Testing of Flyboard Operation in Coventry Lake

An Examination of Potential Effects on a Thermally Stratified Inland Lake

John Woike Hartford Courant July 30, 2015

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Introduction

Technical information *(see: https://en.wikipedia.org/wiki/Flyboard)*

A flyboard is a type of water jetpack attached to a personal water craft (PWC) which supplies propulsion to drive the flyboard through air and water. A rider stands on a board connected by a long hose to a personal watercraft. Water is forced under pressure to a pair of boots with jet nozzles underneath which provide thrust for the rider to fly up in the air or to dive through the water. In Connecticut Flyboards are included in a boating category called Jet Articulated Vessels (JAV).

The flyboard was invented in Fall 2012 by a French watercraft rider, Franky Zapata. The design allows the rider to climb out of the water and be stable in the air. Since its introduction in 2012, the Flyboard has sold around 2500 units.

The Flyboard is a bolt-on device that is attached to a personal watercraft (PWC). It is designed so that the PWC follows behind the rider's trail, allowing the rider multiple degrees of freedom, including allowing the rider to go underwater if they desire. The pilot on the Flyboard is secured in by bindings similar to a wakeboard and the rider is propelled from water jets below the device. The Flyboard is buoyant for safety, which also allows the rider to rest in the water between rides if the rider happens to get fatigued. Device power is controlled by a throttle on the PWC. The equipment may be used in two modes: The primary one requires two people, one to control the PWC throttle which regulates the power and height of the rider. The secondary mode relies on an accessory called an Electronic Management Kit (EMK) which allows the rider to control the PWC throttle.

Concern over potential environmental impacts were raised when use of Flyboards on Coventry Lake began during the summer of 2015. Most identified potential effects were related to the high velocity downward thrust of the Flyboard jets and potential disruption of thermal stratification, sediment disturbance and resuspension, nutrient enrichment of surface waters, and increased fragmentation of invasive macrophytes.

Study Site

Coventry Lake (Lake Wangumbaug) is a temporate dimictic lake covering 373 acres (151 ha) with a mean depth of 28ft (8.8m) and maximum depth of 39ft (12m). The lake is a soft water system that is thermally stratified during the summer. The hypolimnion (deep cold water layer) below approximately 25ft (7.5m) becomes anoxic during the summer (devoid of dissolved oxygen). The lake has been monitored annually for over three decades (see appended limnological data from 2014). The iron cycle is the dominant redox couple of anaerobic respiration. As a result of anoxia and anaerobic respiration, both iron and phosphorus accumulate in the hypolimnion during summer. During most summer stratification seasons the anoxic boundary ascends up into the metalimnion, penetrating the thermocline during some years. Coventry Lake exhibits oligomesotrophic conditions, with total phosphorus (TP) in the 15-20 µg/L range in the trophogenic surface waters, and up to several hundred µg/L TP in the

anoxic hypolimnion. Ammonia-N also accumulates in the hypolimnion due to anoxia and a lack of nitrification. The watershed:lake area ratio is 5.6; the watershed area is relatively small and has a rapid time of runoff concentration. The littoral zone includes several invasive macrophytes, including the recent discovery of Hydrilla fragments (colony location currently unknown).

A State Boat Ramp is located on the eastern shore. Coventry Lake is very popular with boaters, waterskiiers, and fisherpersons.

Methods

Flyboard testing was conducted in three locations with depths of 11ft, 20ft, and 30ft on September 28, 2015. A flyboard was operated for approximately 10 minutes in each location, with multiple "takeoffs" and "porpoising". Surface water and water from 3 ft over the bottom was measured for Temperature, Dissolved Oxygen (DO), % Oxygen Saturation, pH, and Oxidation-Reduction Potential (ORP), before initiating flyboarding in the site location using a YSI ProPlus multi-probe instrument. The multi-probe was then suspended 3ft over the bottom at each test location and flyboarding was initiated within a radius of approximately 75ft of the sampling boat. Measurements were recorded at approximately 1.5 minute intervals during each site test. At the 30ft deep site, flyboarding was performed within 20-30 ft of the sampling boat during the last 5 minutes, again with multiple "takeoffs" and "porpoising".

Water samples were collected approximately 3 ft deep and 3 ft over the bottom at each of the three test sites before and following flyboarding using a Van Dorn water sampler. Before and after samples were analyzed for Total Phosphorus (TP), Nitrate-N, Ammonia-N, Total Nitrogen, Turbidity (NTU), and Total Suspended Solids (TSS). Additionally, the deep over-bottom samples were analyzed for Total Iron at each site before and following flyboarding. Sample analyses were performed by the Center for Environmental Science and Engineering lab at the University of Connecticut.

Results

SCUBA Diver Observations

Coventry Lake was in the process of Fall turnover during testing. Although a small deep hypolimnion persisted on September 28, the lake had mixed down to approximately 23 ft with uniform temperature of 20.8 ^{o}C. (See appended Lake Monitoring Data from 2014). Transparency was at an annual low (approximately 2m Secchi disk reading), which is typical during Fall turnover. The bottom cold water layer was at 16.4 ^{o}C. The divers noted the temperature difference at the 30 ft deep site. The 10 ft and 20 ft sites exhibited uniform temperature from the surface to the bottom during testing. The divers did not sense any significant water turbulence or disturbance of bottom sediments during flyboarding. The 10 ft deep site was blanketed with 100% bottom coverage by macrophytes and macro algae (*Ceratophyllum sp*. and *Chara sp*.). The 20ft and 30ft deep sites exhibited a muck sediment bottom.

Over-Bottom Total Iron

30 ft Deep Site

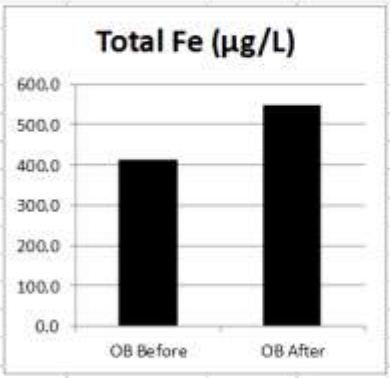
	Total Fe (µg/L)
OB Before	411.6
OB After	546.7
Change=	135.1
% Change=	32.8%

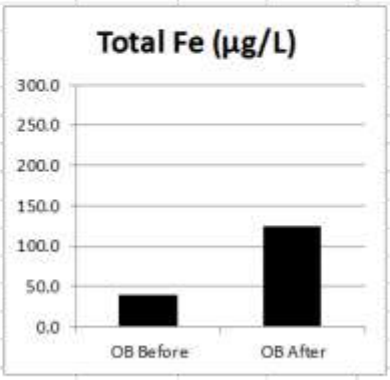
20 ft Deep Site

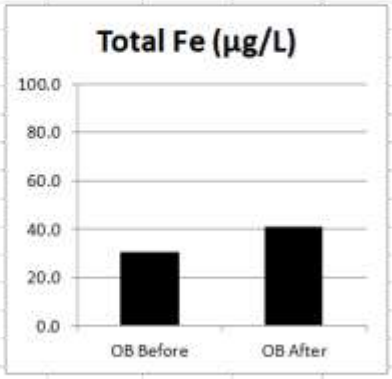
	Total Fe (µg/L)
OB Before	40.1
OB After	125.2
Change=	85.1
% Change=	212.2%

10 ft Deep Site

	Total Fe (µg/L)
OB Before	30.2
OB After	40.7
Change=	10.5
% Change=	34.7%







Fe	µg/L
Practical Quantitation Limit (PQL)	100
Method Detection Limit (MDL)	25

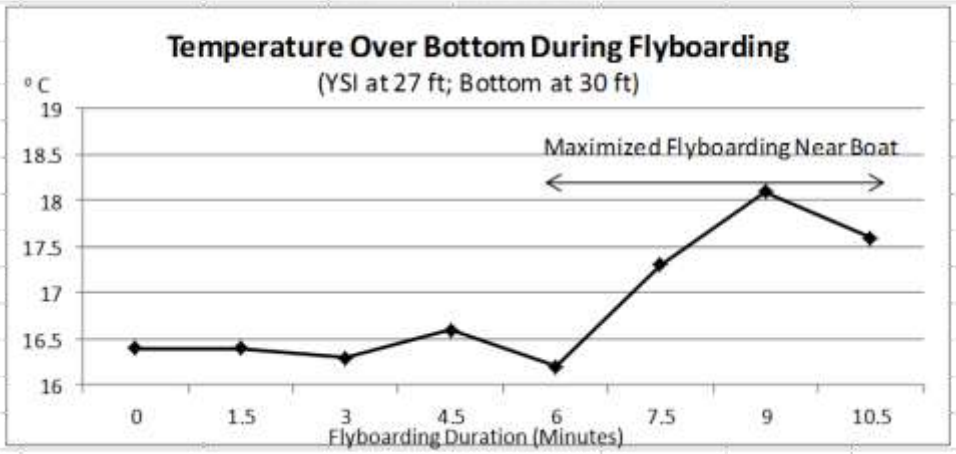
Over-bottom Total Iron increased at all three flyboard test sites (Note the y-axis scale maximum of 600 µg/L, 300 µg/L, and 100 µg/L, for the 30ft, 20ft, and 10ft sites, respectively). Total Fe increased by approximately 30-35% at the 10ft and 30ft sites, and by over 200% at the 20ft test site. These % increase data suggest that the exposed sediment surface and benthic zone water at the 20ft site are more vulnerable to disturbance than the plant-covered 10ft site or the deeper 30ft site. However, the deeper 30ft site exhibited the greatest absolute concentration change (+135 µg/L).

30 ft Deep Testing Location

30 ft Deep Testing Site

30 foot OB during testing

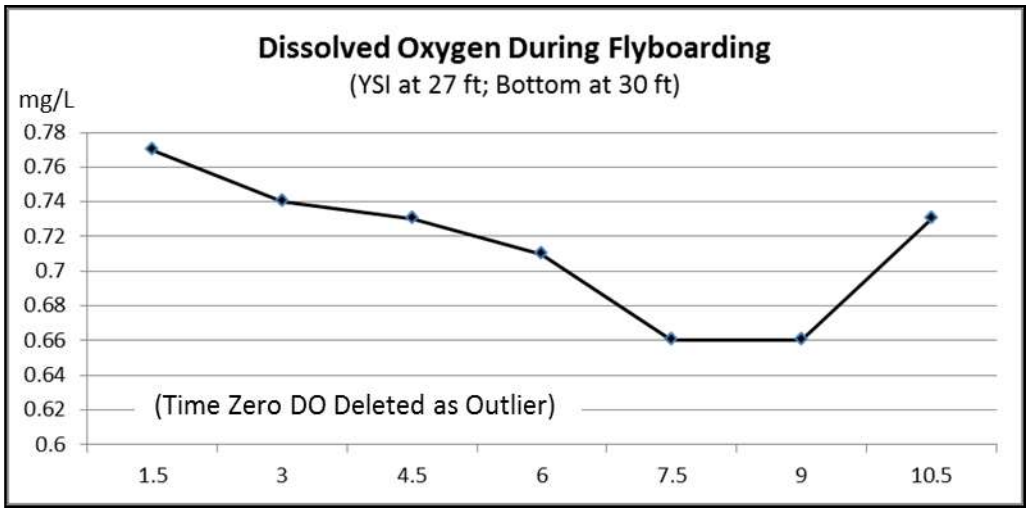
	Duration (min)	Temp	DO (mg/L)	Do %	pH	ORP
	0	16.4	3.02	35.9	7.38	21.7
	1.5	16.4	0.77	7.8	7.15	36.1
	3	16.3	0.74	7.7	7.13	39.9
	4.5	16.6	0.73	7.3	7.06	44.6
MAX Flying	6	16.2	0.71	7.2	7.03	47.2
MAX Flying	7.5	17.3	0.66	6.7	6.99	49.2
MAX Flying	9	18.1	0.66	6.7	6.99	49.2
MAX Flying	10.5	17.6	0.73	7.7	6.98	62
Surface Before		20.9	8.77	96.9	7.97	50.6
		(Initial DO still dropping)				



1:1 Surface + OB Temperature Mix would = 18.65 degrees C

During the first 5 minutes of flyboarding within approximately 75 ft of the sampling boat the monitoring instrument suspended at 27ft (3ft over the bottom) detected very little change in any of the parameters. For the second 5 minutes flyboarding was performed close to the sampling boat (within approximately 20-30 ft; a wet experience for the samplers on board). During that closer "maximized flying" several changes were detected by the instrument at 27ft deep. Temperature is a "conservative parameter" and can provide an estimate of mixing when two water layers are of different temperatures. During maximized nearby flyboarding,

temperature at 27ft deep increased, to an observed maximum of 18.1 ^{o}C. A 1:1 mixture of surface water with over-bottom water would result in a temperature of 18.65 ^{o}C. Maximized proximal flyboarding had a mixing effect at 27ft deep.



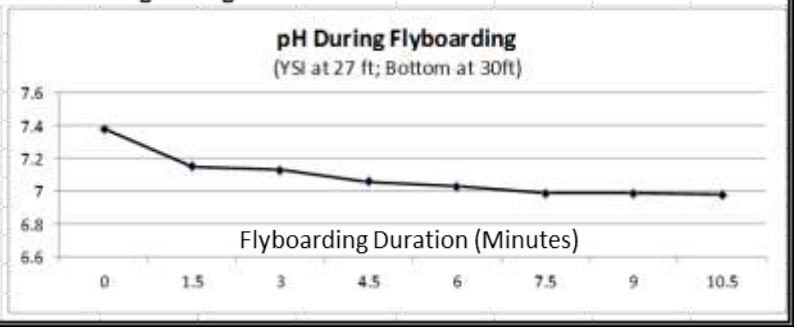
Flyboarding Duration (Minutes)

(Time Zero DO Deleted as Outlier)

Dissolved oxygen at 27ft appeared to decrease gradually during flyboarding, with the most significant change occurring during maximized flyboarding. Dissolved oxygen increased when maximized flyboarding ceased. The total variation in dissolved oxygen during flyboarding at the 30ft site was only 0.12 mg/L, which may have been due to instrument drift or non-equilibrium conditions during Fall overturn.

30 foot OB during testing

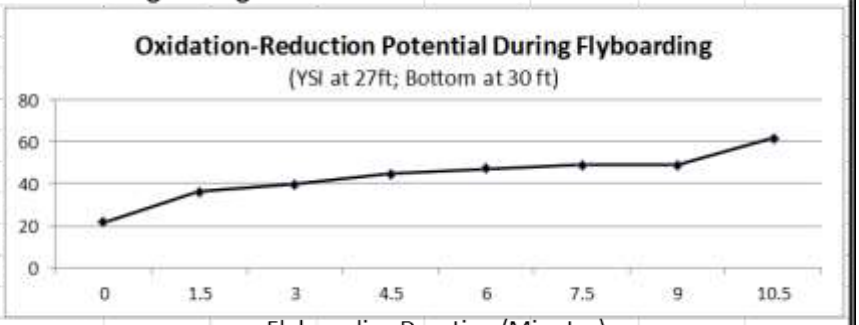
	Duration (min)	pH
	0	7.38
	1.5	7.15
	3	7.13
	4.5	7.06
MAX Flying	6	7.03
MAX Flying	7.5	6.99
MAX Flying	9	6.99
MAX Flying	10.5	6.98
	Surface Before	7.97



The over-bottom pH appeared to gradually decrease during flyboarding at the 30ft deep site, with a total decrease of 0.4 pH units. That may have been due to mixing of high carbon dioxide concentrations immediately over the bottom, and is consistent with the observed gradual decrease in dissolved oxygen.

30 foot OB during testing

	Minutes	ORP
	0	21.7
	1.5	36.1
	3	39.9
	4.5	44.6
MAX Flying	6	47.2
MAX Flying	7.5	49.2
MAX Flying	9	49.2
MAX Flying	10.5	62



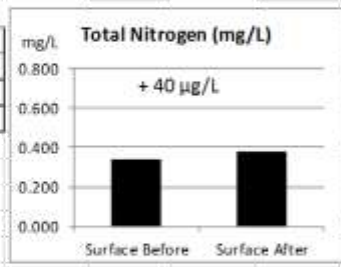
Surface Before 50.6
(Initial DO still dropping)

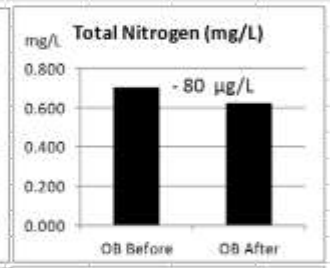
The oxidation-reduction potential (ORP) is a measure of how reducing the environment is. ORP gradually increased during flyboarding at the 30ft deep site. The decrease in dissolved oxygen, decrease in pH, and increase in ORP are consistent and suggest gradual mixing of the benthic water with more shallow water.

30 ft Deep Site	mg/L NH3	mg/L NOX	mg/L TN	mg/L TP	mg/L TSS	NTU TURB
Surface Before	0.005	ND	0.342	0.010	3	2.6
Surface After	ND	ND	0.382	0.011	5	2.8
OB Before	0.196	ND	0.704	0.035	12	7.8
OB After	0.200	ND	0.624	0.035	12	8.4

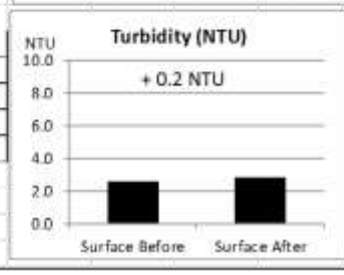
30 ft Deep Site

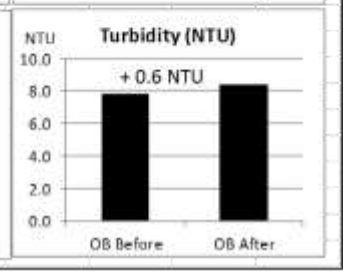
	mg/L TN
Surface Before	0.342
Surface After	0.382
OB Before	0.704
OB After	0.624





	NTU TURB
Surface Before	2.6
Surface After	2.8
OB Before	7.8
OB After	8.4





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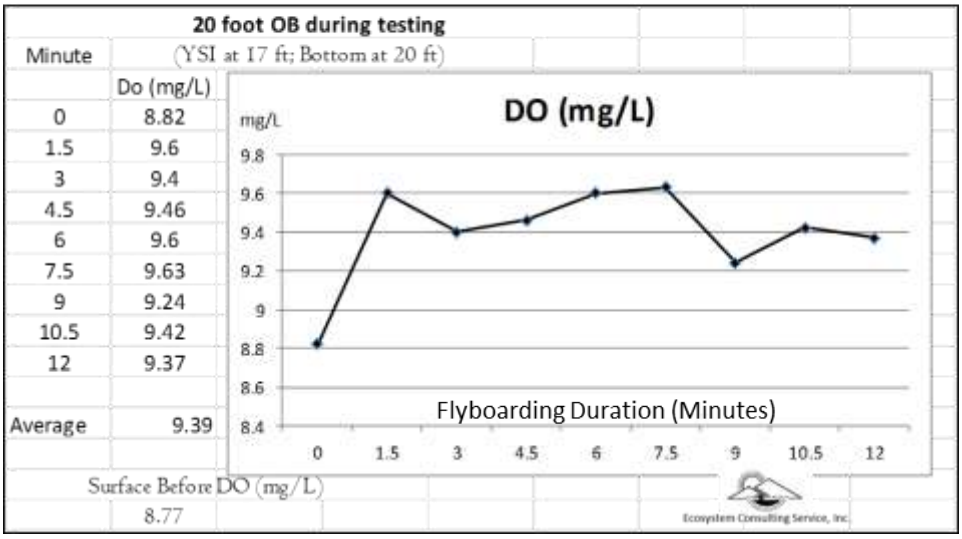
Ammonia-N, Nitrate-N, Total Phosphorus (TP), and Total Suspended Solids (TSS) exhibited little, if any, change in over-bottom samples collected before and after flyboarding. Total Nitrogen (TN) increased in the surface water and decreased in the over-bottom water, consistent with some mixing of the layers.

20 ft Deep Testing Location

20 foot OB during testing					
	(YSI at 17 ft; Bottom at 20 ft)				
Minute	Temp	Do (mg/L)	Do %	pH	ORP
0	20.8	8.82	99	7.8	52.8
1.5	20.8	9.6	107	7.81	53.6
3	20.8	9.4	106.1	7.8	53
4.5	20.8	9.46	106	7.83	51.7
6	20.8	9.6	106.9	7.84	51.2
7.5	20.8	9.63	107.4	7.85	49.9
9	20.8	9.24	104.9	7.88	52.5
10.5	20.8	9.42	105.5	7.88	53.7
12	20.8	9.37	105.2	7.88	54.9

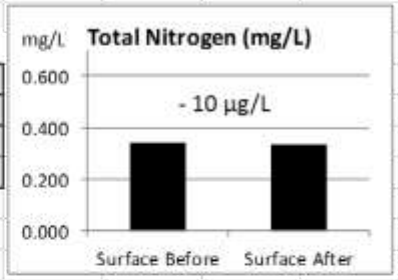


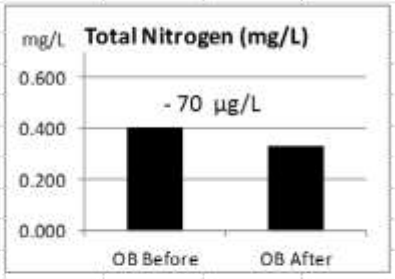
The 20ft deep location was isothermal during testing (same temperature surface to bottom) and no change was apparent for Temperature, pH, or ORP. The lake was well circulated in the 20 ft deep location. The Dissolved Oxygen concentration increased and fluctuated during flyboard testing. DO was initially near saturation with the atmosphere, but then increased to 105% to 107% saturation. The DO change may be related to the jet ejection of water at high pressure through the JAV nozzle. A similar phenomenon can be observed in the plunge pool below a high waterfall where DO saturation can exceed 100%. DO greater than 100% also typically occurs in productive lake surface waters due to photosynthetic oxygen production.

20 ft Deep Site	mg/L NH3	mg/L NOX	mg/L TN	mg/L TP	mg/L TSS	NTU TURB
Surface Before	0.003	ND	0.342	0.010	3	2.6
Surface After	ND	ND	0.332	0.019	3	2.6
OB Before	ND	ND	0.403	0.011	0	3.3
OB After	ND	ND	0.333	0.027	19	5.1

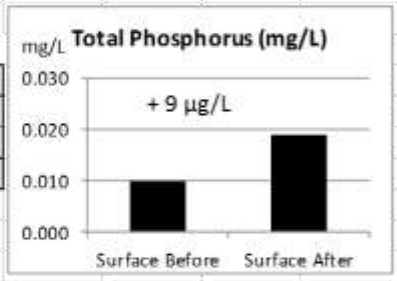
20 ft Deep Site

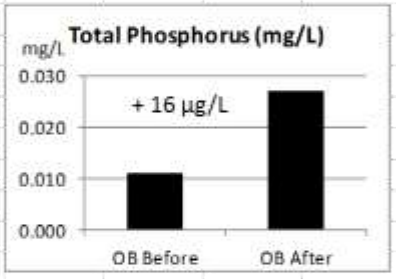
	mg/L TN
Surface Before	0.342
Surface After	0.332
OB Before	0.403
OB After	0.333



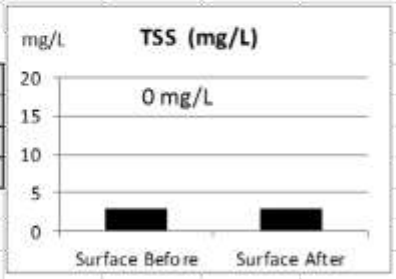


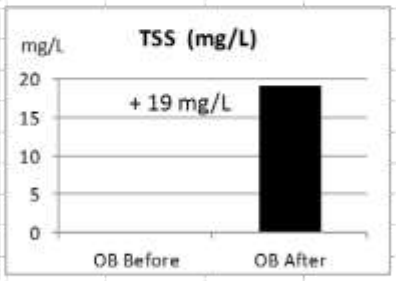
	mg/L TP
Surface Before	0.010
Surface After	0.019
OB Before	0.011
OB After	0.027



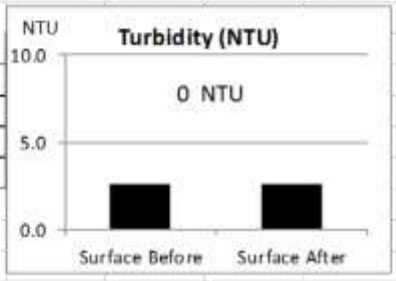


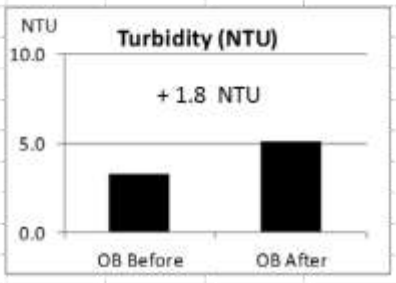
	mg/L TSS
Surface Before	3
Surface After	3
OB Before	0
OB After	19





	NTU TURB
Surface Before	2.6
Surface After	2.6
OB Before	3.3
OB After	5.1





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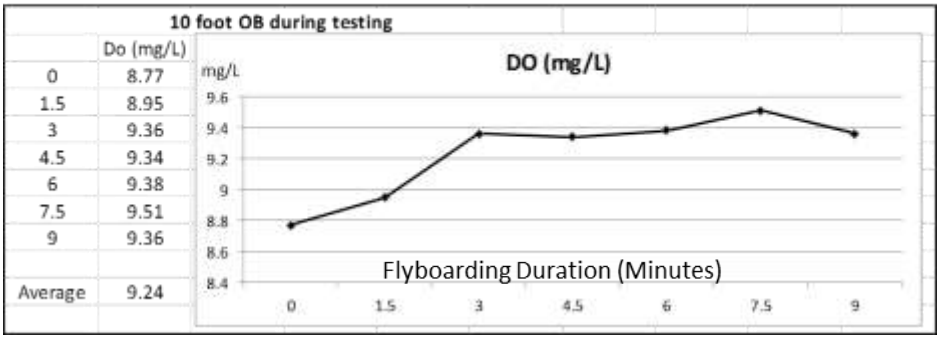
Several water chemistry changes were observed at the 20ft deep testing site. Surface samples decreased in Total Nitrogen (although the decrease in near-surface TN was small and probably is not significant), while inorganic nitrogen compounds remained low, and Turbidity was not changed. Surface Total Phosphorus nearly doubled during flyboard testing. Total Nitrogen appeared to decrease in the over-bottom sample. Over-bottom Total Phosphorus more than doubled. Total suspended solids (TSS) in over-bottom water increased from below

detection limits to 19 mg/L. Although surface turbidity remained unchanged, over-bottom turbidity increased from 3.3 to 5.1 NTU.

10 ft Deep Testing Location

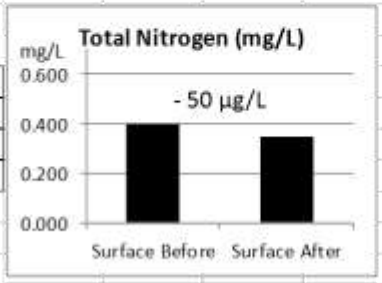
10 foot OB during testing					
Minute	Temp	Do (mg/L)	Do %	pH	ORP
0	20.9	8.77	96.9	7.97	50.6
1.5	20.9	8.95	100	7.98	51
3	20.9	9.36	104.5	7.98	51.8
4.5	20.9	9.34	104.7	7.98	52.2
6	20.9	9.38	105.3	7.99	52.7
7.5	20.9	9.51	106.9	7.99	53
9	20.9	9.36	104.1	8	53
Average	20.90	9.24	103.20	7.98	52.04

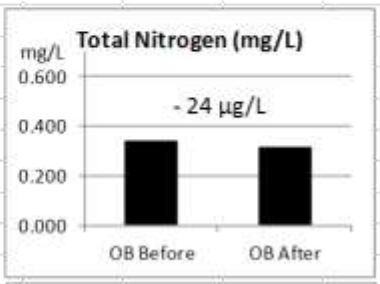


The 10ft deep testing site was also isothermal surface-to-bottom during testing, and no significant change was noted in over-bottom water for Temperature, pH, or ORP. An increase in dissolved oxygen and % DO saturation similar to that observed at the 20ft deep site was observed at the 10ft deep testing location. Dissolved oxygen increased from near equilibrium with the atmosphere to nearly 107 % saturation.

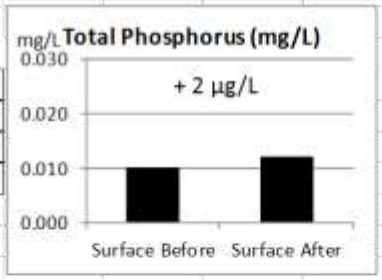
10 ft Deep Site	mg/L NH3	mg/L NOX	mg/L TN	mg/L TP	mg/L TSS	NTU TURB
Surface Before	ND	ND	0.395	0.010	ND	2.5
Surface After	ND	ND	0.345	0.012	ND	2.3
OB Before	ND	ND	0.339	0.016	ND	2.3
OB After	ND	ND	0.315	0.011	ND	3.1

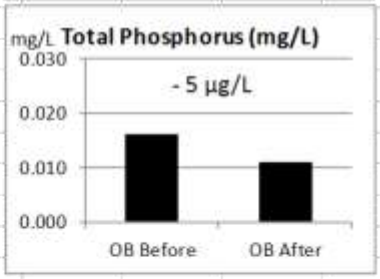
	mg/L TN
Surface Before	0.395
Surface After	0.345
OB Before	0.339
OB After	0.315



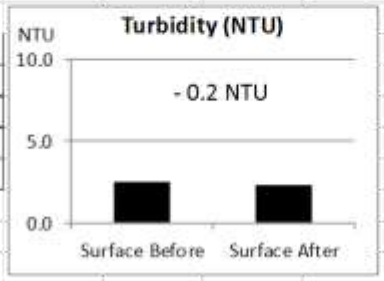


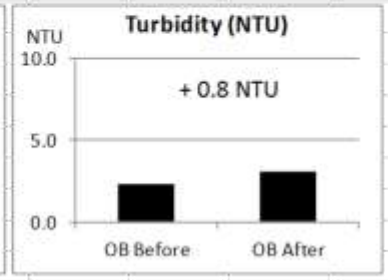
	mg/L TP
Surface Before	0.010
Surface After	0.012
OB Before	0.016
OB After	0.011





	NTU TURB
Surface Before	2.5
Surface After	2.3
OB Before	2.3
OB After	3.1





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Over-bottom Nitrate-N and Ammonia-N concentrations remained below detection limits. Total Nitrogen appeared to decrease in both surface and over-bottom samples collected before and after flyboarding at the 10ft deep testing site. Very small changes were observed for Total Phosphorus and Turbidity in samples collected before and after flyboarding at the 10ft deep site.

Comparison of Analytical Results to PQL and MDL of the Lab

In the following table, the change in parameter between before and after flyboarding is calculated for the surface and over-bottom samples. Negative values indicate a decrease in the parameter during flyboarding. Positive values indicate an increase in the parameter during flyboarding.

Changes in each parameter were compared to the Method Detection Limit (MDL) and the Practical Quantitation Limit (PQL) to get an indication of whether changes were greater than the precision range of the analytical procedure. Unshaded results are probably not actual changes resulting from flyboarding. Lightly shaded cells indicate differences that are greater than the MDL, and dark shaded cells indicate changes that exceeded the PQL. The MDL represents approximately 3x the standard deviation in sample blank detection of the analytical procedure. The PQL represents approximately 10x the standard deviation in sample blank detection of the analytical procedure. Although duplicate samples were not collected for statistical analysis, differences before-after that are dark shaded are probably due to flyboard operation, and not within the variability of the analytical procedure (analytical precision).

After - Before (Parameter Change)

	mg/L	mg/L	mg/L	mg/L	mg/L	NTU
Practical Quantitation Limit (PQL)	0.010	0.010	0.050	0.010	5	0.3
Method Detection Limit (MDL)	0.003	0.003	0.008	0.001	2	0.1
30 ft deep Site	**NH3**	**NOX**	**TN**	**TP**	**TSS**	**TURB**
Surface	-0.005	0.000	0.040	0.001	2.000	0.200
Over Bottom	0.004	0.000	-0.080	0.000	0.000	0.600
20 ft deep Site	**NH3**	**NOX**	**TN**	**TP**	**TSS**	**TURB**
Surface	-0.003	0.000	-0.010	0.009	0.000	0.000
Over Bottom	0.000	0.000	-0.070	0.016	19.000	1.800
10 ft deep Site	**NH3**	**NOX**	**TN**	**TP**	**TSS**	**TURB**
Surface	0.000	0.000	-0.050	0.002	0.000	-0.200
Over Bottom	0.000	0.000	-0.024	-0.005	0.000	0.800
Absolute Difference > MDL						
Absolute Difference > PQL						

Absolute difference in Parameter before and after Flyboarding compared to the "Practical Quantitation Limit" and "Method Detection Limit" of the parameter. (After – Before; negative indicates a decrease, positive indicates and increase). Dark shading indicates the most significant change after flyboarding. All parameters reported as mg/L except Turbidity (NTU).

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Fluorometer Results

Turner Fluorometers and a UV254 instrument were used to determine changes in Colored Dissolved Organic Matter (CDOM), UV254, Chlorophyll-a, Phycocyanin, and Phycoerythrin in samples collected at the surface and over-bottom before and after flyboarding.

Turner Fluorometer					
	CDOM	UV254	Chl-a	Phycocyanin	Phycoerythrin
30 ft-Surface Before	17.020	0.046	3.719	18.807	8.415
30 ft-Surface After	16.287	0.041	4.417	14.773	1.710
Change	-0.732	-0.005	0.698	-4.034	-6.705
30 ft- OB Before	34.221	0.089	7.082	28.074	12.360
30 ft- OB After	33.142	0.081	6.809	21.423	11.046
Change	-1.079	-0.008	-0.273	-6.650	-1.314
20 ft-Surface Before	16.431	0.033	4.643	12.739	1.808
20 ft-Surface After	18.306	0.044	4.575	15.624	2.667
Change	1.875	0.012	-0.068	2.886	0.859
20 ft- OB Before	18.692	0.037	4.682	19.921	2.786
20 ft- OB After	16.906	0.044	5.490	18.146	2.118
Change	-1.786	0.007	0.808	-1.775	-0.668
10 ft-Surface Before	16.258	0.044	3.537	12.885	1.867
10 ft-Surface After	14.813	0.043	3.466	10.916	1.661
Change	-1.445	-0.001	-0.071	-1.969	-0.207
10 ft- OB Before	16.342	0.044	4.165	18.306	1.872
10 ft- OB After	16.327	0.055	3.899	10.213	1.213
Change	-0.015	0.012	-0.266	-8.093	-0.659

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Discussion

Testing at the 30ft deep site indicated that some downward mixing to below 27ft was induced by flyboarding, especially when maximized near the sampling boat. Peak observed over-bottom temperature increase suggested just less than a 1:1 mix blend of surface and near-bottom water. Over-bottom pH and dissolved oxygen appeared to gradually decrease, while oxidation-reduction potential gradually increased, during flyboarding. Total Nitrogen (TN) appeared to decrease in the over-bottom sample and increase in the surface sample at the 30ft deep testing site. These observations are consistent with the temperature observations, and further suggest some mixing of sediment-overlying water and water from more shallow depths. Over-bottom Total Iron (TFe) increased by 135 µg/L.

The water column was isothermal surface-to-bottom at the 20ft site and 10ft testing site and therefore temperature changes could not be used to quantify mixing influence. At both of these sites dissolved oxygen and % DO saturation increased during flyboarding. This phenomenon is believed to be related to the water ejection through JAV nozzles at high pressure.

The 20ft deep test site had a muck sediment bottom. Here increases in TP, TSS, and Turbidity were observed in samples from 3ft over the bottom. Interestingly, Total Nitrogen appeared to decrease in surface and over-bottom waters at the 10ft and 20ft deep sites. Total Iron increased by more than 200% at the 20ft site, suggesting that this depth range (exposed sediment, more shallow than the deepest area) is especially vulnerable to the mixing effects of flyboarding.

The changes in water chemistry at the 10ft deep site were relatively small. The bottom was covered with aquatic macrophytes (e.g. *Ceratophyllum sp*.), and macro alga (*Chara sp*. and *Nitella sp.*) at the 10ft deep site. The dense plant cover may provide some protection to the benthic interface.

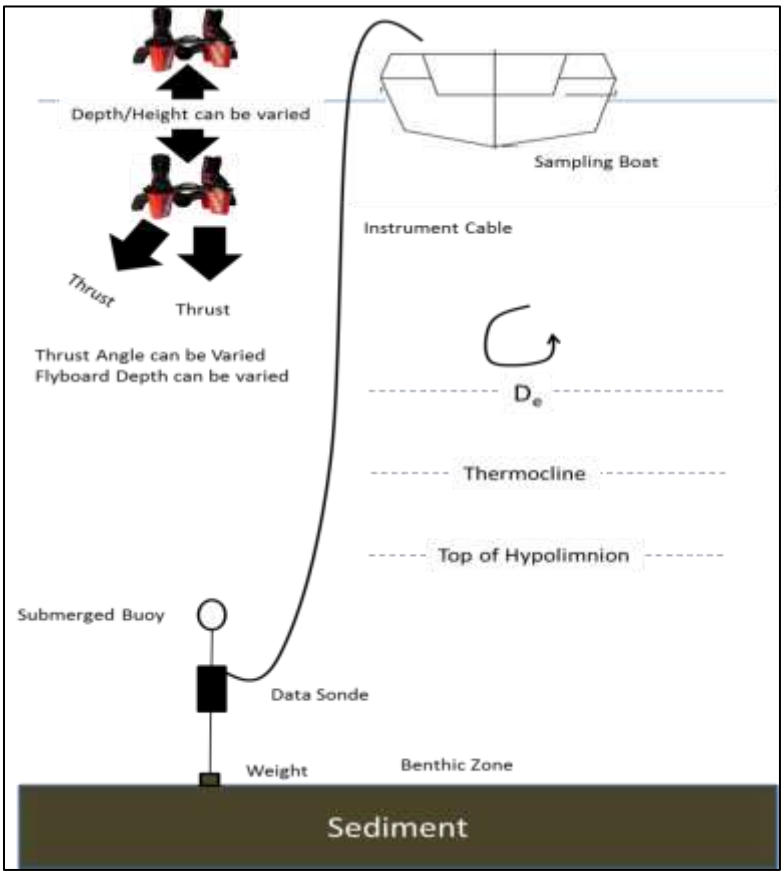
Although the lake still retained a temperature difference between the surface and deep layers, it was in the process of gradually circulating (surface layer expanding downward). Stratification was not as it exists between Memorial Day and Labor Day (Relative Thermal Resistance to Mixing is typically 300+ units; see appended data). During testing, the thermocline was deeper and had weakened to approximately 195 RTRM units. These results provide insight into potential effects of flyboard operation. However, additional testing during the peak of thermal stratification in June, July, and August would be prudent for developing management procedures that protect against adverse effects of JAVs. Based on these initial testing results, flyboarding in lake areas where the compensation depth reaches the bottom (approximately 1.8 x Secchi depth), and where plant cover protects the sediment surface, would have lower impact potential than where deeper stratified water layers and exposed sediment surfaces exist.

Further Testing Suggestions

Testing at additional depth sites, with replicate before and after samples for statistical analysis, and longer duration flyboarding in closer proximity to monitoring instruments and the water sampling location is recommended when the lake exhibits stronger thermal stratification (Total RTRM > 300 units). Testing with replicate samples collected before flyboarding, after 10 minutes, and after 20 minutes, would provide more information regarding the hydrodynamics of flyboarding and effects on thermal stratification and the benthic boundary layer.

Flyboarding at the 30ft deep site within approximately 75 ft of the sampling boat showed little effect on the YSI instrument parameters (during the first 5 minutes) until it was performed closer to the sampling boat (within approximately 20-30 ft). A more controlled test of the flyboard could be performed by fixing the apparatus from the sampling boat at known depths, heights above water surface, and locations relative to the data sonde and water collection sites, rather than having the rider moving around a larger area.

Other aspects of flyboarding should also be studied, such as developing a decontamination procedure for the interior elements (e.g. flattened hose) to prevent the spread of invasive macrophytes between lakes.



Appended Monitoring Data – Coventry Lake 2014

2014 Coventry Lake Monitoring Data

Secchi

Compensation Depth

Temperature (°C)		> 24°C			
Depth (m)	28-Feb	14-Apr	16-Jun	6-Aug	6-Oct
0.5	2.4	10.2	22.2	25.5	18.2
1	3.1	10.1	21.9	25.5	18.1
2	3.2	10.0	20.2	25.4	18.1
3	3.2	10.0	20.0	25.4	18.1
4	3.2	8.6	19.9	25.3	18.0
5	3.2	8.2	19.4	25.1	17.8
6	3.2	7.8	15.6	24.2	17.8
7	3.2	7.5	13.2	21.4	17.7
8	3.3	7.1	12.3	16.0	17.5
9	3.6	7.0	11.7	13.6	16.9
10	3.6	6.7	11.0	12.4	16.1
10.5	3.9	6.7	10.6		

Mixed Epilimnion
To ca. 4.5m (15 ft)

Metalimnion
Thermocline

Hypolimnion
Below ca. 7.5m (24 ft)

RTRM	> 20	> 50			
Depth (m)	28-Feb	14-Apr	16-Jun	6-Aug	6-Oct
0.5	0	0	0	0	0
1	2	1	8	0	0
2	0	1	43	3	2
3	0	1	8	0	0
4	0	13	2	3	2
5	0	3	12	6	2
6	0	3	83	28	2
7	0	2	41	81	2
8	0	2	15	128	2
9	0	1	8	44	13
10	0	1	8	19	17
10.5	0	0	5		
SumRTRM	**3**	**29**	**234**	**313**	**43**
MaxRTRM	**2**	**13**	**83**	**128**	**17**

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Anoxic Hypolimnion
High TP Ammonia Iron

Dissolved Oxygen (mg/L)			<1.0mg/L	<0.5mg/L	
Depth (m)	28-Feb	14-Apr	16-Jun	6-Aug	6-Oct
0.5	14.2	10.5	8.5	9.6	8.4
1	13.0	11.1	8.8	9.2	8.4
2	12.7	11.2	9.2	9.2	8.4
3	12.4	11.3	9.2	9.2	8.4
4	12.3	11.0	9.2	9.2	8.3
5	12.1	11.1	9.2	9.1	8.1
6	11.6	11.0	7.8	8.4	8.0
7	11.1	10.9	5.2	6.2	7.7
8	10.0	10.8	3.6	1.8	7.3
9	8.3	10.7	2.3	0.0	3.1
10	8.3	10.2	0.9	0.0	1.2
10.5	6.3	9.9	0.4		

2014 Coventry Lake Monitoring Data

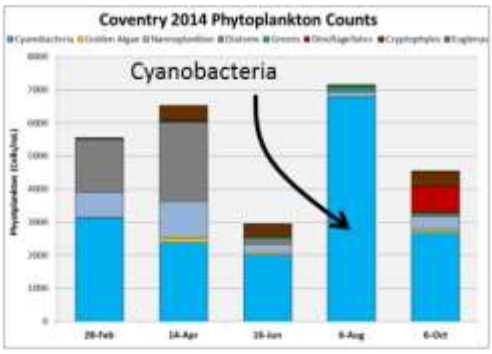
Light Extinction Depths (m)			
Date	14-Apr	16-Jun	6-Oct
10% IL	2.4	2.8	1.7
1% IL	5.4	5.0	5.7

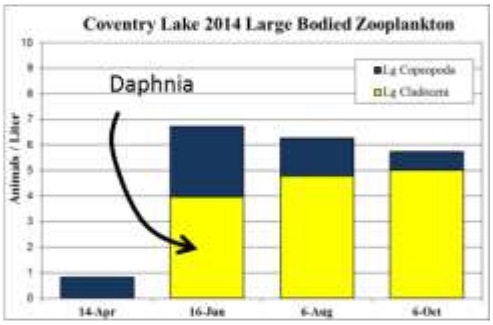
Transparency (m)	2014.0			
Date	14-Apr	16-Jun	6-Aug	6-Oct
Secchi	2.8	5.9	4.1	3.2
Comp Dpth	5.5	11.8	8.2	6.4

Percent Incident Light (%)			
Depth (m)	14-Apr	16-Jun	6-Oct
0.5	48.0	50.4	28.4
1	23.7	23.6	19.0
2	13.0	15.0	6.6
3	4.6	8.4	6.3
4	3.2	4.7	1.9
5	1.2	0.9	1.4
6	0.6	0.5	0.8
7	0	0	0.5
8	0	0	0
9	0	0	0
10	0	0	0
10.5	0	0	

Secchi

Compensation Depth





Total Phosphorus as P (µg/L)					
Depth (m)	28-Feb	14-Apr	16-Jun	5-Aug	6-Oct
1m	7	11	5	7	14
Mid	10	11	9	7	
OB	11	13	20	47	43

Ammonia as N (µg/L)					
Depth (m)	28-Feb	14-Apr	16-Jun	5-Aug	6-Oct
1m	74		15	<10	32
Mid	71		20	<10	
OB	101		410	163	305

Nitrite / Nitrate (µg/L)					
Depth (m)	28-Feb	14-Apr	16-Jun	5-Aug	6-Oct
1m	59	59	23	<10	<10
Mid	55		28	<10	
OB	134		<10	<10	<10

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