Monitoring of the algal bloom in the Edward-Wakool system, update #3

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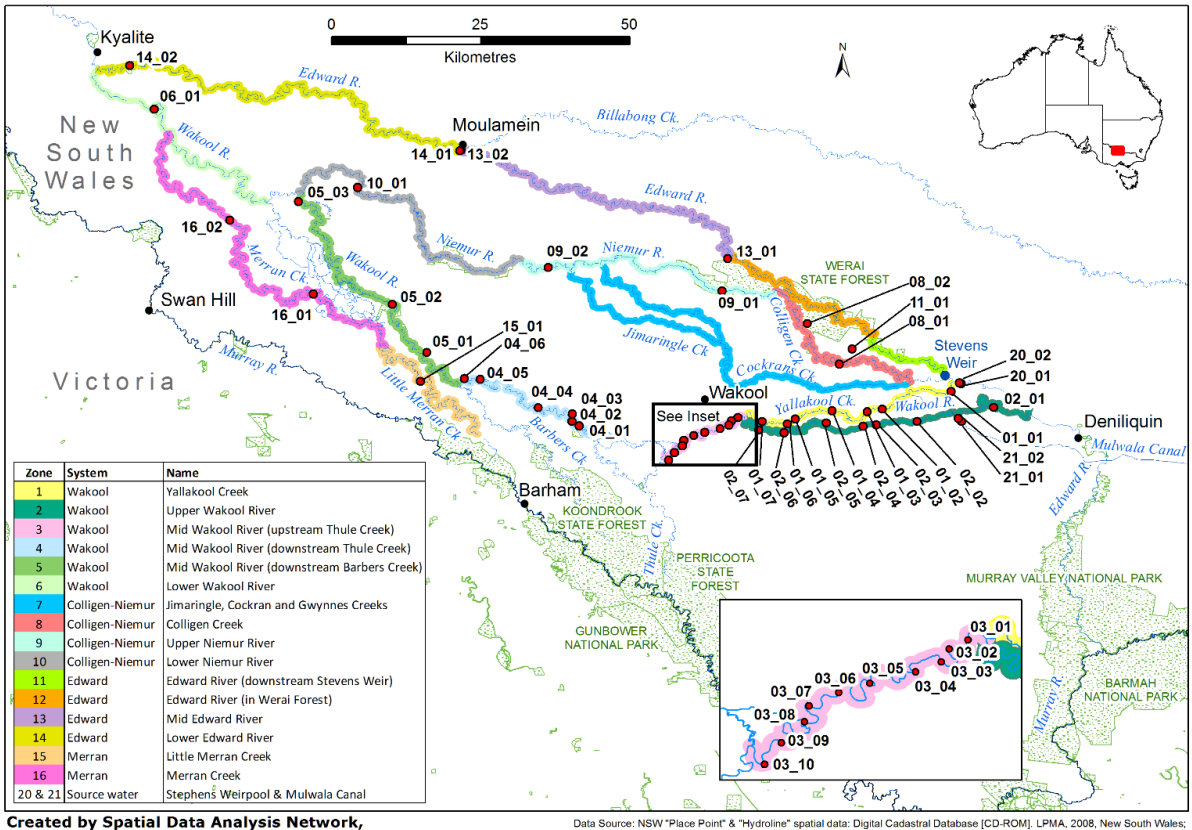
Sites monitored 21st to 22nd March 2016

Fifteen sites were monitored on 21st to 22nd March.

1. Yallakool Creek, LTIM zone 1 site 2 (Hopwood)
2. Yallakool Creek, LTIM zone 1 site 7 (Windra Vale)
3. Upper Wakool River, LTIM zone 2 site 2 (Yaloke)
4. Upper Wakool River, LTIM zone 2 site 6 (Widgee 1)
5. Mid Wakool River, LTIM zone 3 site 2 (Tralee)
6. Mid Wakool River, LTIM zone 3 site 10 (Llanos Park)
7. Mid Wakool River, LTIM zone 4 site 1 (Barham Bridge)
8. Mid Wakool River, LTIM zone 4 site 6, (Noorong 2)
9. Mid Wakool River, LTIM zone 5 site 2 (Gee Gee Bridge)
10. Niemur River, at Nancurrie Rd Bridge (not shown in Figure 1, but is approximately midway between of zone 10 site 1 and zone 9 site 2)
11. Colligen Creek, Murray LLS aquatic veg sample site 1 (Bowen Park, just upstream of site 08_01)
12. Colligen Creek, Murray LLS aquatic veg project sample site 4 (near Werai station site 08_02)
13. Edward River, LTIM zone 20 site 2 (Stevens Weir)
14. Mulwala canal, LTIM zone 21 site 1 (Canal 1)
15. Mulwala canal, near Berrigan (not on map, east of Deniliquin)



Zone	System	Name
1	Wakool	Yallakool Creek
2	Wakool	Upper Wakool River
3	Wakool	Mid Wakool River (upstream Thule Creek)
4	Wakool	Mid Wakool River (downstream Thule Creek)
5	Wakool	Mid Wakool River (downstream Barbers Creek)
6	Wakool	Lower Wakool River
7	Colligen-Niemur	Jimaringle, Cockran and Gwynnes Creeks
8	Colligen-Niemur	Colligen Creek
9	Colligen-Niemur	Upper Niemur River
10	Colligen-Niemur	Lower Niemur River
11	Edward	Edward River (downstream Stevens Weir)
12	Edward	Edward River (in Werai Forest)
13	Edward	Mid Edward River
14	Edward	Lower Edward River
15	Merran	Little Merran Creek
16	Merran	Merran Creek
20 & 21	Source water	Stephens Weirpool & Mulwala Canal

Created by Spatial Data Analysis Network, Charles Sturt University, May, 2015

Data Source: NSW "Place Point" & "Hydroline" spatial data: Digital Cadastral Database [CD-ROM]. LPMA, 2008, New South Wales; Australian Reserves GEODATA TOPO 250K Series 3, 2006, OEH NSW National Parks 2012

Figure 1. Edward-Wakool Long term Intervention Monitoring sites

Observations from 21-22 March 2016

There was visual evidence that the blue-green algal bloom had extended further downstream since last week. On 14th March the bloom was not evident at Gee Gee Bridge on the Wakool River (Figure 2a), but on 21st March the water was very green at this site (Figure 2b). The water colour at Gee Gee Bridge appeared the greenest of all the sites sampled on 21 and 22nd March. The DO concentration at the Gee Gee bridge gauge (gauge 409062) increased rapidly on 16/3/2016 (Figure 3). This suggests that the flow transported the bloom to the Gee Gee bridge site around 16/3/2016.

Figure 2. a) No blue green algae was evident at Gee Gee bridge on the Wakool River 14/3/16. (Photo R Watts) b) Blue green algae evident at Gee Gee bridge 21/3/16 (Photo J. Abell)

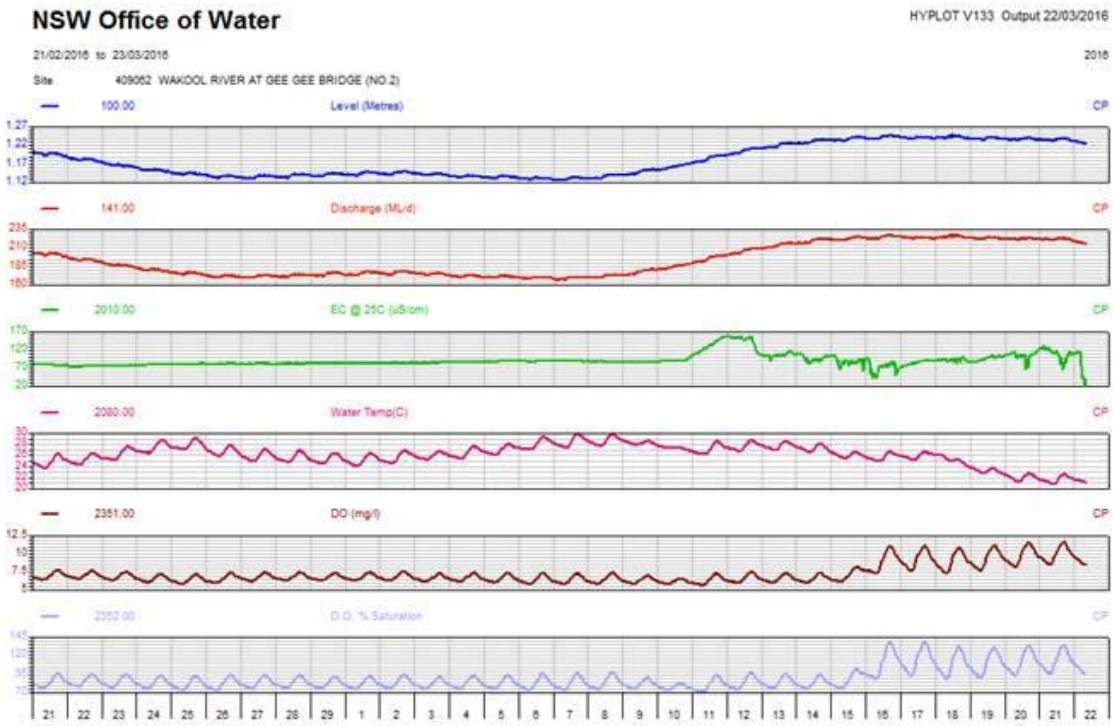


Figure 3. Discharge and water quality results for the Wakool River at the Gee Gee bridge gauge from 21/2/2016 to 22/3/2016.

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The bloom was not evident at Nancurrie Road Bridge on the Niemur River on 14th March (Figure 4a) but the water was very green at this site on 21st March (Figures 4b), suggesting the algae arrived at that site sometime in the previous week. The DO concentration at the gauge on the Niemur River at the Barham-Moulamein Rd Bridge (gauge 409048) increased rapidly on 8/3/2016 (Figure 5). There is not a hydrological gauge on the Niemur River at Nancurrie Road, however from monitoring observations it appears that the bloom spread downstream to the Nancurrie Road site sometime between14/3/16 and when it was first observed on 21/3/16.

Figure 4. a) No blue green algae was evident at Nancurrie Road bridge on the Niemur River 14/3/16. (Photo R Watts) b) Blue green algae at Nancurrie Road bridge on the Niemur River 22/3/16 (Photo J. Abell)

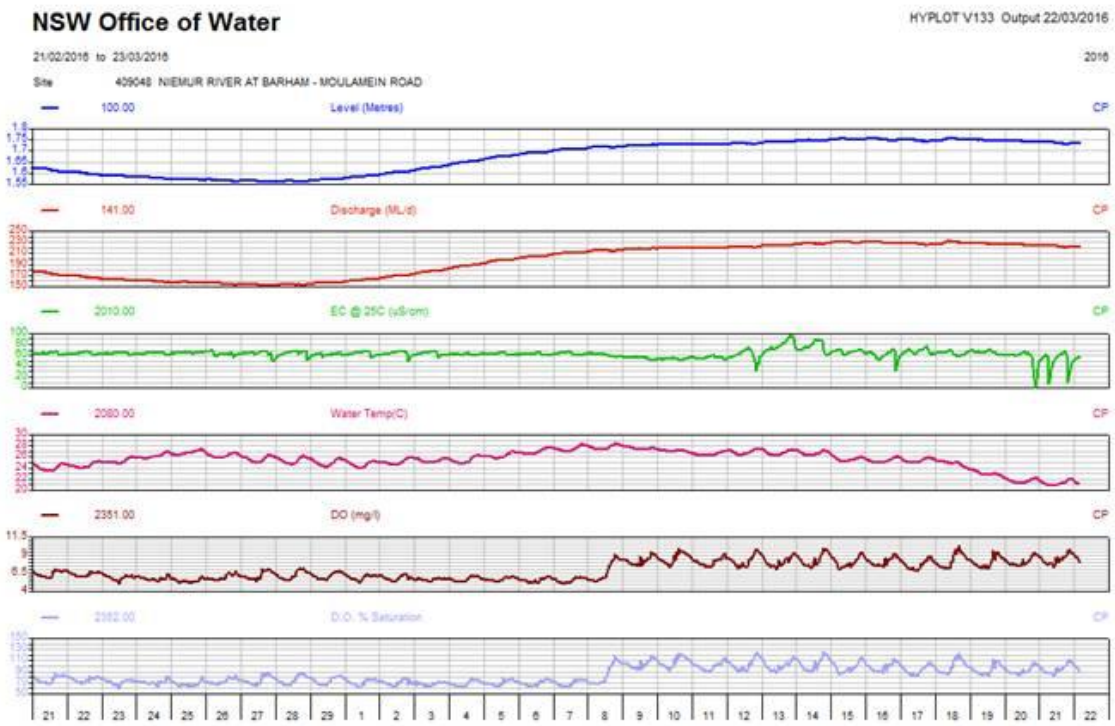

Figure 5. Discharge and water quality results for the Niemur River at the Barham-Moulamein Rd gauge (409048) from 21/2/2016 to 22/3/2016.

The presence of algal scum on the surface of the water was variable among sites. Those sites with faster flowing water had minimal scum, whereas sites with slower flowing water and low discharge had extensive areas of scum. This was particularly evident in slow flowing water in the upper Wakool River zone 2 (Figure 6a) and mid Wakool zone 3 (Figure 6b).

The red scum that was present at some sites on 14-15th March (see update #2) was not as evident this week, with just a few areas of light red scum evident (e.g. zone 3 site 5) (Figure 7).

Figure 6. a) Blue green algae scum was evident amng aquatic vegetation in a) the upper Wakool River (zone 2) on 22/3/16 and b) mid Wakool River zone 3 on 22/3/16 (Photo J. Abell)

Figure 7. a) Slightly red scum evident in the mid Wakool River (zone 3 site 5) on 21/3/16 (Photo J. Abell)

Spot water quality data from 21 -22 March 2016

Spot water results are shown in Table 1. Note that the time of day will influence the temperature, dissolved oxygen and pH results. So it is not reliable to compare results taken at different times of the day. Key points:

- The water temperature ranged between 20.5 and 23.1 °C reflecting the cooler air temperatures this week. The water temperature was several degrees lower than last week (range 24.5 to 28.8 °C on 14-15th March) and the previous week (range 26.3 to 31 °C on 7th-8th March).
- The percent concentration of dissolved oxygen was generally lower than last week and the first week in March when there was very hot weather. Spot measures of DO cannot be directly compared with data from last week because they were measured at different times of the day.
- The water in the Mulwala canal at the Deniliquin-Wakool Road crossing was banked up against the gate and was not flowing. The turbidity was considerably higher at this site than in the canal at Berrigan where the water was flowing.

Table 1. Spot water quality results on 21/3/16 to 22/3/16 at sites in the Edward-Wakool system

Zone	Zone name	Site	Name	Date	Time	Temp	pH	EC	Turb (NTU)	DO (mg/L)	DO %
1	Yallakool Ck	2	Hopwood	22/03/16	13:50	22.62	8.70	0.028	123	8.71	103.2
1	Yallakool Ck	7	Windra Vale	22/03/16	12:24	21.09	8.06	0.021	116	9.43	114.3
2	Upper Wakool	2	Yaloke	22/03/16	13:21	21.26	8.62	0.483	160	8.37	96.9
2	Wakool R	6	Widgee1	22/03/16	12:45	20.49	8.74	0.380	184	9.6	116.9
3	Mid Wakool R	2	Tralee	22/03/16	11:35	21.18	8.16	0.069	149	6.86	79.2
3	Mid Wakool R	5	Llanos Park	22/03/16	10:35	21.26	8.12	0.075	157	8.25	95.5
4	Mid Wakool R	1	Barham Bridge	21/03/16	17:00	22.87	10.03	0.062	188	11.85	141
4	Mid Wakool R	5	Noorong 2	21/03/16	16:00	23.14	9.88	0.066	205	10.68	127.7
5	Mid Wakool R	2	Gee Gee	21/03/16	15:00	22.81	9.75	0.067	196	10.41	123.7
10	Niemur River		Nancurrie Rd	22/03/16	9:30	20.50	8.26	0.022	253	7.92	90.3
8	Colligen Creek	1	Bowen Park	21/03/16	13:00	22.38	8.54	0.027	94.2	8.96	105.7
8	Colligen Creek	4	Werai Station	21/03/16	13:45	21.97	9.63	0.020	136	108	120.5
20	Edward River	2	Stevens Weir	21/03/16	12:00	23.04	8.68	0.029	147	8.33	99.4
21	Mulwala Canal	1	Canal - Wakool	22/03/16	14:15	21.17	9.76	0.034	239	9.3	107.5
21	Mulwala Canal		Canal - Berrigan	22/03/16	16:00	22.62	9.84	0.030	112	10.5	124.4

Visual assessment of algal concentration

Visual assessment of water shows that the algae was particularly concentrated in the Wakool River at Gee Gee bridge and in the mid Wakool River zone 3 (Figure 7). The water from Steven's weir and Yallakool Creek appeared to have the lowest concentration of algae (Figure 8).

Figure 8. Water samples from sites in the Edward-Wakool system collected on 21/3/16 and 22/3/16

Algal counts

Water samples are being processed for total algal counts. The results currently available (Table 2) show that the algal count in Yallakool Creek, the upper Wakool River (zone 2), Stevens weir and the Mulwala canal increased between 7th and 14th March. The counts at some sites were extremely high, over 1 million cells per millilitre. On the 14th March the concentration of algae at Gee Gee Bridge was very low compared to the other sites.

The dominant genus of cyanobacteria in the Edward-Wakool system has been confirmed to be Chryosporum (previously known as Aphanizomenon), that is the dominant genus reported in the Murray River during this algal bloom event. *Chryosporum ovalisorum* is a toxic bloom-forming cyanobacterium that has been reported to bloom in freshwater systems mainly around the Mediterranean Sea. Blooms of this species have been reported in Lebanon at the subsurface water temperature of 22 °C (Fadel et al. 2014), and have been associated with water temperatures above 26 °C in Israel (Pollinghe et al. 1998), Greece (Gkelis et al. 2005) and Spain (Quesada et al. 2006). In a stratified water column the gas vacuoles of this species enable it to migrate between surface layers with high light availability and deeper layers with high nutrient availability (Reynolds et al 1987). It has cells called heterocysts that are dedicated to atmospheric nitrogen fixation during periods of nitrogen limitation.

Table 2. Total algal count in water samples from sites in the Edward-Wakool system. Counts are in number/mL. No data yet available for samples collected on 21/3 and 22/3/ 2016

Zone	Zone name	Site	Name	7/3/16 to 8/3/16	14/3/16 to 15/3/16	21/3/16 to 22/3/16
1	Yallakool Ck	2	Hopwood	358000		
1	Yallakool Ck	7	Windra Vale	219,000	1,200,000	
2	Upper Wakool	2	Yaloke	2,030,000		
2	Wakool R	6	Widgee1	335,000	1,630,000	
3	Mid Wakool R	2	Tralee	1,420,000		
3	Mid Wakool R	5	Llanos Park	427,000		
4	Mid Wakool R	1	Barham Bridge	1,140,000		
4	Mid Wakool R	5	Noorong 2	690,000		
5	Mid Wakool R	2	Gee Gee	50,000	43,600	
10	Niemur River		Nancurrie Rd	Not sampled		
8	Colligen Creek	1	Bowen Park	91,900		
8	Colligen Creek	4	Werai Station	1,950,000		
20	Edward River	2	Stevens Weir	356,000	878,000	
21	Mulwala Canal	1	Canal - Wakool	438,000	1,700,000	

Dissolved carbon - Absorbance and fluorescence data

No water samples had spectroscopic characteristics that would suggest problematic concentrations of dissolved organic matter at this time. Absorbance data across all samples (Figure 8) was generally similar to the previous week with the most notable change being an increase in dissolved organic carbon at the Gee Gee Bridge site. The Niemur River sample from 22/3/16 grouped with the rivers with higher absorbance, indicating an increase in carbon from the previous week. Fluorescence analysis is more sensitive to changes in carbon composition and analysis of these data is ongoing. The increase in organic matter at the Gee Gee Bridge site over the past three weeks was evident in the fluorescence results for this site over the past 3 weeks (Figure 9).

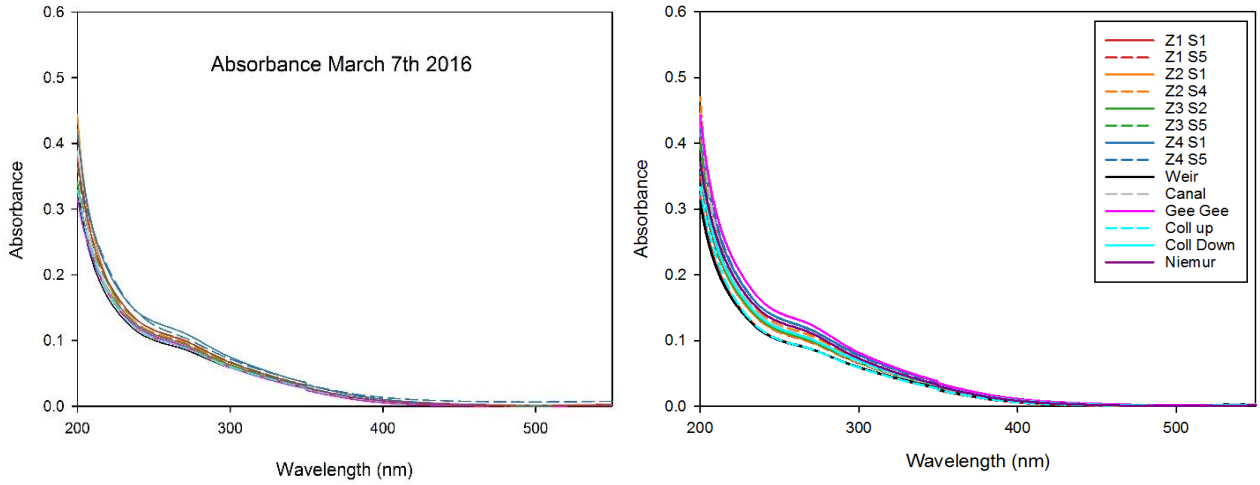

Figure 8. Absorbance scans for water samples taken 7th March (left) and 21st/22nd March 2016 (right).

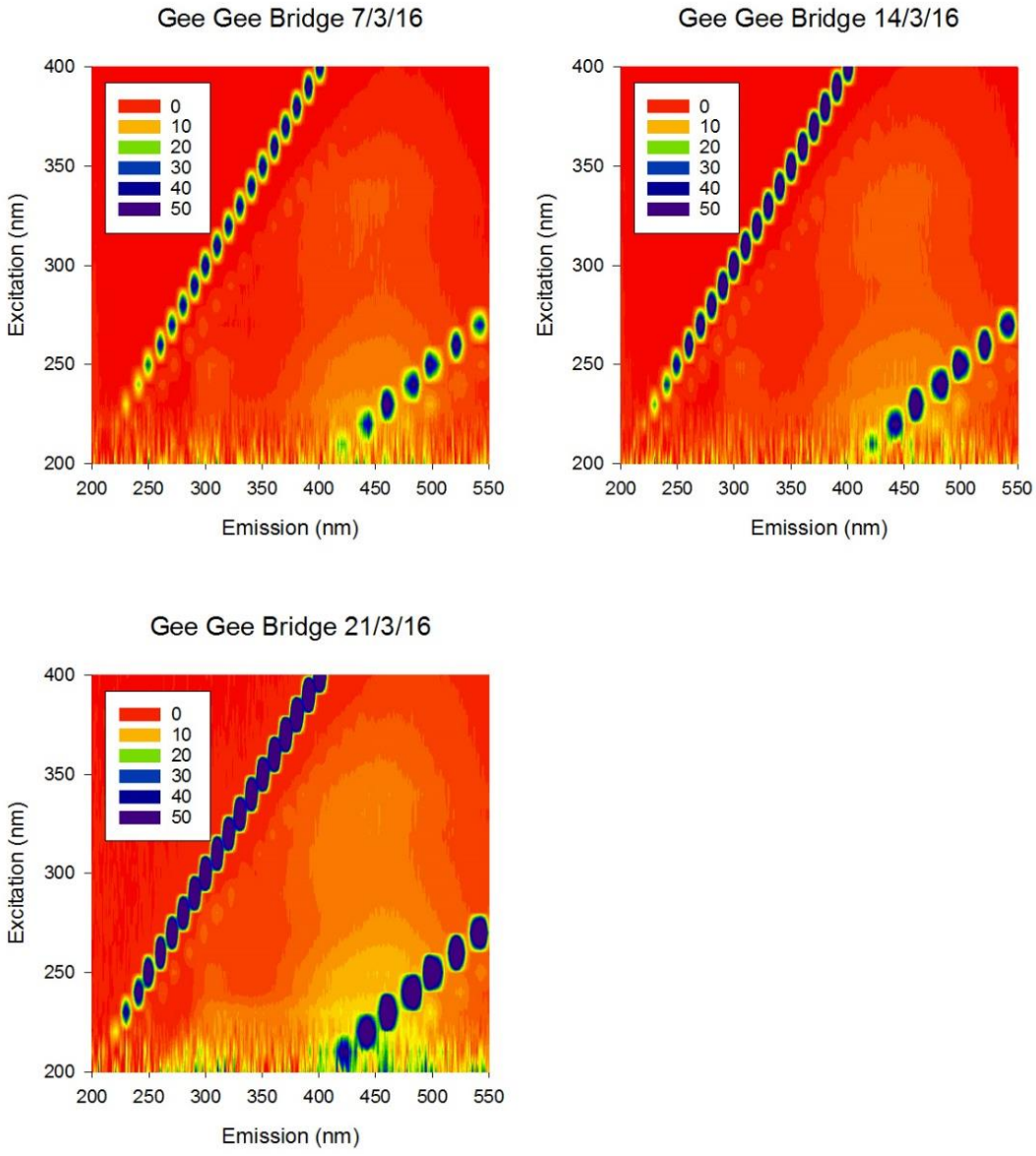

Figure 9. Progressive increase in organic matter fluorescence at the Gee Gee Bridge site over the past three weeks from 7/3/16 to 21/3/16. For interpretation of this figure see explanation in Watts et al (2014).

Comments

- The algal bloom was absent from at Gee Gee Bridge on the Wakool River and Nancurrie Rd Bridge on the Niemur River on 14-15th March but was strongly present at both of these sites on 21st and 22nd March.
- In Yallakool Creek where the water was flowing faster there was no scum present on the surface of the water. Visual assessment suggested the algal count was lower in Yallakool Creek than in the upper Wakool River zone 2 where the water was flowing very slowly, despite these two sites having the same source water. This could be due to the algae not being able to maintain their position at the top of the water column in the faster flowing water in Yalakool Creek. Also the turbulence of the faster flowing water may prevent the establishment of a very thin warm layer of surface water which would slow the growth of the cyanobacteria because they can reproduce faster in warmer water.
- The lighter green colour of the water in Stevens Weir and Yallakool Creek this week compared to samples collected last week suggest that the algal concentration is starting to reduce at those sites (to be confirmed when total algal count data is finalised). The water was very strongly green in the mid Wakool River site at Gee Gee Bridge and the Niemur River site at Nancurrie road suggesting the bloom is at higher levels in the mid reaches of these rivers.

Acknowledgements

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