



JNCC/Cefas Partnership Report Series

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East of Haig Fras MCZ: Sea-pen and Burrowing Megafauna Communities: Quality Assurance

Hawes, J.

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1 Introduction

East of Haig Fras (MCZ) is part of a network of sites designed to meet conservation objectives under the Marine and Coastal Access Act (2009). These sites will also contribute to an ecologically coherent network of Marine Protected Areas (MPAs) across the North-east Atlantic, as agreed under the Oslo Paris (OSPAR) Convention and other international commitments to which the UK is signatory.

The Joint Nature Conservation Committee (JNCC) and the Centre for Environment, Fisheries and Aquaculture Science (Cefas) have conducted three surveys aboard RV *Cefas Endeavour* (CEND0312, CEND0513 and CEND0915) to gather evidence and to monitor East of Haig Fras Marine Conservation Zone (MCZ) and to inform assessment of condition of the designated features of the sites (Eggleton & Downie 2017). The 2015 monitoring survey (CEND0915) found indicative evidence of the presence of Sea-pen and burrowing megafauna within the site (Callaway 2015).

Sea-pen and burrowing megafauna communities (SPBMC) is a habitat Feature of Conservation Importance (FOCI) listed on the Ecological Network Guidance for Marine Conservation Zones in England. The feature is defined using the OSPAR definition and consists of plains of fine mud between 15-200m deep "...which are heavily bioturbated by burrowing megafauna with burrows and mounds typically forming a prominent feature of the sediment surface..." (OSPAR 2010). JNCC have suggested additional recommendations which are useful when classifying Sea-pen and burrowing megafauna communities, notably that while burrowing megafauna are essential, sea-pens may or may not be present; the feature can occur in subtidal areas; and the feature can occur in sandy or fine muds (JNCC 2014).

JNCC are in the process of analysing the videos from the CEND0915 survey in house to verify the presence and extent of this habitat. This report presents the findings of an external quality assurance (QA) analysis undertaken on the outputs of JNCC's analysis of camera tow video footage, collected on the CEND0915 survey within East of Haig Fras MCZ. This QA analysis follows the same protocol as developed by JNCC for the assessment of presence/absence and extent of the Sea-pen and burrowing megafauna habitat within this designated MCZ.

1.1 Aims and objectives

1.1.1 Report aims and objectives

The primary aim of this Quality Assurance report is assess the accuracy of the macrofaunal burrow enumeration analysis, undertaken by JNCC on video data acquired on the CEND0915 cruise, within the East of Haig Fras MCZ.

To meet the overall aim of this request, the objectives are to:

1. Analyse 10% of the video transects data using the JNCC protocol (see Annex 1).
2. Compare results with JNCC results using a Bray-Curtis similarity index, noting discrepancies and any comments you may wish to make on the data.
 - i. A grade will be applied (Excellent match – Poor match) on a video segment and still image basis using a grading system related to the untransformed Bray-Curtis scores.
 - ii. Further investigation to be undertaken on any transect comparisons which score below the "Acceptable match" threshold.

3 Results

Figure 1 presents an overview of the segment vs segment similarities between initial analysis (blue) and QA analysis (red) for all samples (i.e. not only matching pairs), using Bray-Curtis similarities and nMDS ordination. The ordination indicates that there is no visually apparent separation between similarities calculated from initial and QA analysis.

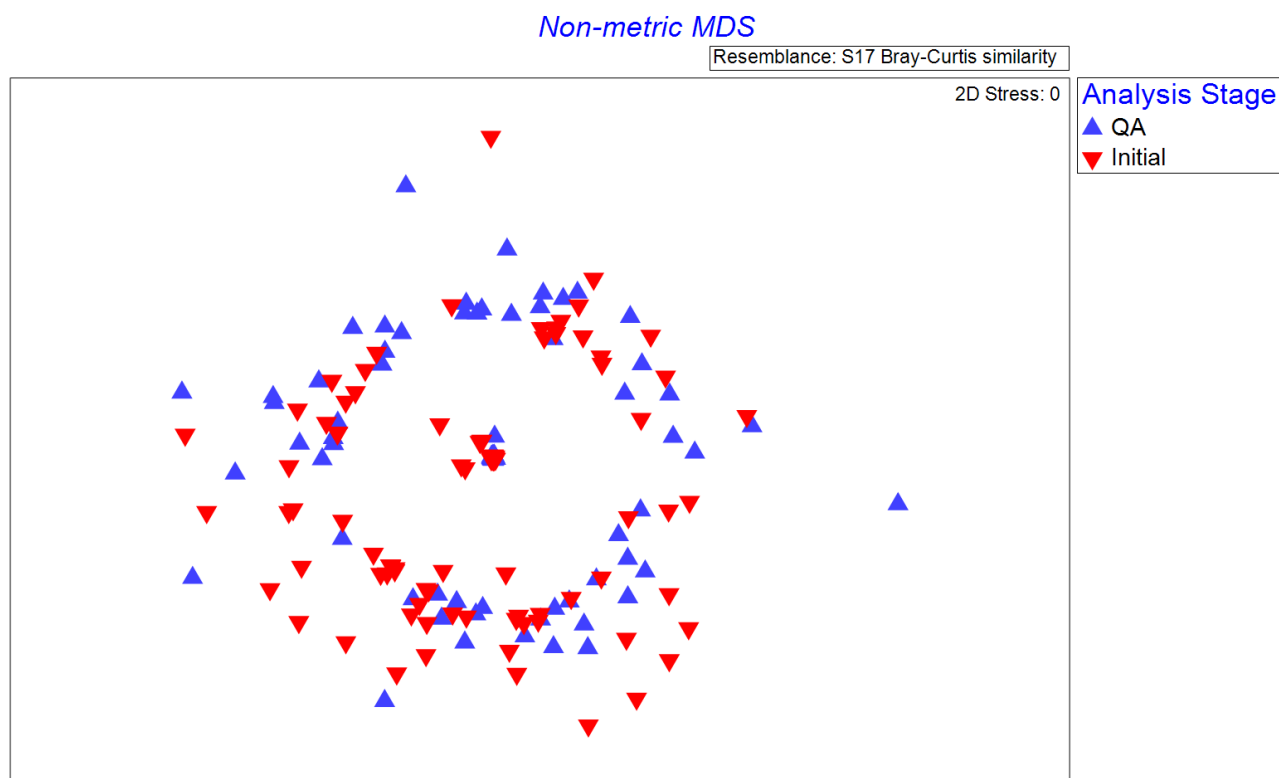


Figure 1. nMDS ordination of segment vs segment Bray-Curtis similarities, with analysis stage overlain.

Figure 1 is of use in determining overall similarity in comparison of initial and QA analyses, however is of limited use in determining accuracy of enumeration by segment and transect. As such, the segment vs segment similarity scores (matching pairs only) were averaged for each transect. The individual segment vs segment scores are displayed in Annex 1., whilst the transect averages (as a more useful metric for assessment of accuracy, are displayed in Table 2.

Table 2. Showing the averaged similarities between transects across Initial and QA analyses (scores of less than “Acceptable – 70%” are displayed in red).

Transect Number	Average Similarity
EHGF105	70.6
EHGF236	81.97
EHGF238	61.72
EHGF067	84.82
EHGF048	94.27
EHGF125	85.61
EHGF255	69.37
EHGF017	84.46

From Table 2 it can be seen that there was, overall, a good degree of agreement between Initial and QA analyses, with 5 out of the 8 transects showing a “Good” or “Excellent” similarity score. One transect (EHGF105) scored “Acceptable”, and another (EHGF225) scored 69.37% - a value so close to the threshold for “Acceptable” that it is considered within this category.

As such, only one transect (EHGF238) scored significantly lower than the threshold for “Acceptable”, with a score of 61.72%. This discrepancy was further investigated by calculating the mean squared error (MSE) between counts from each analysis stage; both overall (a pooled MSE from all segments) and for each transect. MSE was calculated for each variable (burrow size category).

Table 3. Showing calculated Mean Squared Error values for each transect, for each size category of burrows.

<i>Transect</i>	<i>Variable</i>	<i>Cumulative Count</i>	<i>MSE</i>
EHGF017	Burrows <3cm	339	20
	Burrows >3cm	9	0
EHGF048	Burrows <3cm	104	2
	Burrows >3cm	5	0
EHGF067	Burrows <3cm	14	1
	Burrows >3cm	1	0
EHGF105	Burrows <3cm	181	3
	Burrows >3cm	3	0
EHGF125	Burrows <3cm	19	0
	Burrows >3cm	0	0
EHGF236	Burrows <3cm	53	1
	Burrows >3cm	14	0
EHGF238	Burrows <3cm	354	21
	Burrows >3cm	97	15
EHGF255	Burrows <3cm	21	1
	Burrows >3cm	7	0

Overall, a low overall MSE was calculated for both categories (and MSE of 6 for Burrows <3cm and MSE of 2 for Burrows >3cm). The calculated MSE values for each transect are displayed in Table 3.

The highest MSEs are associated with transect EHGF238, as expected from the Bray-Curtis similarity analysis – however a high MSE of 20 is noted at EHGF017 (which scored an average similarity of 84.46%). This is a notable mis-match. Table 3 also shows the cumulative counts (i.e. summed across both initial and QA analyses) for each burrow size category at each transect. This can be plotted against MSE to provide an indication of loss of accuracy in response to increased abundance in burrows, as displayed in Figure 2.

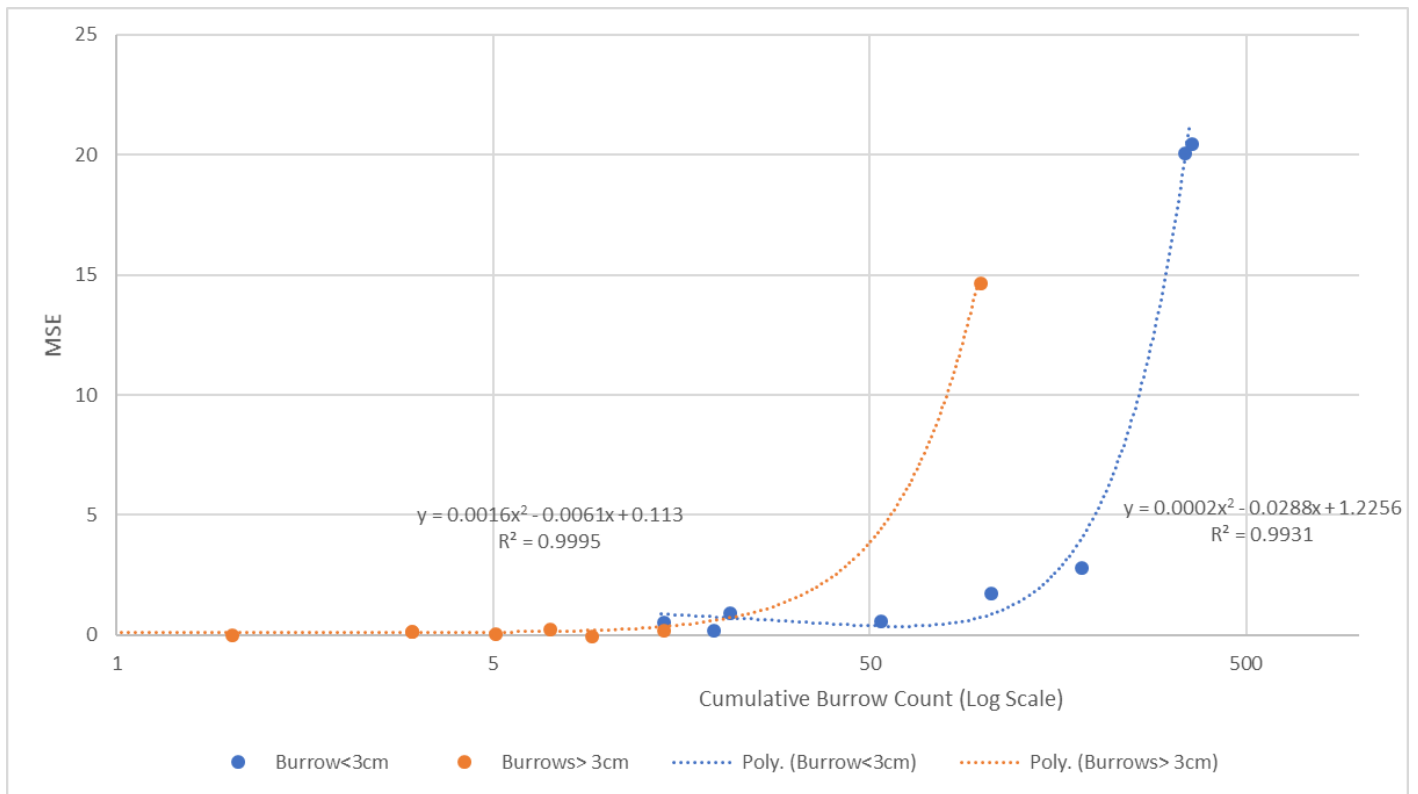


Figure 2. Scatter plot showing cumulative burrow count (Log scale) against MSE. Trendlines have been added using polynomial regression.

The polynomial regression analysis displayed in Figure 2, for each burrow size class, highlights the loss of accuracy in enumeration of both burrow size classes above a cumulative count of ~300 (Burrows < 3cm) and above ~100 for the >3cm class. Strong R^2 values of 0.99 are calculated for each of the curves.

4 Discussion

A generally high level of agreement was seen in comparison of the transect averaged count values (for both burrow size classes) between the initial and the QA analysis, with an average Bray-Curtis similarity score of 79.11%.

Two sites scored lower on the similarity metric than the threshold for “Acceptable” (70%), of these two sites, only EHGF238 was significantly below this threshold. Further investigation into this discrepancy was undertaken using the univariate MSE metric. This metric, with a higher value indicative of lower agreement between initial and QA analyses (displayed in Table 3), also highlighted EHGF238 as having limited agreement. The MSE metric also flagged a potential lower similarity between the initial and QA counts for EHGF017 – this was not highlighted by the multivariate approach.

Direct review of the initial and QA count data for both burrow size classes at transect EHGF238 showed a similarity in overall counts, and the scale of those counts, however the QA analysis noted four segments where no burrows were counted in initial analysis. Further investigation using the MSE metric shows that the major source of discrepancy was, in fact, the error between larger counts of the <3cm class in latter segments of the transect. The QA analysis recorded ~ more burrows in segments 12 and 13, a fewer in segments 15, 16 and 18. As regards the >3cm class, the QA analysis determined considerably more burrows of this size to be present in segments 16 and 17, which contribute the majority of the error. As such, it is considered that size estimation and high burrow abundance are the main drivers of discrepancy seen in this transect.

The source of the high MSE observed between the initial and QA analyses of EHGF017 can be traced to substantially fewer burrows of the <3cm class being enumerated by QA analysis. This transect is located over an area of slightly coarser substrate, with large patches of slightly gravelly, shelly, sand present and a comparatively quick camera tow speed noted. It is considered likely that over enumeration of <3cm burrows in initial analysis is a result of difficulty in differentiating small burrows from discrete grains of gravel / very small pebbles – given the attitude of the camera and speed of tow.

Overall, although generally good agreement between initial and QA analyses validates the enumeration methodology, there is some degree of inherent error observed - as emphasised by Figure 2. It is possible to infer a likely limitation in the enumeration method with increasing burrow abundance, which is especially marked in the case of the <3cm burrow size class at counts (cumulative) of greater than ~300.

5 Results

Based upon the above discussion, based upon the analysis method as stipulated by the JNCC and including the further (univariate metric) investigations devised, the following recommendations are made for future consideration in analysis of the SPBMC FOCI, using video data:

- Recommendation to include the use of the univariate MSE metric for further investigation and to validate findings of the multivariate analysis.
- A second assessment (counts of both size classes) of those transects with coarser sediment (gravelly/ shelly sand) and/or moderate video quality.
- The removal of analysis requirement for transects/segments with poor video quality.
- Consideration of the error associated with enumeration of the <3cm burrow class using video analysis. We suggest that enumeration of this size class should be undertaken on still imagery only. We also query the requirement to enumerate this size class, in the context of burrow function within the SPBMC habitat FOCI.

6 References

Bray, J.R. & Curtis, J.T. (1957) An Ordination of Upland Forest Communities of Southern Wisconsin. *Ecological Monographs*, 27, 325-349.

Callaway, A. 2015. CEND0915 cruise report: monitoring at Haig Fras candidate Special Area of Conservation / Site of Community Importance and East of Haig Fras Marine Conservation Zone. *JNCC/Cefas Partnership Report Series No. 5*, JNCC, Peterborough, ISSN 2051-6711.

Eggleton, J. & Downie, A. 2017. East of Haig Fras rMCZ Post-survey Site Report, Version 3. Department for Environment, Food and Rural Affairs.

JNCC. 2014. JNCC clarifications on the habitat definitions of two habitat FOCI. Peterborough, UK.

OSPAR Commission. 2010. Background Document for Seapen and Burrowing megafauna communities.

Annex 1. Bray-Curtis Similarity Matrices

Sample	EHGF017_Q	EHGF017_Q	EHGF017_Q	EHGF017_Q	EHGF017_Q	EHGF017_Q	EHGF017_Q	EHGF017_Q	EHGF017_Q	EHGF017_Q	EHGF017_Q	EHGF017_Q	EHGF017_Q	EHGF017_Q	EHGF017_Q	EHGF017_Q	EHGF017_Q	EHGF017_Q	EHGF017_Q	EHGF017_Q
	A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_10	A_11	A_12	A_13	A_14	A_15	A_16	A_17	A_18	A_19	A_19
EHGF017_RAW_1	88.89	88.89	71.43	90.91	90.91	88.89	76.92	71.43	100.00	83.33	83.33	50.00	58.82	83.33	57.14	76.92	45.45	52.63	76.92	76.92
EHGF017_RAW_2	72.73	72.73	87.50	76.92	92.31	72.73	93.33	87.50	83.33	100.00	100.00	63.64	73.68	100.00	44.44	93.33	58.33	66.67	93.33	93.33
EHGF017_RAW_3	50.00	50.00	85.71	55.56	66.67	50.00	70.00	85.71	58.82	73.68	73.68	88.89	100.00	73.68	28.57	80.00	82.76	92.31	80.00	80.00
EHGF017_RAW_4	66.67	66.67	82.35	85.71	85.71	66.67	100.00	82.35	76.92	93.33	93.33	60.87	70.00	93.33	40.00	87.50	64.00	72.73	87.50	87.50
EHGF017_RAW_5	80.00	80.00	80.00	83.33	100.00	80.00	85.71	80.00	90.91	92.31	92.31	57.14	66.67	92.31	50.00	85.71	52.17	60.00	85.71	85.71
EHGF017_RAW_6	53.33	53.33	90.00	58.82	70.59	53.33	73.68	90.00	62.50	77.78	77.78	84.62	95.65	77.78	30.77	84.21	78.57	88.00	84.21	84.21
EHGF017_RAW_7	38.10	38.10	69.23	52.17	52.17	38.10	64.00	69.23	45.45	58.33	58.33	93.75	82.76	58.33	21.05	64.00	94.12	90.32	64.00	64.00
EHGF017_RAW_8	50.00	50.00	85.71	55.56	66.67	50.00	70.00	85.71	58.82	73.68	73.68	88.89	100.00	73.68	28.57	80.00	82.76	92.31	80.00	80.00
EHGF017_RAW_9	57.14	57.14	94.74	62.50	75.00	57.14	77.78	94.74	66.67	82.35	82.35	80.00	90.91	82.35	33.33	88.89	74.07	83.33	88.89	88.89
EHGF017_RAW_10	33.33	33.33	62.07	38.46	46.15	33.33	50.00	62.07	40.00	51.85	51.85	85.71	75.00	51.85	18.18	57.14	81.08	76.47	57.14	57.14
EHGF017_RAW_11	72.73	72.73	87.50	76.92	92.31	72.73	93.33	87.50	83.33	100.00	100.00	63.64	73.68	100.00	44.44	93.33	58.33	66.67	93.33	93.33
EHGF017_RAW_12	44.44	44.44	78.26	50.00	60.00	44.44	63.64	78.26	52.63	66.67	66.67	96.55	92.31	66.67	25.00	72.73	90.32	92.86	72.73	72.73
EHGF017_RAW_13	61.54	61.54	100.00	66.67	80.00	61.54	82.35	100.00	71.43	87.50	87.50	75.00	85.71	87.50	36.36	94.12	69.23	78.26	94.12	94.12
EHGF017_RAW_14	72.73	72.73	87.50	76.92	92.31	72.73	93.33	87.50	83.33	100.00	100.00	63.64	73.68	100.00	44.44	93.33	58.33	66.67	93.33	93.33
EHGF017_RAW_15	66.67	66.67	36.36	50.00	50.00	66.67	40.00	36.36	57.14	44.44	44.44	23.53	28.57	44.44	100.00	40.00	21.05	25.00	40.00	40.00
EHGF017_RAW_16	53.33	53.33	90.00	58.82	70.59	53.33	73.68	90.00	62.50	77.78	77.78	84.62	95.65	77.78	30.77	84.21	78.57	88.00	84.21	84.21
EHGF017_RAW_17	36.36	36.36	66.67	50.00	50.00	36.36	61.54	66.67	43.48	56.00	56.00	90.91	80.00	56.00	20.00	61.54	91.43	87.50	61.54	61.54
EHGF017_RAW_18	50.00	50.00	85.71	66.67	66.67	50.00	80.00	85.71	58.82	73.68	73.68	81.48	91.67	73.68	28.57	80.00	82.76	92.31	80.00	80.00
EHGF017_RAW_19	66.67	66.67	94.12	71.43	85.71	66.67	87.50	94.12	76.92	93.33	93.33	69.57	80.00	93.33	40.00	100.00	64.00	72.73	100.00	100.00

Sample	EHGF048_Q	EHGF048_Q	EHGF048_Q	EHGF048_Q	EHGF048_Q	EHGF048_Q	EHGF048_Q	EHGF048_Q	EHGF048_Q	EHGF048_Q	EHGF048_Q	EHGF048_Q	EHGF048_Q	EHGF048_Q	EHGF048_Q	EHGF048_Q	EHGF048_Q	EHGF048_Q	EHGF048_Q	EHGF048_Q	EHGF048_Q
	A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_10	A_11	A_12	A_13	A_14	A_15	A_16	A_17	A_18	A_19	A_20	A_20
EHGF048_RAW_1	100.00	100.00	100.00	100.00	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	100.00	100.00	100.00
EHGF048_RAW_2	100.00	100.00	100.00	100.00	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	100.00	100.00	100.00
EHGF048_RAW_3	100.00	100.00	100.00	100.00	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	100.00	100.00	100.00
EHGF048_RAW_4	100.00	100.00	100.00	100.00	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	100.00	100.00	100.00
EHGF048_RAW_5	100.00	100.00	100.00	100.00	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	100.00	100.00	100.00
EHGF048_RAW_6	0.00	0.00	0.00	0.00	0.00	100.00	0.00	66.67	40.00	25.00	50.00	15.38	13.33	40.00	40.00	0.00	0.00	0.00	0.00	0.00	0.00
EHGF048_RAW_7	100.00	100.00	100.00	100.00	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	100.00	100.00	100.00
EHGF048_RAW_8	0.00	0.00	0.00	0.00	0.00	66.67	0.00	100.00	66.67	44.44	80.00	28.57	25.00	66.67	66.67	0.00	0.00	0.00	0.00	0.00	0.00
EHGF048_RAW_9	0.00	0.00	0.00	0.00	0.00	40.00	0.00	66.67	100.00	72.73	85.71	50.00	44.44	100.00	75.00	0.00	0.00	0.00	0.00	0.00	0.00
EHGF048_RAW_10	0.00	0.00	0.00	0.00	0.00	15.38	0.00	28.57	50.00	73.68	40.00	91.67	92.31	50.00	37.50	0.00	0.00	0.00	0.00	0.00	0.00
EHGF048_RAW_11	0.00	0.00	0.00	0.00	0.00	33.33	0.00	57.14	88.89	83.33	75.00	58.82	52.63	88.89	66.67	0.00	0.00	0.00	0.00	0.00	0.00
EHGF048_RAW_12	0.00	0.00	0.00	0.00	0.00	15.38	0.00	28.57	50.00	73.68	40.00	91.67	92.31	50.00	37.50	0.00	0.00	0.00	0.00	0.00	0.00
EHGF048_RAW_13	0.00	0.00	0.00	0.00	0.00	13.33	0.00	25.00	44.44	66.67	35.29	92.31	92.86	44.44	44.44	0.00	0.00	0.00	0.00	0.00	0.00
EHGF048_RAW_14	0.00	0.00	0.00	0.00	0.00	50.00	0.00	80.00	85.71	60.00	100.00	40.00	35.29	85.71	85.71	0.00	0.00	0.00	0.00	0.00	0.00
EHGF048_RAW_15	0.00	0.00	0.00	0.00	0.00	33.33	0.00	57.14	88.89	83.33	75.00	58.82	52.63	88.89	66.67	0.00	0.00	0.00	0.00	0.00	0.00
EHGF048_RAW_16	100.00	100.00	100.00	100.00	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00
EHGF048_RAW_17	100.00	100.00	100.00	100.00	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00
EHGF048_RAW_18	100.00	100.00	100.00	100.00	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00
EHGF048_RAW_19	100.00	100.00	100.00	100.00	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00
EHGF048_RAW_20	100.00	100.00	100.00	100.00	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00

East of Haig Frs MCZ: Sea-pen and Burrowing Megafauna Communities: Quality Assurance

Sample	EHGF067_Q	EHGF067_Q	EHGF067_Q	EHGF067_Q	EHGF067_Q	EHGF067_Q	EHGF067_Q	EHGF067_Q	EHGF067_Q	EHGF067_Q	EHGF067_Q	EHGF067_Q	EHGF067_Q	EHGF067_Q	EHGF067_Q	EHGF067_Q
	A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_10	A_11	A_12	A_13	A_14	A_15	A_16
EHGF067_RAW_1	100.00	0.00	0.00	0.00	0.00	100.00	66.67	0.00	66.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EHGF067_RAW_2	0.00	100.00	0.00	100.00	100.00	0.00	0.00	100.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
EHGF067_RAW_3	0.00	100.00	0.00	100.00	100.00	0.00	0.00	100.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
EHGF067_RAW_4	0.00	100.00	0.00	100.00	100.00	0.00	0.00	100.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
EHGF067_RAW_5	0.00	100.00	0.00	100.00	100.00	0.00	0.00	100.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
EHGF067_RAW_6	0.00	100.00	0.00	100.00	100.00	0.00	0.00	100.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
EHGF067_RAW_7	66.67	0.00	0.00	0.00	0.00	66.67	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EHGF067_RAW_8	0.00	100.00	0.00	100.00	100.00	0.00	0.00	100.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
EHGF067_RAW_9	33.33	0.00	0.00	0.00	0.00	33.33	57.14	0.00	57.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EHGF067_RAW_10	0.00	100.00	0.00	100.00	100.00	0.00	0.00	100.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
EHGF067_RAW_11	0.00	100.00	0.00	100.00	100.00	0.00	0.00	100.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
EHGF067_RAW_12	0.00	100.00	0.00	100.00	100.00	0.00	0.00	100.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
EHGF067_RAW_13	0.00	100.00	0.00	100.00	100.00	0.00	0.00	100.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
EHGF067_RAW_14	0.00	100.00	0.00	100.00	100.00	0.00	0.00	100.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
EHGF067_RAW_15	0.00	100.00	0.00	100.00	100.00	0.00	0.00	100.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
EHGF067_RAW_16	0.00	100.00	0.00	100.00	100.00	0.00	0.00	100.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Sample	EHGF105_Q	EHGF105_Q	EHGF105_Q	EHGF105_Q	EHGF105_Q	EHGF105_Q	EHGF105_Q	EHGF105_Q	EHGF105_Q	EHGF105_Q	EHGF105_Q	EHGF105_Q	EHGF105_Q	EHGF105_Q	EHGF105_Q	EHGF105_Q	EHGF105_Q	EHGF105_Q	EHGF105_Q	EHGF105_Q	
	A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_10	A_11	A_12	A_13	A_14	A_15	A_16	A_17	A_18	A_19	A_20	A_21
EHGF105_RAW_1	88.89	76.92	62.50	57.14	33.33	57.14	33.33	88.89	100.00	75.00	100.00	75.00	0.00	0.00	57.14	0.00	88.89	88.89	100.00	50.00	38.46
EHGF105_RAW_2	72.73	93.33	77.78	44.44	25.00	44.44	25.00	72.73	83.33	60.00	83.33	60.00	0.00	0.00	44.44	0.00	72.73	72.73	83.33	63.64	50.00
EHGF105_RAW_3	80.00	85.71	70.59	50.00	28.57	50.00	28.57	80.00	90.91	66.67	90.91	66.67	0.00	0.00	50.00	0.00	80.00	80.00	90.91	57.14	44.44
EHGF105_RAW_4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00
EHGF105_RAW_5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00
EHGF105_RAW_6	40.00	22.22	16.67	66.67	100.00	66.67	100.00	40.00	33.33	50.00	33.33	50.00	0.00	0.00	66.67	0.00	40.00	40.00	33.33	12.50	9.09
EHGF105_RAW_7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00
EHGF105_RAW_8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00
EHGF105_RAW_9	88.89	76.92	62.50	57.14	33.33	57.14	33.33	88.89	100.00	75.00	100.00	75.00	0.00	0.00	57.14	0.00	88.89	88.89	100.00	50.00	38.46
EHGF105_RAW_10	85.71	54.55	42.86	80.00	50.00	80.00	50.00	85.71	75.00	100.00	75.00	100.00	0.00	0.00	80.00	0.00	85.71	85.71	75.00	33.33	25.00
EHGF105_RAW_11	80.00	85.71	70.59	50.00	28.57	50.00	28.57	80.00	90.91	66.67	90.91	66.67	0.00	0.00	50.00	0.00	80.00	80.00	90.91	57.14	44.44
EHGF105_RAW_12	85.71	54.55	42.86	80.00	50.00	80.00	50.00	85.71	75.00	100.00	75.00	100.00	0.00	0.00	80.00	0.00	85.71	85.71	75.00	33.33	25.00
EHGF105_RAW_13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00
EHGF105_RAW_14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00
EHGF105_RAW_15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00
EHGF105_RAW_16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00
EHGF105_RAW_17	100.00	66.67	53.33	66.67	40.00	66.67	40.00	100.00	88.89	85.71	88.89	85.71	0.00	0.00	66.67	0.00	100.00	100.00	88.89	42.11	32.00
EHGF105_RAW_18	100.00	66.67	53.33	66.67	40.00	66.67	40.00	100.00	88.89	85.71	88.89	85.71	0.00	0.00	66.67	0.00	100.00	100.00	88.89	42.11	32.00
EHGF105_RAW_19	72.73	93.33	77.78	44.44	25.00	44.44	25.00	72.73	83.33	60.00	83.33	60.00	0.00	0.00	44.44	0.00	72.73	72.73	83.33	63.64	50.00
EHGF105_RAW_20	42.11	69.57	84.62	23.53	12.50	23.53	12.50	42.11	50.00	33.33	50.00	33.33	0.00	0.00	23.53	0.00	42.11	42.11	50.00	93.33	83.33
EHGF105_RAW_21	36.36	61.54	75.86	20.00	10.53	20.00	10.53	36.36	43.48	28.57	43.48	28.57	0.00	0.00	20.00	0.00	36.36	36.36	43.48	84.85	92.31

East of Haig Frs MCZ: Sea-pen and Burrowing Megafauna Communities: Quality Assurance

Sample	EHGF238_Q	EHGF238_Q	EHGF238_Q	EHGF238_Q	EHGF238_Q	EHGF238_Q	EHGF238_Q	EHGF238_Q	EHGF238_Q	EHGF238_Q	EHGF238_Q	EHGF238_Q	EHGF238_Q	EHGF238_Q	EHGF238_Q	EHGF238_Q	EHGF238_Q	EHGF238_Q
	A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_10	A_11	A_12	A_13	A_14	A_15	A_16	A_17	A_18
EHGF238_RAW_1	0.00	100.00	0.00	100.00	0.00	0.00	0.00	100.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EHGF238_RAW_2	0.00	100.00	0.00	100.00	0.00	0.00	0.00	100.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EHGF238_RAW_3	0.00	100.00	0.00	100.00	0.00	0.00	0.00	100.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EHGF238_RAW_4	0.00	100.00	0.00	100.00	0.00	0.00	0.00	100.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EHGF238_RAW_5	66.67	0.00	88.89	0.00	40.00	85.71	40.00	0.00	40.00	57.14	0.00	36.36	34.78	50.00	28.57	17.02	13.33	13.56
EHGF238_RAW_6	57.14	0.00	100.00	0.00	33.33	75.00	33.33	0.00	33.33	50.00	0.00	43.48	41.67	58.82	34.48	20.83	16.39	16.67
EHGF238_RAW_7	100.00	0.00	57.14	0.00	66.67	80.00	66.67	0.00	66.67	80.00	0.00	20.00	19.05	28.57	15.38	8.89	6.90	7.02
EHGF238_RAW_8	0.00	100.00	0.00	100.00	0.00	0.00	0.00	100.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EHGF238_RAW_9	0.00	100.00	0.00	100.00	0.00	0.00	0.00	100.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EHGF238_RAW_10	0.00	100.00	0.00	100.00	0.00	0.00	0.00	100.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EHGF238_RAW_11	0.00	100.00	0.00	100.00	0.00	0.00	0.00	100.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EHGF238_RAW_12	40.00	0.00	76.92	0.00	22.22	54.55	22.22	0.00	22.22	36.36	0.00	61.54	59.26	70.00	50.00	31.37	25.00	25.40
EHGF238_RAW_13	40.00	0.00	76.92	0.00	22.22	54.55	22.22	0.00	22.22	54.55	0.00	61.54	59.26	80.00	50.00	31.37	25.00	25.40
EHGF238_RAW_14	50.00	0.00	72.73	0.00	28.57	66.67	28.57	0.00	28.57	66.67	0.00	50.00	48.00	66.67	40.00	24.49	19.35	19.67
EHGF238_RAW_15	11.76	0.00	27.03	0.00	6.06	17.14	6.06	0.00	6.06	17.14	0.00	72.00	74.51	54.55	82.14	85.33	72.73	73.56
EHGF238_RAW_16	8.89	0.00	20.83	0.00	4.55	13.04	4.55	0.00	4.55	13.04	0.00	59.02	61.29	40.00	56.72	86.05	78.79	87.76
EHGF238_RAW_17	9.52	0.00	22.22	0.00	4.88	13.95	4.88	0.00	4.88	13.95	0.00	62.07	64.41	46.15	68.75	96.39	83.33	84.21
EHGF238_RAW_18	6.45	0.00	15.38	0.00	3.28	9.52	3.28	0.00	3.28	9.52	0.00	46.15	48.10	33.33	57.14	83.50	77.59	90.43

Sample	EHGF255_Q	EHGF255_Q	EHGF255_Q	EHGF255_Q	EHGF255_Q	EHGF255_Q	EHGF255_Q	EHGF255_Q	EHGF255_Q	EHGF255_Q	EHGF255_Q	EHGF255_Q	EHGF255_Q	EHGF255_Q	EHGF255_Q	EHGF255_Q	EHGF255_Q
	A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_10	A_11	A_12	A_13	A_14	A_15		
EHGF255_RAW_1	100.00	100.00	100.00	0.00	0.00	100.00	100.00	0.00	100.00	0.00	100.00	100.00	0.00	0.00	0.00	0.00	0.00
EHGF255_RAW_2	100.00	100.00	100.00	0.00	0.00	100.00	100.00	0.00	100.00	0.00	100.00	100.00	0.00	0.00	0.00	0.00	0.00
EHGF255_RAW_3	100.00	100.00	100.00	0.00	0.00	100.00	100.00	0.00	100.00	0.00	100.00	100.00	0.00	0.00	0.00	0.00	0.00
EHGF255_RAW_4	100.00	100.00	100.00	0.00	0.00	100.00	100.00	0.00	100.00	0.00	100.00	100.00	0.00	0.00	0.00	0.00	0.00
EHGF255_RAW_5	100.00	100.00	100.00	0.00	0.00	100.00	100.00	0.00	100.00	0.00	100.00	100.00	0.00	0.00	0.00	0.00	0.00
EHGF255_RAW_6	100.00	100.00	100.00	0.00	0.00	100.00	100.00	0.00	100.00	0.00	100.00	100.00	0.00	0.00	0.00	0.00	0.00
EHGF255_RAW_7	100.00	100.00	100.00	0.00	0.00	100.00	100.00	0.00	100.00	0.00	100.00	100.00	0.00	0.00	0.00	0.00	0.00
EHGF255_RAW_8	100.00	100.00	100.00	0.00	0.00	100.00	100.00	0.00	100.00	0.00	100.00	100.00	0.00	0.00	0.00	0.00	0.00
EHGF255_RAW_9	100.00	100.00	100.00	0.00	0.00	100.00	100.00	0.00	100.00	0.00	100.00	100.00	0.00	0.00	0.00	0.00	0.00
EHGF255_RAW_10	0.00	0.00	0.00	100.00	50.00	0.00	0.00	50.00	0.00	50.00	0.00	0.00	0.00	50.00	75.00	50.00	50.00
EHGF255_RAW_11	100.00	100.00	100.00	0.00	0.00	100.00	100.00	0.00	100.00	0.00	100.00	100.00	0.00	0.00	0.00	0.00	0.00
EHGF255_RAW_12	100.00	100.00	100.00	0.00	0.00	100.00	100.00	0.00	100.00	0.00	100.00	100.00	0.00	0.00	0.00	0.00	0.00
EHGF255_RAW_13	0.00	0.00	0.00	85.71	40.00	0.00	0.00	40.00	0.00	40.00	0.00	0.00	66.67	88.89	40.00		
EHGF255_RAW_14	0.00	0.00	0.00	80.00	66.67	0.00	0.00	66.67	0.00	66.67	0.00	66.67	0.00	28.57	57.14		66.67
EHGF255_RAW_15	0.00	0.00	0.00	80.00	66.67	0.00	0.00	66.67	0.00	66.67	0.00	66.67	0.00	28.57	57.14		66.67

