P2022004: Creag Riabhach Wind Farm Extension Technical Appendix 7.2

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Submission Date

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Creag Riabhach Wind Farm: 2019 Preconstruction fish and invertebrate surveys for Creag Riabhach Windfarm

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1. Introduction

1.1. Background

In 2018, an updated Fishery Management Plan[1] (FMP) based on an agreed format was presented within the "Creag Riabhach Windfarm; Windfarm construction and operational Fish Management plan", produced by Caledonian Conservation (McDermott, 2018). This document presented the background, methodology, results and interpretations of the FMP required under the Planning Permission conditions and used aquatic communities to monitor potential impacts of construction and operation of the Creag Riabhach Wind Farm (CRW) on aquatic receptors.

As part of this document, baseline biological standards were produced to assist with construction and operational monitoring. These standards were produced by developing measures of multi-year ecological quality (measured by density, community composition and metric scores), using historic data provided by local District Salmon Fishery Boards.

However, the 2018 FMP document was produced in the expectation of construction beginning in 2019. When it became clear that work would not begin until 2020, further surveys to support the ecological baselines were planned. Historic data were not present for any of the ten macroinvertebrate sites, and for one electrofishing site (ST09[2]). Therefore, these sites, initially sampled in 2018, were to be surveyed again in 2019 and added to the baselines.

1.2. Purpose of this document

This document presents the results of the 2019 surveys for Benthic Macroinvertebrates (BMI) from ten sites and the fish results from ST09. These data are then used to develop and present an average site condition for the receptor in question, against which future monitoring results should be compared. This document is not to be used in isolation and should be used in conjunction with the 2018 document.

1.3. Project area

The locations of the biological monitoring sites are shown below in Figure 1.1, with site detail and British National Grids (BNGs) presented within the FMP.

[1] Although termed an FMP, the plan will allow monitoring for pressures that could potentially impact a wide range of aquatic ecology receptors.

[2] Note ST09 nomenclature reflects the proposed site naming convention within the 2018 report, and not the site name used by KOSFT.

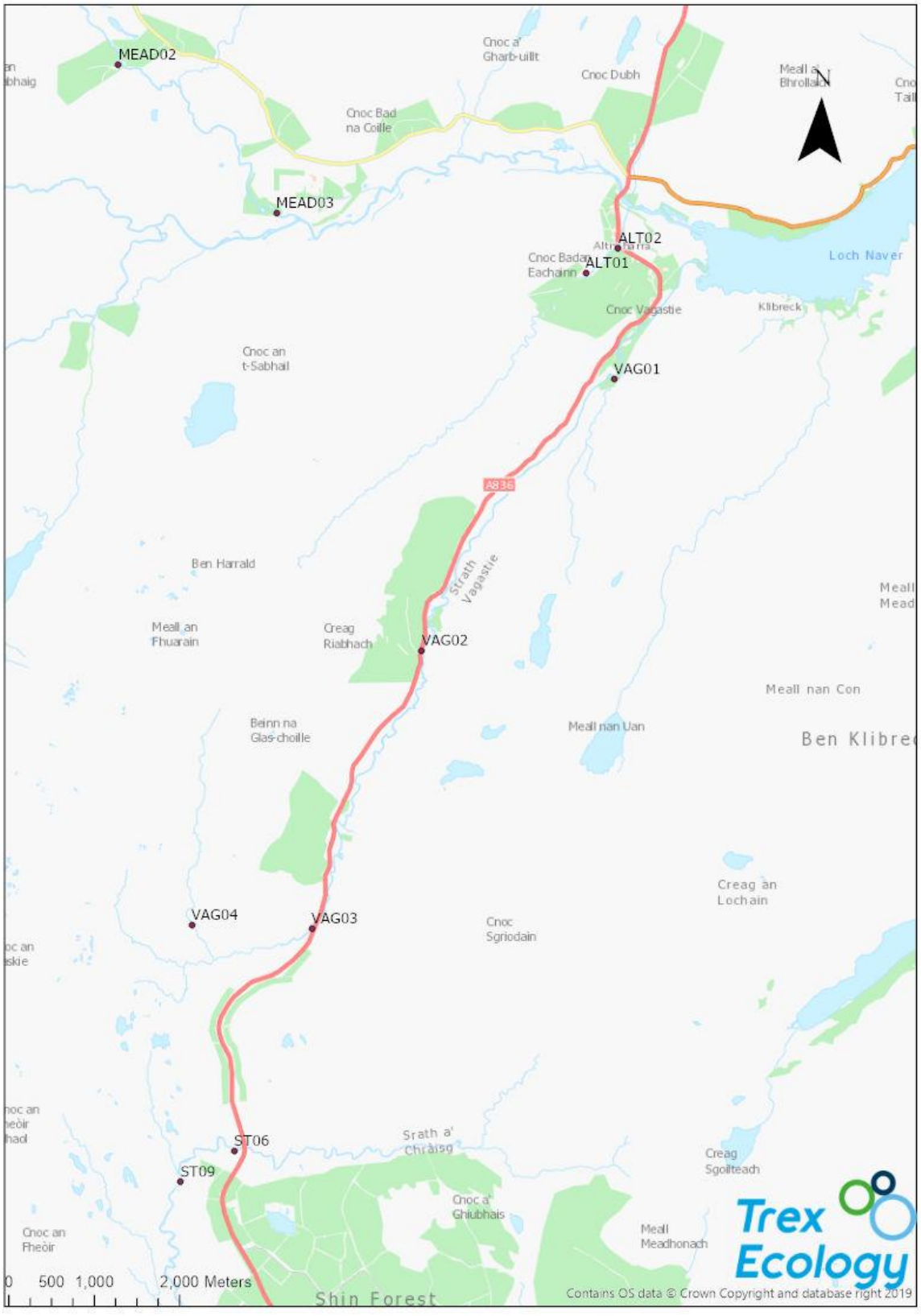

Figure 1.1. Location of biological monitoring points

2. Approach

2.1. Fish survey

Electrofishing at ST09 was carried out on the 3rd of October 2019 by the KOSFT.

Standard electrofishing Standard Operational Protocols (SOPs) in Scotland are well established by the SFCC[3][4][5] (e.g. Anon.2019). In a change from the 2018 FMP, these protocols are now available on the Scottish Government website via the SFCC (see footnotes 3-5). However, they have been re-written expressly for the National Electrofishing Programme in Scotland (NEPS) system, and therefore some information may be unnecessary or contraindicative for the purposes of the CRW FMP. The detailed sampling procedure from the FMP should be followed.

As it is normally impossible to capture all the fish in a delineated area, no matter how many times it is electro-fished, a depletion method was used which involves a successive number of electrofishing runs of the same area. An estimate of the site population density with confidence limits is then made using the Zippin Model for juvenile salmonid fry (first year fish) and parr (1 year or older). Using the SFCC protocol ensures that the assumptions of the Zippin Model are followed, which includes making sure there is equal probability of capture in each run and the probability of fish capture does not vary between runs.

A three-person team of one team leader and two trained staff were used for sampling and processing. An approximate minimum area of 100m^2 was electro-fished, with the section delineated using top and bottom stop nets to prevent migration of fish in or out of the site. The processing and bankside electro-fishing equipment was then set up and a smooth voltage setting chosen that is appropriate to the conductivity of the water.

Electro-fishing started at the downstream end of the site, methodically covering the entire area, following the requirement for equal sampling effort throughout the site. Due to the potentially high number of fish that could be present, a banner net was used to capture fish each time the probe is energised. All fish species were captured and taken for processing rather than selective capture of a particular species.

Once an electro-fishing run was completed, fish were processed following the standard fish handling method. When the electro-fishing has been completed for the three runs, habitat features were then recorded by the team leader.

2.2. Benthic Macroinvertebrate Survey

All ten macroinvertebrate sites were surveyed on the 23rd and 24th of September. River flows were very low, and conditions were warm and clear. Details of the sampling methodology and supporting information are presented in the 2018 FMP.

[3] Summary webpage of protocols here: https://www.sfcc.co.uk/resources/more-protocols.html
[4] SOPs here: https://www2.gov.scot/Topics/marine/Salmon-Trout-Coarse/Freshwater/Monitoring/ElectrofishingProgramme/SOPs
[5] Note data entry protocol refers to the national database and should not be used for CRW data

BMI surveys consisted of three-minute kick with two 30 second visual searches. The survey location was sampled in an upstream direction with the operator agitating the substrates using kicks. A sample net was drawn behind the kicking leg, capturing invertebrates dislodged from the substrate into the water column. For flow biotypes of lower energy or where vegetation is present, the net was actively swept. Fine sediments and organic particles were removed from the net by washing the net in the stream. A one-minute visual search of larger littoral boulders and bedrock provided additional information on habitats which cannot be kicked.

Samples were stored in ethanol for transport. The site code was written on the lid and recorded on waterproof paper stored within the pot.

These samples take the form of obtaining a semi-quantitative count and diversity of benthic macroinvertebrates and were analysed to Taxonomic Level (TL2), which is generally termed Family level. These samples were then used to create several metrics related to the Biological Monitoring Working Party (BMWP) system, namely the BMWP score, the Number of TAXA (NTAXA) and the Average Score Per Taxon (ASPT). These scores are generally linked to water quality effects but do also provide a general idea of ecological water quality and habitat conditions.

3. Results

3.1. Fish

Brown trout and salmon were recorded at ST09 and densities of fish are presented in Table 3.1.

Table 3.1. Fish densities (fish /100m^2) for Atlantic salmon (AS) fry (0+) and older (>0+) and brown trout (BT) fry and older. Underline = Minimum Density Estimate

Site	area	0+ AS	>0+ AS	0+ BT	>0+ BT
ST09	155.80	0	5	7	4

No salmon fry were recorded in 2019, in common with 2018, although trout fry were present after being absent in 2018. Densities of older salmon fry were much reduced when compared with 2018, while trout numbers increased. The density and composition of the fish community suggest that spawning is rare at the site, and it may be more appropriate as parr[6] habitat.

3.2. Benthic Macroinvertebrates results

The calculated metric results for each site are presented below in Table 3.2., while the community compositions are presented in Appendix A.

Table 3.2. BMI calculated metrics from the ten monitoring locations

Site	ASPT	Biotic Score	NTAXA
ALT01	6.82	116	17
ALT02	6.81	109	16
MEAD02	7.87	118	15
MEAD03	7.25	58	8
VAG01	6.79	95	14
VAG02	6.20	62	10
VAG03	7.08	85	12
VAG04	7.27	109	15
ST06	6.93	97	14
ST09	6.69	87	13

Biotic score is the sum of scores of the observed taxonomic groups from the sample. This is then divided by the number of taxa encountered (NTAXA) to provide the Average Score Per Taxon (ASPT). ASPT scores of 6 and above are generally considered to be high quality and composed of groups that are intolerant of poor water quality (i.e. found in very clean water). However, NTAXA identifies the biodiversity of the site, and therefore habitat quality. NTAXAs of over 15 are likely to represent good community structure in Northern Scotland. Therefore, in general these results suggest that the sites have excellent water quality, but some may have reduced habitat quality or presence in 2019.

[6] Parr are juvenile salmon and trout which have spent at least one winter in the river.

3.3. Additions to baseline monitoring standards

Fish

Although all other electrofishing sites have three year's baseline data, ST09 only has two. Therefore, the baseline here may be less certain than for other sites, however it is still more robust than using a single year's data as a baseline. For ST09, the average values and standard errors for salmon and trout fry and older to be used for comparison with future monitoring data are shown below in Figure 3.1. Values are presented in Appendix B.

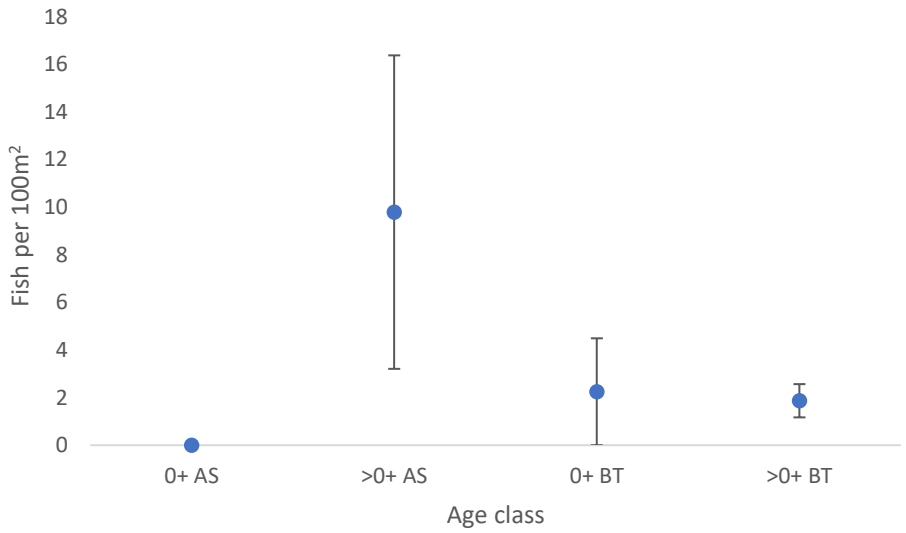

Figure 3.1. Summary chart of average fish density and standard error for salmon and trout fry and older fish at ST09, from data collected in 20018 and 2019

Data from ST09 present an image of an unproductive and unstable site. This may present issues when using this information as per the recommendations within the FMP, which is to investigate more fully any results from construction and post construction surveys which suggest densities are falling below the standard error range of the baseline values. Therefore, any changes to ST09 which meet that criteria should be subject to expert review.

Macroinvertebrates

Two-year baselines for each macroinvertebrate site are presented in Figures 3.2 to 3.4. These charts show the 2-year average value for each metric with standard error bars, as per the baselines established for the fish communities (but using two rather than three years data). Values in table form are presented in Appendix C.

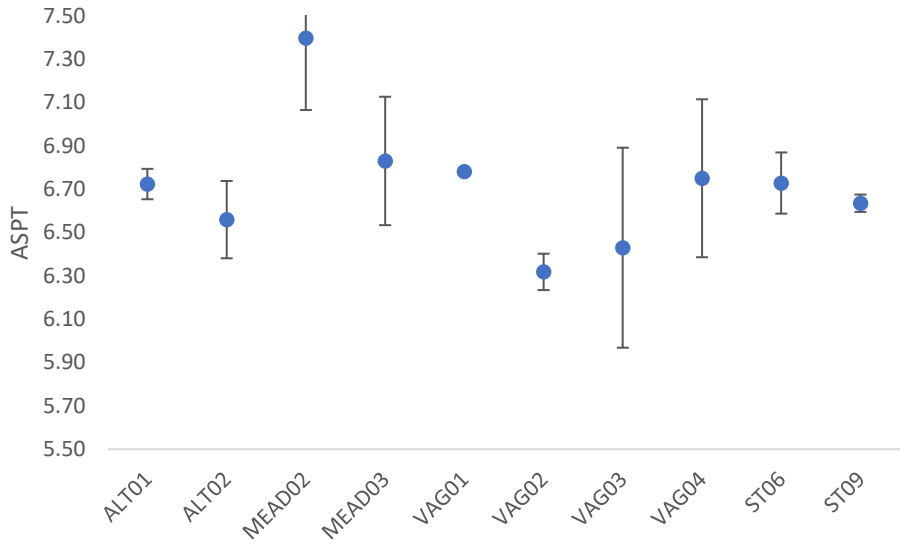

Figure 3.2. Summary chart of average ASPT values with standard error from data collected in 2018 and 2019

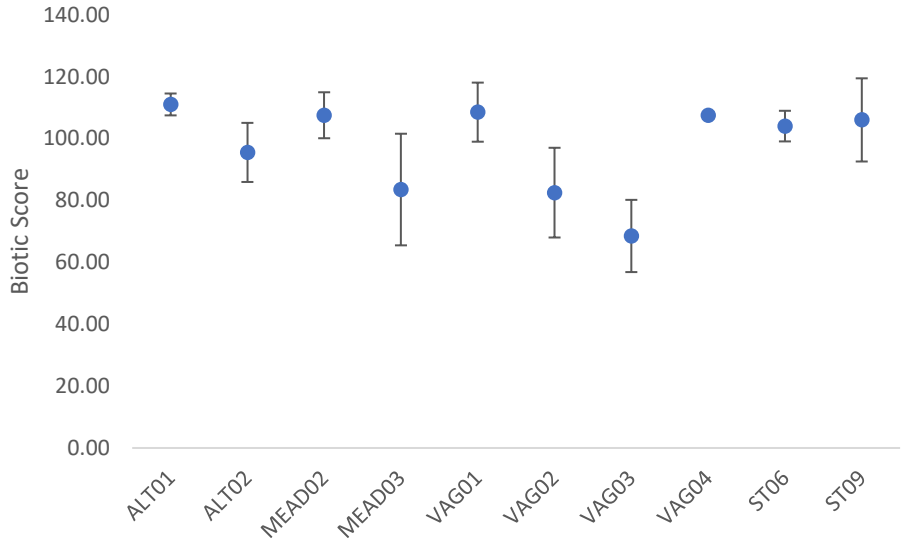

Figure 3.3. Summary chart of average Biotic Score values with standard error from data collected in 2018 and 2019

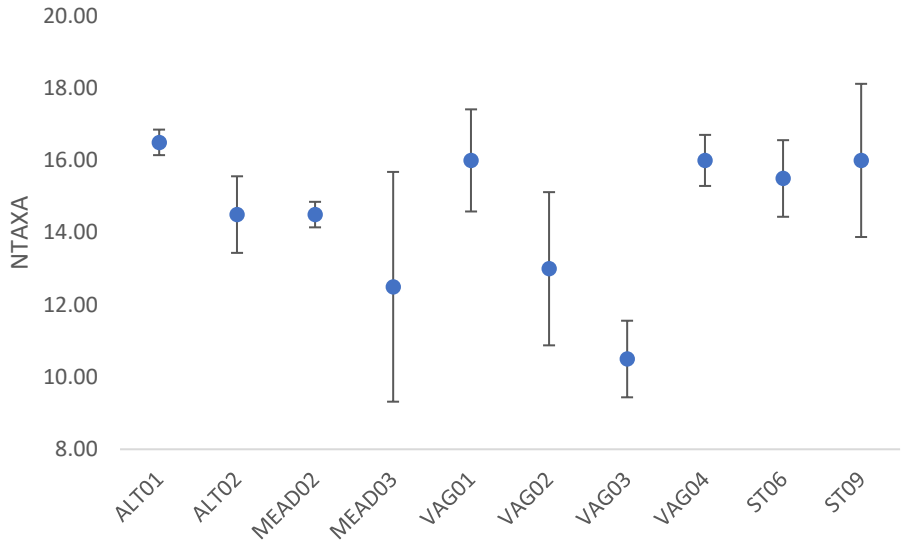

Figure 3.4. Summary chart of average NTAXA values with standard error from data collected in 2018 and 2019

These data should be used in a fashion similar to fish data; any results that sit outside the standard error values for each metric at each site from surveys collected during construction and operational phases will warrant a further investigation. This investigation should involve checking of other factors which may have resulted in the vagrant result, and discussion with the local Fishery Board. If no satisfactory "other" explanation can be made, then the potential of the Creag Riabhach Wind Farm having caused the change should be explored. **This replaces the 15% change approach proposed within the 2018 construction and operational FMP. This provides a more robust long-term approach to site monitoring when compared with the 15% method proposed in 2018; however, it should be subject to regulator approval as per the 2018 document.**

4. Discussion

4.1. Document use and limitations

This document should be used in conjunction with the 2018 construction and operational FMP. The data from ST09 presented here will sit with the fisheries data from the 2018 document, while the BMI data here adds to and replaces the proposed approach for using BMIs to monitor potential impact within the 2018 document.

The data presented here, especially in relation to ST09, do highlight the potential pitfalls of using baselines which represent only relatively minor timeframes and potentially suffer from excessively large or small variances, so all data collected in future should be analysed by a suitably qualified ecologist.

4.2. 2020

A full suite of electrofishing and BMI surveys should be carried out in 2020 in late summer/early autumn (as in 2018 and 2019 as the first stage of construction monitoring. This data should be processed and analysed using the methods presented here and within the 2018 document.

5. References

Anon. 2019. *National data collection protocols.* Scottish Government. 9pp.

McDermott, T. 2018. *Creag Riabhach Windfarm; Windfarm construction and operational Fish Management plan*. Technical report prepared for Caledonian Conservation Ltd.

Appendix A Macroinvertebrate community composition 2019

BMWP	Taxa	MEAD02	ALT01	VAG02	VAG04	MEAD03	ALT02	VAG01	VAG03	ST09	ST06
6	Ancylidae									1	
4	Baetidae	4	5	2	12	4	7	5	6		2
10	Brachycentridae	1									1
10	Capniidae		2		2	1			2		1
2	Chironomidae		6	1	2	2	8	4			1
10	Chloroperlidae	1	2		3		3				
8	Cordulegastridae						1				
5	Dytiscidae									1	
5	Elmidae	1	19	4	8		10	4		31	28
10	Ephemerellidae	1									
5	Gyrinidae			1				1			
10	Heptageniidae	20	11	1	14	3	20	23	2	5	5
5	Hydrophillidae		1						1		
5	Hydropsychidae	6	2	1	3	11	1	12	2	5	3
6	Hydroptillidae								3	2	6
10	Leptophlebiidae	1	3				2			1	
10	Leuctridae	6	4	1	12		5	5	7	12	2
7	Limnephilidae				1						
7	Nemouridae	1	7		1			8	1	2	4
1	Oligochaeta		3				2		1	3	7
10	Perlidae	1						1			

BMWP	Taxa	MEAD02	ALT01	VAG02	VAG04	MEAD03	ALT02	VAG01	VAG03	ST09	ST06
10	Perlodidae	7	1		6	2	1	5	3	2	1
7	Polycentropodidae			3	4		5	1	3	2	
7	Rhyacophilidae	2	1		1	1	2				2
5	Scirtidae	18	9				2	2			
4	Sialidae			1							
5	Simuliidae							4			
10	Taenopterygidae		4	2	3	2	8	4	1		2
5	Tipulidae	1	1		3		1			1	
	NTAXA	15	17	10	15	8	16	14	12	13	14
	BMWP	118	116	62	109	58	109	95	85	87	97
	ASPT	7.87	6.82	6.20	7.27	7.25	6.81	6.79	7.08	6.69	6.93

Appendix B ST09 fish population variance values 2018-2019

Excessive variation values are shown in red

Class	Density	SE	SD	CoV
0+ AS	0	-	-	-
>0+ AS	9.79	6.59	9.31	95.08
0+ BT	2.25	2.25	3.18	141.42
>0+ BT	1.87	0.70	0.99	52.88

Appendix C BMI community metric variances 2018-2019

ASPT				
Site	**Mean**	**SE**	**SD**	**CoV**
ALT01	6.72	0.07	0.14	2.09
ALT02	6.56	0.18	0.36	5.44
MEAD02	7.40	0.33	0.66	8.97
MEAD03	6.83	0.30	0.59	8.68
VAG01	6.78	0.00	0.01	0.08
VAG02	6.32	0.08	0.17	2.66
VAG03	6.43	0.46	0.92	14.36
VAG04	6.75	0.36	0.73	10.80
ST06	6.73	0.14	0.28	4.19
ST09	6.64	0.04	0.08	1.21

Biotic Score				
Site	**Mean**	**SE**	**SD**	**CoV**
ALT01	111.00	3.54	7.07	6.37
ALT02	95.50	9.55	19.09	19.99
MEAD02	107.50	7.42	14.85	13.81
MEAD03	83.50	18.03	36.06	43.19
VAG01	108.50	9.55	19.09	17.60
VAG02	82.50	14.50	28.99	35.14
VAG03	68.50	11.67	23.33	34.06
VAG04	107.50	1.06	2.12	1.97
ST06	104.00	4.95	9.90	9.52
ST09	106.00	13.44	26.87	25.35

NTAXA				
Site	**Mean**	**SE**	**SD**	**CoV**
ALT01	16.50	0.35	0.71	4.29
ALT02	14.50	1.06	2.12	14.63
MEAD02	14.50	0.35	0.71	4.88
MEAD03	12.50	3.18	6.36	50.91
VAG01	16.00	1.41	2.83	17.68
VAG02	13.00	2.12	4.24	32.64
VAG03	10.50	1.06	2.12	20.20
VAG04	16.00	0.71	1.41	8.84
ST06	15.50	1.06	2.12	13.69
ST09	16.00	2.12	4.24	26.52