3	0.000	0.023		0.001
4	C4	0.362	0.156	0.001	

Table S13. Duncan's post hoc test for Chl *b* in *Stuckenia pectinata*.

	Conditions	1	2	3	4
1	C1		0.063	0.000	0.304
2	C2	0.063		0.016	0.322
3	C3	0.000	0.016		0.002
4	C4	0.304	0.322	0.002	

Table S14. Two-way measures of variance of RGR in *Stuckenia pectinata*.

Response variable	Effect	df	MS	F	p-Value	Transformations and significance level
RGR	Intercept	1	0.037	342.617	<0.001	Non. a= 0.01
	Irradiance	1	0.000	2.096	0.163	
	Salinity	1	0.000	1.196	0.287	
	Irradiance*Salinity	1	0.000	0.701	0.412	
	Error	20	0.000			