NATIONAL PARKS AND WILDLIFE SERVICE

Restoring Active Raised Bog in Ireland's SAC Network 2016 - 2020

D3 - Discharge and water quality report

1 Contents

Table of Tables

Table of Figures

2 Introduction

The purpose of this document is present a synopsis of the discharge and water quality data collected as part of Action item D3 - Water Chemistry & Climate Change Monitoring and recommendations for future work.

2.1 Water Quality Monitoring

2.1.1 Manual Water Quality Sampling summary

The LIFE project has monitored discharge water quality on 6 sites since September 2019. Manual grab are collected on the same schedule as the monthly dipping of groundwater levels collected under Action item D1. Samples have been analysed by an external laboratory for the 14 parameters shown in Figure 1 and Table 1. The six sites: Carrowbehy Bog SAC, Carrownagappul Bog SAC, Clara Bog SAC, Garriskil Bog SAC, Ferbane Bog SAC and Killyconny Bog SAC were selected as suitable monitoring locations existing with large upstream catchments where works were proposed. The timing of the sample was also selected for reasons of convenience. Consequently, the data set cannot be considered a truly random sample.

None of the inorganic nutrient parameters are present in significant concentrations with Ammoniacal Nitrogen the only nutrient parameter to exceed 1.5 mg/l in the data set. This implies that nitrogen and phosphorous are present mainly as organically bound molecules and are not immediately bio-available. It would also indicate that Total Nitrogen and Total Phosphorous should be principally correlated with Colour in the discharge. However, some 27% of Total Nitrogen values were below the detection limit of 0.5 mg/l and 65% of the Total Phosphorous values were below the detection limit of 0.05 mg/l and it is not possible to test this hypothesis with the available. The low concentration levels encountered have resulted in a sparse data set. This has been compounded by the disruptions to the sampling programme due to Covid-19 restrictions.

TOC and DOC are approximately equal for all sites and monthly intervals, implying that POC is a negligible component in the discharge from the 6 sites. The data does not show a trend in DOC, TOC or Colour, and the concentrations, though the break in the time series due to the Covid 19 lockdowns has complicated analysis of trends in the data set.

Some summary statistics are provided in Table 1. Note that these statistics have been derived by dropping rows that contained non-numerical data i.e results that were below detection limits. Figure 1 provides a visual indication of the distribution of values for each of the parameters for which predominantly numerical rather than categorical data is available. It is interesting to note that the KDE plots on the diagonals indicate that a log-normal distribution would be an appropriate model for the concentration data. However, given the limitations of the data set and the absence of true random sampling due to resource constraints, it would be misleading to quote inferential statistics derived from the current data set.

Figure 1: Water quality Matrix Scatter Plot with Kernal Density Estimator plots on Diagonal)

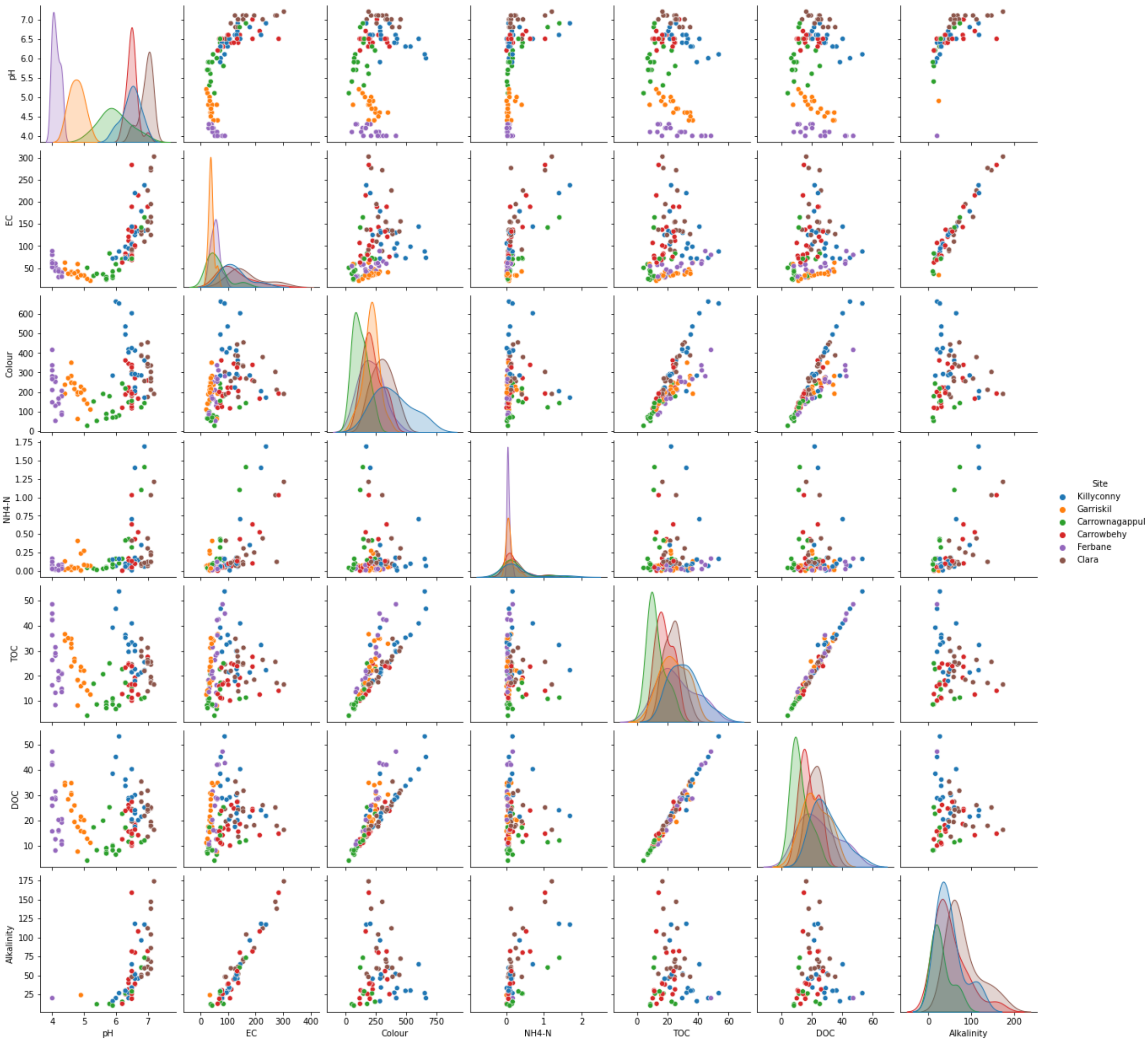


Table 1: Water Quality Analysis Parameter's Monthly descriptive statistics

Parameter	count	mean	std	min	25%	50%	75%	max
pH	112	5.78	1.06	4	4.775	6.25	6.6	7.2
EC	112	92.74	63.33	21	42.1	72.5	131.5	303
Total Nitrogen	112	0.97	0.50	0.5	0.5	0.8	1.3	3.0
TKN	112	0.87	0.48	0.2	0.5	0.7	1.0	2.9
PO4	112	0.02	0.04	0.0	0.0	0.0	0.0	0.2
PO4-P	112	0.01	0.01	0.0	0.0	0.0	0.0	0.1
Total P	112	0.09	0.15	0.1	0.1	0.1	0.1	1.3
Organic P	19	0.22	0.34	0.0	0.0	0.1	0.2	1.3
NO3	112	0.72	0.81	0.4	0.4	0.4	0.4	5.0
NO2	112	0.02	0.02	0.0	0.0	0.0	0.0	0.2
Colour	112	239.83	124.55	26.7	158.5	216.5	294.5	664
NH4-N	112	0.19	0.31	0.0	0.0	0.1	0.2	1.7
TOC	112	22.40	10.01	4.2	15.7	21.6	27.9	53.6
DOC	112	21.64	9.73	4.3	14.8	20.3	27.4	53.2
Alkalinity	65	55	37.76	10.2	26.6	48	70.8	174

2.2 Discharge Monitoring and FDOM sensors

The Living Bog project has installed FDOM sensors on Carrownagappul and Ferbane to monitor Dissolved Organic Carbon (DOC) fluctuations. These sensors also monitored stage, pH, EC, and Temperature at 15-minute intervals on both sites. A flume has been installed on Carronagappul while a compound weir constructed from a corrugated plastic sheet has been installed on Ferbane.

2.2.1 Carrownagappul Discharge Monitoring

A Manta 2 unit was deployed at a flume on Carrownagappul in late July 2019. It developed a mechanical fault that was detected in April 2020 and was returned to the UK for repair and calibration of the FDOM sensor. Covid restrictions resulted in significant delays in the repairs and the units were not received back from the UK until Late July 2020, and the unit was re-deployed at the Flume in August 2020.

The Manta 2 unit records a depth, calculated by converting the pressure reading P_S from the unit's piezometer into a head measurement. Measurements in the field indicate that the centre line of the pressure port on the Manta 2 unit is installed 4 cm below the invert level of the flume. This datum offset induces a systematic error in depth values recorded by the manta 2 unit of – 4 cm. Thus a datum offset constant of -4 must be added to the water head to convert the reading to a stage at the measuring section.

Figure 2 shows the discharge hydrograph for the Carrownagappul flume obtained from the application of these relationships. The discharge hydrograph has been combined with the cdom concentration data to develop load graphs for the mass flux of cdom from the site over time, shown in Figure 3: Carrownagappul CDOM Load graph Time Series.

Figure 2: Carrownagappul 15-minute Discharge Hydrograph

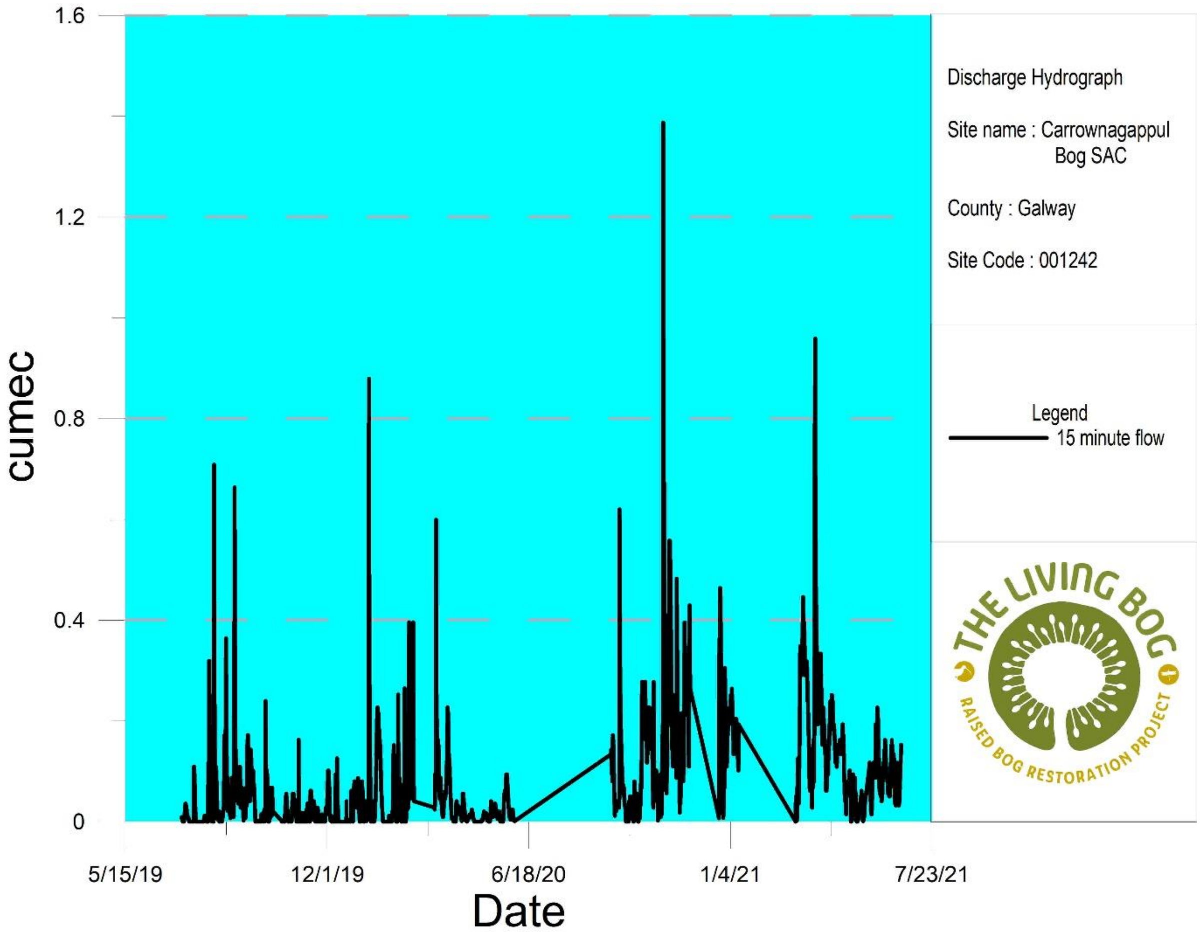
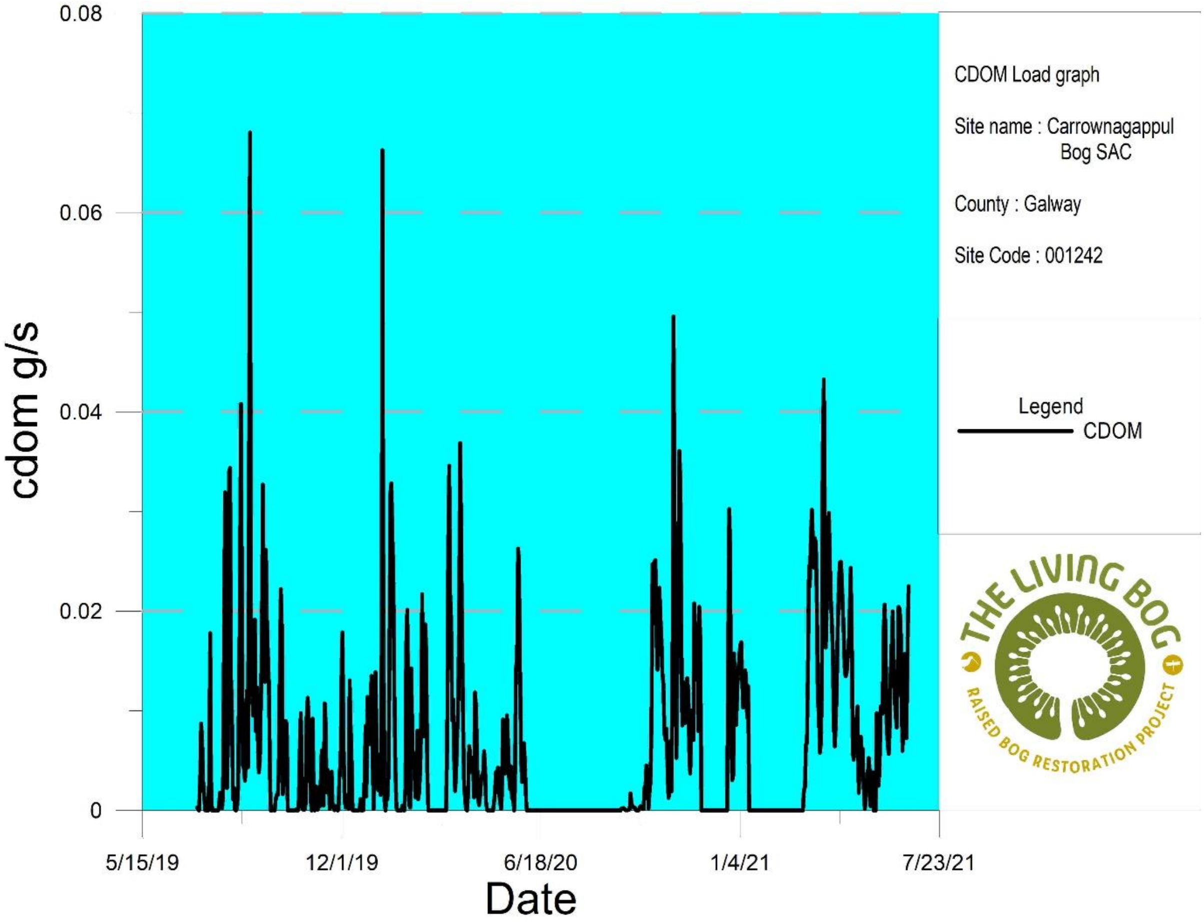


Figure 3: Carrownagappul CDOM Load graph Time Series



2.2.2 Ferbane Discharge Monitoring

Discharge at the compound weir in Ferbane was logged at 15-minute intervals from 18/04/2019 to 22/01/2020 using Solinst Level Logger Serial Number 2069557. The Level logger was replaced by the Manta 2 Unit. A communications fault with the Manta 2 unit was detected in early February 2020 that required the unit to be returned to RS Hydro in the UK for fault diagnosis and repair. A faulty block connector was replaced under warranty. The unit was received back from the UK in mid-March 2020 and was redeployed in April 2020, coinciding with the early stages of the COVID-19 restrictions. The unit developed a second fault that was detected at the end of April 2020. This fault was due to faulty caps supplied with the unit. Again, the unit had to be returned to the UK for repair under warranty.

The available stage data for Ferbane has stage data that has not been converted to a discharge hydrograph or DOC and should be completed as part of the AfterLIFE project when longer-term datasets are available.

2.3 Recommendations for future discharge/water quality monitoring

Due to delays experienced in the design phase, the flumes weren't installed in time to obtain data over a full hydrological year prior to restoration, limiting the comparison that could be completed with post-restoration data. However, the flume can still provide long-term datasets that improve our current understanding of peatland hydrology and hence continued monitoring of these stations has been included in the AfterLIFE plan charge.

It is not recommended that the water quality monitoring is continued on the LIFE project sites as a full year of baseline measurements could not be obtained due to delays in establishing suitable monitoring locations that would accurately characterise the impact of restoration within the peatland catchment. The lessons learned during the LIFE project have been incorporated into current best practice guidance and provide recommendations for future projects to ensure sufficient baseline data is collected prior to restoration to enable statistical comparison of the datasets post-restoration. This will enable sufficient data to be obtained to accurately characterise the impact peatland restoration has had on water quality and peatland discharge.