Table 3.
Design of laboratory studies of physiological effects of intermittent turbulence.

Species:
Amblema plicata plicata

Size Classes:
Small = 35 mm mean shell length
Large = 68 mm mean shell length

Treatments		
1	**2**	**3**
Infrequent (5 minutes per 0.5 hour)	Moderately frequent (5 minutes per 2.0 hours)	Frequent (5 minutes per 5.0 hours)

Physiological Indicators of Stress:
Filtration Rate (FR)
Respiration Rate (VO_2)
Nitrogen Excretion Rate (NE)
O:N
Tissue Condition Index (TCI)

Notes:
The 5-minute period of tublence consisted of an increase from an ambient water velocity of 11 cm per second to a high velocity of 45 cvm per second.

Table 4. Tissue condition index (TCI), filtration rate (FR), respiration rate (VO2), nitrogen excretion rate (NE), and O:N ratios of mussels exposed to brief periods of high water velocity at low, medium, and high frequency.

	Mussel Group	Variable	Freqency of High Velocity Exposure			ANOVA		
			Low	Medium	High	df	F	p
small	*Fusconaia*	TCI	2.10 ± 0.11	2.13 ± 0.12	2.01 ± 0.09	2, 24	0.3515	0.7072
	ebena	FR (mg · g^{-1} · h^{-1})	0.78 ± 0.18	0.74 ± 0.16	0.81 ± 0.23	2, 24	0.0288	0.9717
		VO_2 (ml · g^{-1} · h^{-1})	0.43 ± 0.04	0.39 ± 0.02	0.37 ± 0.04	2, 22	0.6883	0.5129
		NE (µg · g^{-1} · h^{-1})	17.99 ± 1.14	18.31 ± 1.17	15.25 ± 2.64	2, 22	0.9093	0.4174
		O:N	27.04 ± 1.92	25.40 ± 1.81	31.28 ± 4.00	2, 22	1.2802	0.2979
large	*Fusconaia*	TCI	3.32 ± 0.18	3.24 ± 0.28	3.53 ± 0.14	2, 24	0.5264	0.5974
	ebena	FR (mg · g^{-1} · h^{-1})	0.38 ± 0.10	0.37 ± 0.07	0.77 ± 0.14	2, 24	3.9669	0.0324
		VO_2 (ml · g^{-1} · h^{-1})	0.24 ± 0.01	0.22 ± 0.02	0.19 ± 0.01	2, 24	2.1484	0.1386
		NE (µg · g^{-1} · h^{-1})	19.84 ± 1.01	20.15 ± 1.24	19.18 ± 1.86	2, 24	0.1221	0.8856
		O:N	14.02 ± 1.32	12.65 ± 1.00	12.29 ± 1.41	2, 24	0.5314	0.5945
	Amblema	TCI	2.41 ± 0.49	2.25 ± 0.84	2.58 ± 0.65	2, 24	0.4811	0.6239
	p. plicata	FR (mg · g^{-1} · h^{-1})	0.33 ± 0.04	0.29 ± 0.07	0.26 ± 0.04	2, 24	0.4140	0.6656
		VO_2 (ml · g^{-1} · h^{-1})	0.21 ± 0.02	0.26 ± 0.04	0.20 ± 0.01	2, 24	1.1474	0.3342
		NE (µg · g^{-1} · h^{-1})	45.57 ± 8.39	77.24 ± 21.59	47.54 ± 9.43	2, 24	1.5104	0.2411
		O:N	6.83 ± 1.22	5.64 ± 1.06	6.49 ± 1.18	2, 24	0.2852	0.7544

Table 6. Design of Experiment I: Effects of Frequent Exposure to Total Suspended Solids and Turbulence.

Species	Treatment n	Control n	Initial Condition n
Amblema p. plicata	14	14	8
Plectomerus dombeyanus	14	14	8
Quadrula p. pustulosa	6	7	6

Treatment - ~ 120 mg/l Suspended Sediments

Control - ~ 20 mg/l Suspended Sediments

Frequency - 5 minutes of every 30 minutes

Duration - 14 Days

Variables Measured:

Filtration Rate

Oxygen Consumption

Nitrogen Excretion

Tissue Mass

TCI

O:N Ratio

Table 7. Design of Experiment II: Effect of Infrequent Exposure to Suspended Solids and Turbulence

Species	Treatment n	Control n	Initial Condition n
Amblema plicata	14	14	14
Plectomerus dombeyanus	14	14	14
Quadrula pustulosa	9	9	9

Treatment - ~ 120 mg/l Suspended Sediments

Control - ~ 20 mg/l Suspended Sediments

Frequency - 5 minutes of every 180 minutes

Duration - 14 Days

Variables Measured:

Filtration Rate

Oxygen Consumption

Nitrogen Excretion

Tissue Mass

TCI

O:N Ratio

Table 8. Design of Experiment III: Effect of High Total Suspended Solids Exposure at Three Different Levels of Turbulence.

Species	Treatment n	Control n	Initial Condition n
Amblema p. plicata	14	14	14
Plectomerus dombeyanus	14	14	14
Quadrula p. pustulosa	10	10	10

Treatments - ~ 120 mg/l Suspended Sediments, 7 cm/second

~ 120 mg/l Suspended Sediments, 30 cm/second

~ 120 mg/l Suspended Sediments, 60 cm/second

Frequency - Continuous Flow

Duration - 14 Days

Variables Measured:

Filtration Rate

Oxygen Consumption

Nitrogen Excretion

Tissue Mass

TCI

O:N Ratio

Table 10. Results of Experiment II: Infrequent Exposure to Suspended Solids and Turbulence.

Species	Variable	Suspended Sediment Treatment		t - Tests		
		Control	High	df	t	P
A. p plicata	TCIa	0.053 ± 0.004	0.062 ± 0.003	26	1.605	0.1206
	TCIb	0.069 ± 0.006	0.078 ± 0.004	26	1.180	0.2487
	FR (mg/g/h)	0.088 ± 0.007	0.084 ± 0.007	26	-0.340	0.7368
	VO2 (ml/g/h)	0.149 ± 0.013	0.141 ± 0.010	26	-0.426	0.6738
	NE (µg/g/h)	16.716 ± 1.475	10.312 ± 1.234	26	-3.329	0.0026
	O:N	11.542 ± 1.048	19.620 ± 2.831	26	2.670	0.0127
P. dombeyanus	TCIa	0.056 ± 0.002	0.057 ± 0.003	26	0.261	0.7964
	TCIb	0.064 ± 0.002	0.063 ± 0.003	26	-0.379	0.7074
	FR (mg/g/h)	0.035 ± 0.004	0.044 ± 0.003	26	1.903	0.0680
	VO2 (ml/g/h)	0.139 ± 0.007	0.125 ± 0.006	26	-1.542	0.1353
	NE (µg/g/h)	22.714 ± 1.463	18.140 ± 0.978	26	-2.599	0.0152
	O:N	8.009 ± 0.576	8.850 ± 0.462	26	1.140	0.2647
Q. p. pustulosa	TCIa	0.030 ± 0.004	0.029 ± 0.002	16	-0.346	0.7341
	TCIb	0.031 ± 0.004	0.026 ± 0.002	16	-0.973	0.3449
	FR (mg/g/h)	0.090 ± 0.051	0.184 ± 0.053	16	1.260	0.2259
	VO2 (ml/g/h)	0.233 ± 0.021	0.233 ± 0.012	16	0.005	0.9958
	NE (µg/g/h)	28.843 ± 2.509	32.928 ± 2.200	16	1.225	0.1192
	O:N	10.329 ± 0.714	9.010 ± 0.440	16	-1.572	0.1354

Table 11. Reulst of Experiment III: Effects of Continous Exposure to High Suspended Solids at Three Water Velocities.

		Velocity Treatment			ANOVA		
Species	Variable	Low	Medium	High	df	F	p
A. p. plicata	TCIa	5.180 ± 0.575	5.319 ± 0.518	5.437 ± 0.527	2, 27	0.063	0.9393
	TCIb	6.125 ± 0.696	6.341 ± 0.562	6.688 ± 0.635	2, 27	0.224	0.8009
	FR (mg/g/h)	0.122 ± 0.019	0.134 ± 0.019	0.078 ± 0.011	2, 27	3.421	0.0474
	VO2 (ml/g/h)	0.150 ± 0.029	0.135 ± 0.025	0.122 ± 0.014	2, 27	0.393	0.6788
	NE (µg/g/h)	23.337 ± 2.083	20.774 ± 1.448	21.512 ± 2.636	2, 27	0.434	0.6525
	O:N	7.966 ± 1.333	8.387 ± 1.610	7.755 ± 0.908	2, 27	0.066	0.9358
P. dombeyanus	TCIa	5.206 ± 0.272	5.881 ± 0.528	4.908 ± 0.734	2, 24	0.925	0.4101
	TCIb	6.142 ± 0.345	7.584 ± 0.712	6.587 ± 0.487	2, 24	2.289	0.1230
	FR (mg/g/h)	0.078 ± 0.012	0.071 ± 0.008	0.054 ± 0.011	2, 24	1.364	0.2747
	VO2 (ml/g/h)	0.248 ± 0.023	0.223 ± 0.019	0.219 ± 0.010	2, 24	0.824	0.4506
	NE (µg/g/h)	14.888 ± 3.141	15.840 ± 3.322	11.667 ± 1.859	2, 24	0.644	0.5343
	O:N	26.033 ± 3.792	22.042 ± 4.016	27.951 ± 4.370	2, 24	0.576	0.5696
Q. p. pustulosa	TCIa	3.315 ± 0.380	2.970 ± 0.304	2.872 ± 0.324	2, 16	0.516	0.6064
	TCIb	2.748 ± 0.252	2.713 ± 0.242	2.479 ± 0.224	2, 16	0.350	0.7096
	FR (mg/g/h)	0.261 ± 0.074	0.224 ± 0.042	0.226 ± 0.020	2, 16	0.173	0.8426
	VO2 (ml/g/h)	0.454 ± 0.050	0.429 ± 0.026	0.472 ± 0.055	2, 16	0.228	0.7612
	NE (µg/g/h)	30.033 ± 3.484	49.809 ± 4.204	30.611 ± 5.687	2, 16	8.492	0.0031
	O:N	19.505 ± 1.627	10.940 ± 0.498	20.701 ± 2.905	2, 16	12.285	0.0006

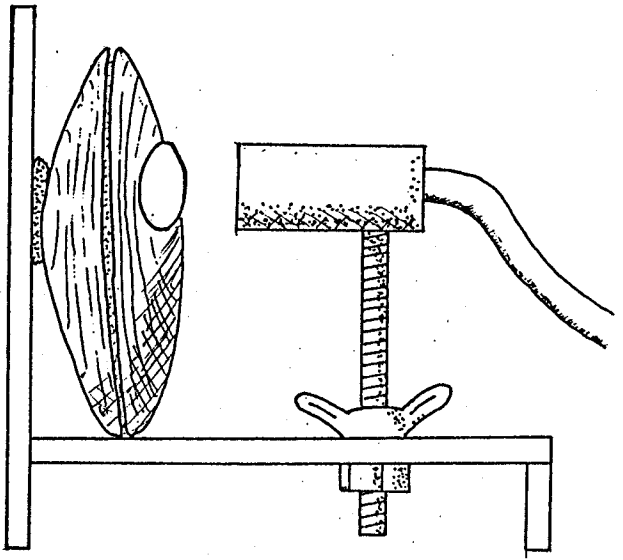

Figure 1. Side view of single sensor directed toward a mussel.

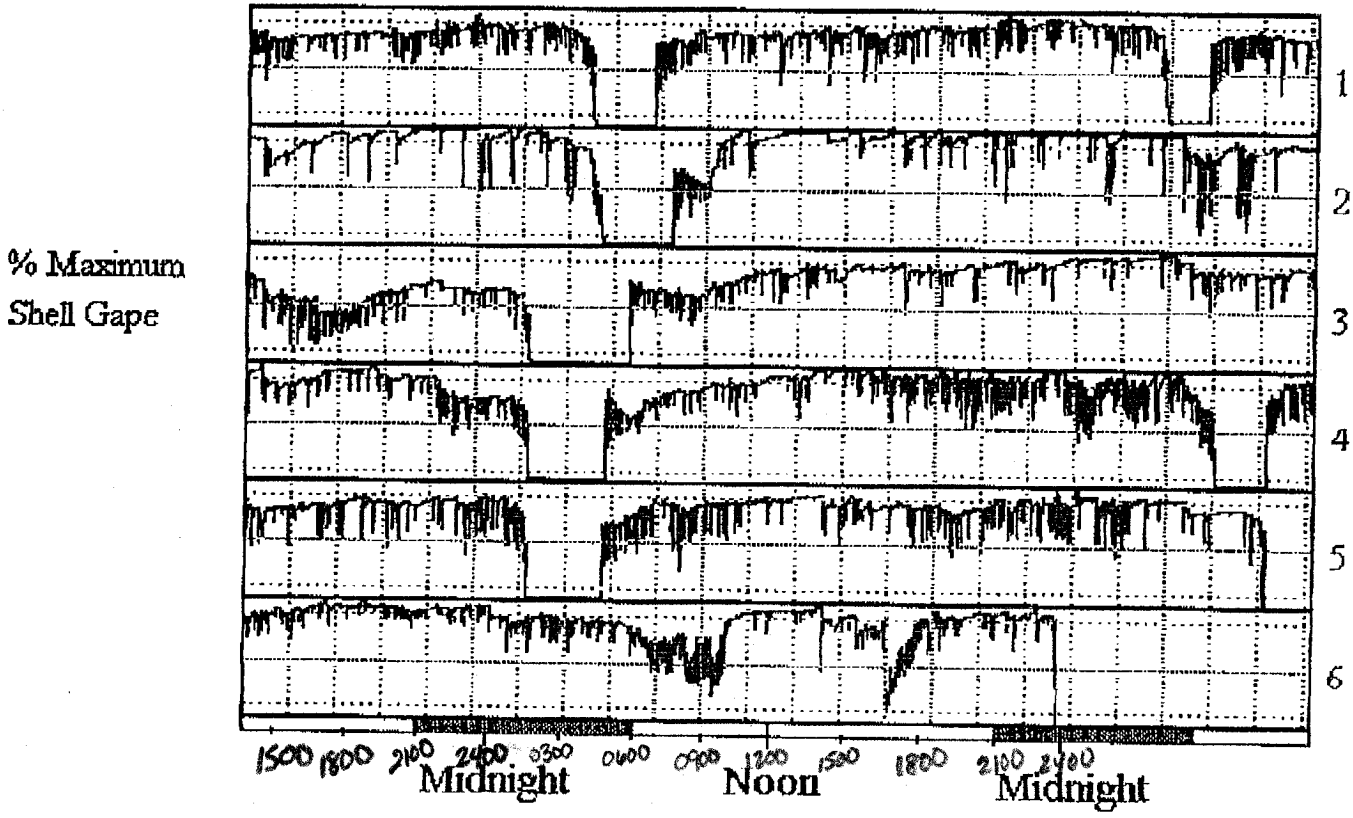

Figure 4. Valve activity of 6 *Amblema p. plicata* over a 2-day period in the East Channel of the upper Mississipi River near Prarie du Chien, WI. The Y-axis is scaled from 0% (closed) to 100% of maximum gape for each individual. The shaded bar represents the approximate period of darkness.

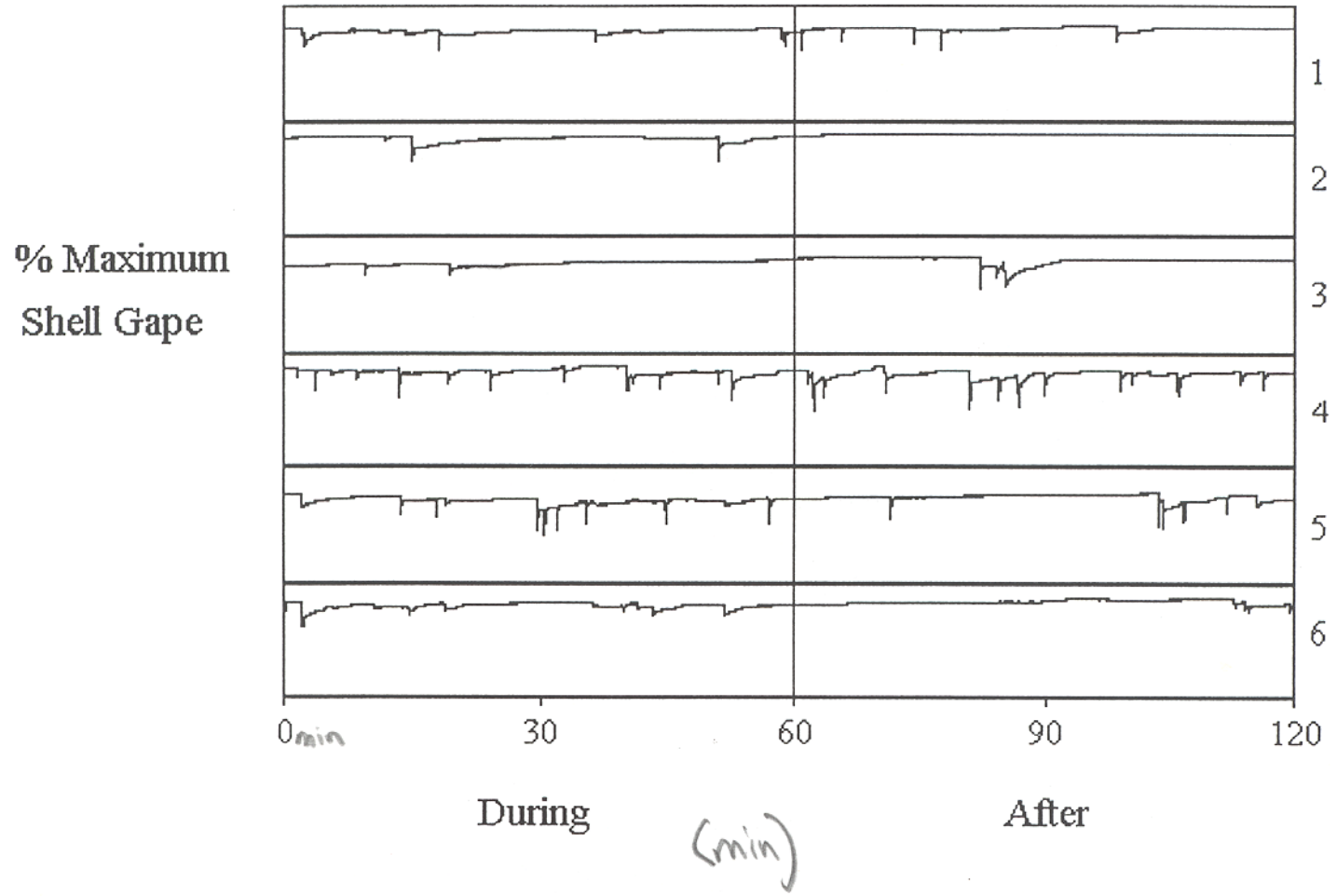

Figure 5. Valve activity of 6 *Amblema p. plicata* over a 2-day period. The first 60 min, to the left of the vertical bar, was a period of high water turbulence brought about by heavy pleasure boat traffic.

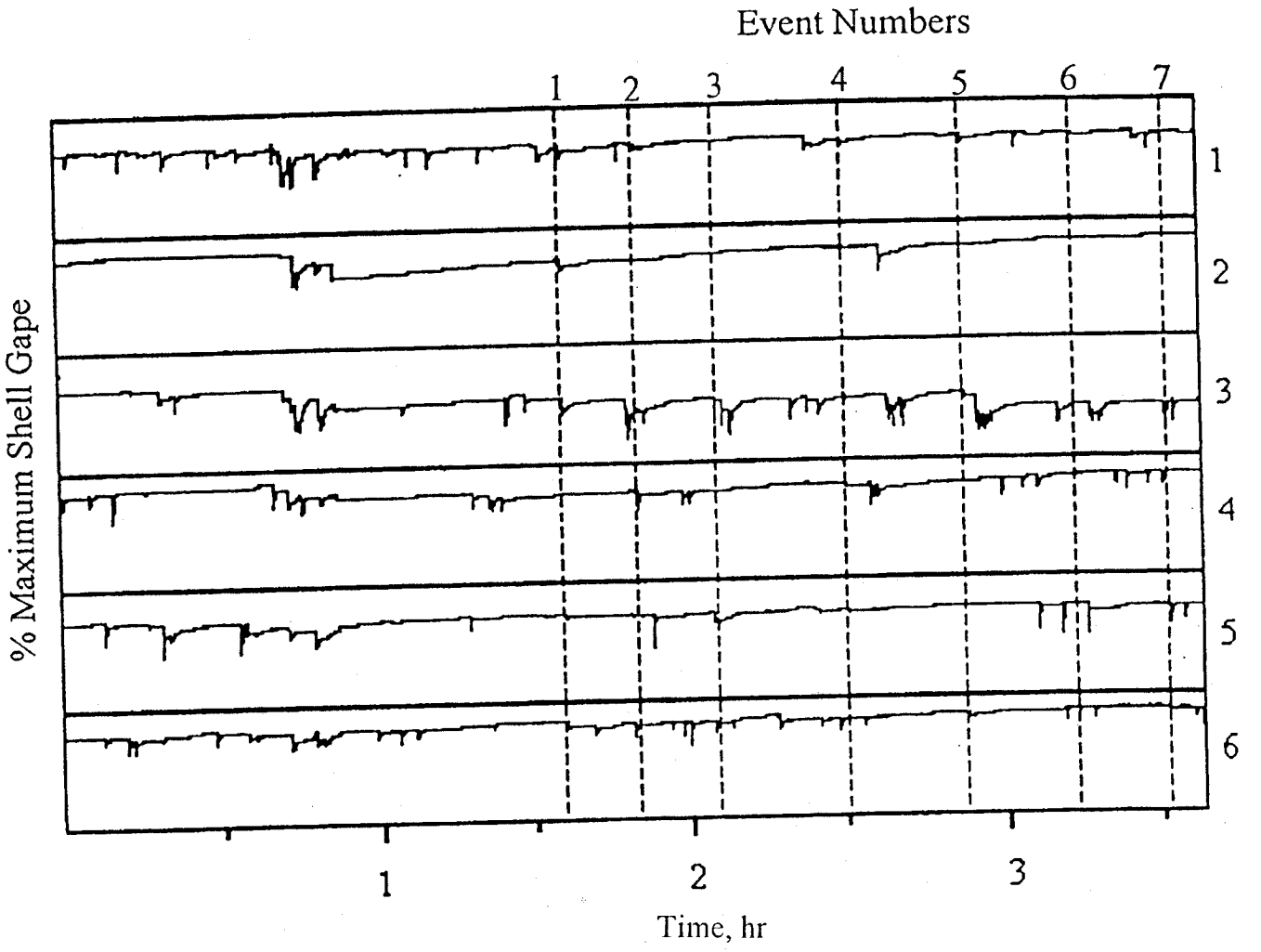

Figure 6. Valve activity of 6 *Amblema p. plicata* over a 2-Day period affected by boat passage. The vertical lines represent passage of a 21-ft work boat (Events 1-7, see Figures 7-12).