Centre for Environment Fisheries & Aquaculture Science

Cefas

Dredged Material Disposal Site Monitoring Round the Coast of England: Results of Sampling (2021-2022)

Outer Tees

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Executive Summary

This report presents the scientific findings of, and implications for subsequent monitoring based on the results from, dredged material disposal site monitoring conducted under a Cefas / Marine Management Organisation Service Level Agreement (SLA 1.2) project (C6794 hereafter) round the coast of England during 2021-2022 (financial year).

The main aims of this report are:

- to aid the dissemination of the monitoring results;
- to assess whether observed changes resulting from dredged material disposal are in line with predictions;
- to compare the results with those of previous years (where possible);
- to facilitate our improved understanding of the impacts of dredged material disposal at both a site-specific and a national (i.e. non site-specific) level.

Two disposal sites were targeted for assessment during this period: Outer Tees and Lyme Bay 2. The survey at Lyme Bay 2 was undertaken late in the reporting year (December 2021) and is reported on within a separate report presenting the outcomes of that survey.

Seabed sampling at eight stations (three replicates being obtained at each) within and in the vicinity the Outer Tees dredged material disposal site during October 2021 revealed that the seabed in the area comprises predominantly slightly gravelly and gravelly muddy sands with some gravelly muds. These sediments range from poorly sorted to extremely poorly sorted. There is a notable spatial variability in sediment granulometric properties, both within station and across stations. Within-station variability is perhaps most evident at one of the two stations within the disposal site boundary (OT2) whose replicates ranged from slightly gravelly muddy sand to muddy gravel with gravel contents ranging from 1.22% to 30.42%. Sampling and laboratory processing differences prevented these data being compared with historically acquired data under this project.

A total of 202 taxa (197 free living taxa, five colonial epifaunal taxa) were recorded from the eight stations sampled across the region. The most prevalent and numerically dominant taxon was the capitellid worm *Peresiella clymenoides*, while *Lumbrineris cingulata* (agg.) and the bivalve *Ennucula tenuis* were also relatively ubiquitous across the Outer Tees survey area. The overall assemblage composition was generally comparable among all stations, both numerically and in terms of species diversity, although the samples from OT2 within the disposal site contained a spatially variable and less diverse benthic assemblage with a different taxonomic composition. This observation matches the varying sediment granulometric properties witnessed for this station.

The diversity, density and biomass of taxa collected during 2021 are comparable to that observed across the site during previous sampling campaigns (2008, 2009, 2010). However, it was evident that the dissimilar and relatively inferior assemblage at station OT2 in 2021 is not in line with that previously observed. Indeed, mean total density of individuals at OT2 in 2010 was almost double that for the other three stations sampled in that year.

The successful survey of the Outer Tees dredged material disposal site during October 2021 under C6794 acquired sediment particle size and macrofaunal data which may be used as a baseline from which any potential impacts associated with the anticipated increases in material destined for the site in subsequent years may be gauged. As such, subsequent sampling, following the methods undertaken during 2021, should be conducted at suitable periods during and after the cessation of such deposits. Any changes, or the rationale to include additional parameters such as sediment samples for contaminants assessment, should be considered in light of contemporary information regarding the site.

1 Introduction

1.1 Regulation of disposal activity in England

Disposal of waste at sea is strictly regulated through the licensing requirements of the Marine and Coastal Access Act 2009 (MCAA). The MCAA provides the principal statutory means by which the UK complies with EU law, such as the Water Framework Directive (WFD, 2000/60/EC), the Habitats and Species Directive (92/43/EEC), the Wild Birds Directive (79/409/EEC) and international obligations such as under the OSPAR Convention and the London Protocol, in relation to disposals at sea. Following the UK's departure from the EU at the end of 2020, the UK legislation transposing these EU Directives was amended to ensure it operated effectively following the UK's departure.

Pursuant to the OSPAR Convention and the London Protocol, only certain wastes or other matter are permitted for disposal at sea. During the 1980s and 1990s, the UK phased out sea disposal of most types of waste, including industrial waste and sewage sludge. Since then, dredged material from ports and harbours, and a small amount of fish waste, has been the only type of material routinely licensed for disposal at sea.

The Marine Management Organisation (MMO) regulates, and is responsible for, licensing activities in the marine environment around England including the disposal of dredged material at sea. The MMO assesses the suitability of dredged material for disposal at sea in line with the OSPAR guidelines for the management of dredged material (OSPAR, 2014). These guidelines provide generic guidance on determining the conditions under which dredged material may (or may not) be deposited at sea and involve the consideration of alternative uses, disposal sites and the suitability of the dredged material for aquatic disposal including the presence and levels of contaminants in the material, along with perceived impacts on any nearby sites of conservation value.

One of the roles of Cefas is to provide scientific advice to the MMO on the suitability of the material for sea disposal at the application stage and, once a licence is granted, to provide technical advice on any monitoring undertaken as a result of licence conditions. Advice on the licensing of dredged material disposal at sea is provided by Cefas' Science for Sustainable Marine Management (SSMM) team, work conducted under C6794 helps underpin the scientific rationale for such advice (see Section 1.3).

1.2 Disposal sites around England

There are currently approximately 110 open sites (numerous sites are opened and closed every year) designated for dredged material disposal round the coast of England, not all of which are used in any one year. While the majority of these are located along the coast of the mainland, generally within a few miles of a major port or estuary entrance, a significant number are positioned within estuaries (e.g. Humber) or on intertidal mudflats as part of beneficial use schemes (Bolam et al., 2006).

Although total quantities vary year to year, approximately 40 Mt (wet weight) are annually disposed to coastal sites around England. Individual quantities licensed may range from a few hundred to several million tonnes, and the nature may vary from soft silts to stiff clay, boulders or even crushed rock according to origin, although the majority consists of finer material (Bolam et al., 2006).

1.3 Overview of Cefas / MMO project C6794 'Monitoring of dredged material disposal sites'

The dredged material disposal site monitoring project C6794, funded by the MMO, falls under a service level agreement (or SLA) between the MMO and Cefas. Operationally, this project represents a continuation of the disposal site monitoring programme SLAB5 which was a component of a former SLA between Defra and Cefas; this SLA formerly ceased at the end of March 2015. C6794 was initiated on 1st April 2015, and, thus, while the project and work planned under this project are termed here under C6794, any reference to its predecessor project is inevitable (i.e. to its survey work, reports or other scientific outputs), and will continue to be referenced herein as SLAB5.

In summary, C6794 provides field evaluations ('baseline' monitoring and 'trouble-shooting' surveys) at dredged material disposal sites around the coast of England. A major component of the project is, therefore, the commissioning of sea-going surveys at targeted disposal sites. Such field evaluations under C6794 are designed to ensure that:

- environmental conditions at newly designated sites are suitable for the commencement of disposal activities;
- predictions for established sites concerning limitations of effects continue to be met; and,
- disposal operations conform with licence conditions.

The outcomes of such surveys contribute, either directly or indirectly, to the licensing process by ensuring that any evidence of unacceptable changes or practices is rapidly communicated and acted upon by the MMO. As such, there are inherently strong links and ongoing discussions between the approaches and findings of this project with the work carried out by Cefas' SSMM team and the licensing team within the MMO. The scientific outcomes of the work undertaken within C6794 are circulated to the Cefas SSMM team and the MMO *via* a number of routes including peer-reviewed publications (including both activity-specific and site-specific findings), reports, direct discussions, and internal and external presentations. The production of this report forms an important element of such scientific communication. The current report, which presents the findings of work undertaken during 2021-22, constitutes the 14th in the series. The previous reports are accessible *via* the Defra website:

https://www.gov.uk/government/publications?departments%5B%5D=centre-for-environment-fisheries-and-aquaculture-science

It is not the purpose of this report to present a detailed appraisal of the processes giving rise to impacts (see Section 1.5) but to encapsulate the essence of the impacts associated with this activity at specific sites targeted within year.

1.4 Sites monitored

To aid with determining which disposal sites should be selected for sampling in any one year, Cefas has derived a tier-based approach that classifies a number of possible issues or environmental concerns that may be associated with dredged material disposal into a risk-based framework (Bolam et al., 2009; Birchenough et al., 2010). The issues that pertain to a disposal site, and where these lie within the tiering system (i.e. their

perceived environmental risk) depict where that site lies within the tiered system. This ultimately determines whether that site is considered for sampling during a particular year. It is intended that this approach increases the transparency of the decision-making process regarding disposal site selection for C6794 monitoring, i.e. it establishes a model for site-specific decisions regarding sampling.

A tiered survey design and site assessment system, therefore, facilitates the prioritisation of dredged material disposal sites in terms of the need for, and the scale of, monitoring required at each site. In practice, this method provides a scientifically valid rationale for the assessment of risks associated with relinquished, current and proposed disposal sites to the surrounding environment and amenities.

Two disposal sites were targeted for Cefas monitoring during 2021-22: Outer Tees (northeast coast) and Lyme Bay 2 (South Devon coast). These sites were identified following consultation between Cefas' SSMM team, Cefas scientists in a number of key disciplines (e.g. benthic ecology, sediment contaminants), together with a significant involvement from the MMO.

1.5 Aims of this report

This report does not aim to present a critique of the processes leading to observed changes at dredged material disposal sites around the coast of England. Such appraisals are conducted *via* other reporting routes, either *via* discussions with Cefas' SSMM team, presentations and subsequent publications at national and international conferences, and *via* papers in peer-reviewed journals (e.g. Bolam and Whomersley, 2005; Bolam et al., 2006; Birchenough et al., 2006; Bolam, 2014; Bolam et al., 2014a; Rumney et al., 2015; Bolam et al., 2016a; Bolam et al., 2021a). The aims of this report are:

- to present the results of sampling undertaken during 2020-21 under C6794, thereby aiding the dissemination of the findings under this project;
- to indicate whether the results obtained are in line with those expected for each disposal site, or whether subsequent investigations should be conducted;
- where possible, to compare the 2020-21 results with those of previous years to provide a temporal assessment (see Bolam et al., 2009; 2011a; 2012a; 2012b; 2014b; 2015a; 2015b; 2016b; 2017; 2018; 2019; 2020 and 2021b for reports of previous years' monitoring);
- to facilitate our improved understanding of the impacts of dredged material disposal at both a site-specific level and a national level; and,
- to promote the development of scientific (or other) outputs under C6794.

2 Outcomes

2.1 Outer Tees

2.1.1 Background

The Outer Tees site receives mainly capital material from the Tees region (maintenance material being mainly disposed of to the Inner Tees site). Currently, there are licence applications that allow the disposal of significant quantities of material to Outer Tees. The placement of significant quantities of material going to a site inherently represents an increased risk and prudent management of the site (and the activity as a whole) dictates that the ecological effects of placing such vast amounts of material on the seabed warrants monitoring of the associated impacts. In view of this, Cefas undertook a survey of the sediments and associated infaunal assemblages within and surrounding the Outer Tees site. These data, which may be regarded as a baseline, will be used to compare with subsequent data from future surveys to quantify ecological impacts of the planned large deposits to the site. As the aim of the survey was to develop an ecological baseline in anticipation of future disposal events, no sediments were collected for contaminants assessment.

2.1.2 Survey design

The survey at Outer Tees comprised of eight seabed stations (Figure 1); two (OT2, OT4) within the disposal site and six (OT1, OT3, OT5, OT6, OT7, OT8) positioned at various distances outside, and different directions from, the disposal site boundary. These stations have been previously sampled under the auspices of C6794/SLAB5 and thus their targeting in 2021 was heavily weighted by the opportunity to afford a temporal assessment of seabed variables. The principle of this historic design is that while the stations inside the site provide an assessment of sediments characteristics that are likely to be directly affected by dredged material disposal, those (OT3, OT5) in the immediate vicinity and along the main sediment transport pathway which runs along a SSE-NNW trajectory are likely to reflect indirect changes resulting from the disposal (i.e., following sediment dispersal from either the plume or subsequent remobilisation and deposition). Stations located further away from the site and/or perpendicular to main transport pathway (OT1, OT6, OT7, OT8) are intended to reflect the unimpacted scenario.

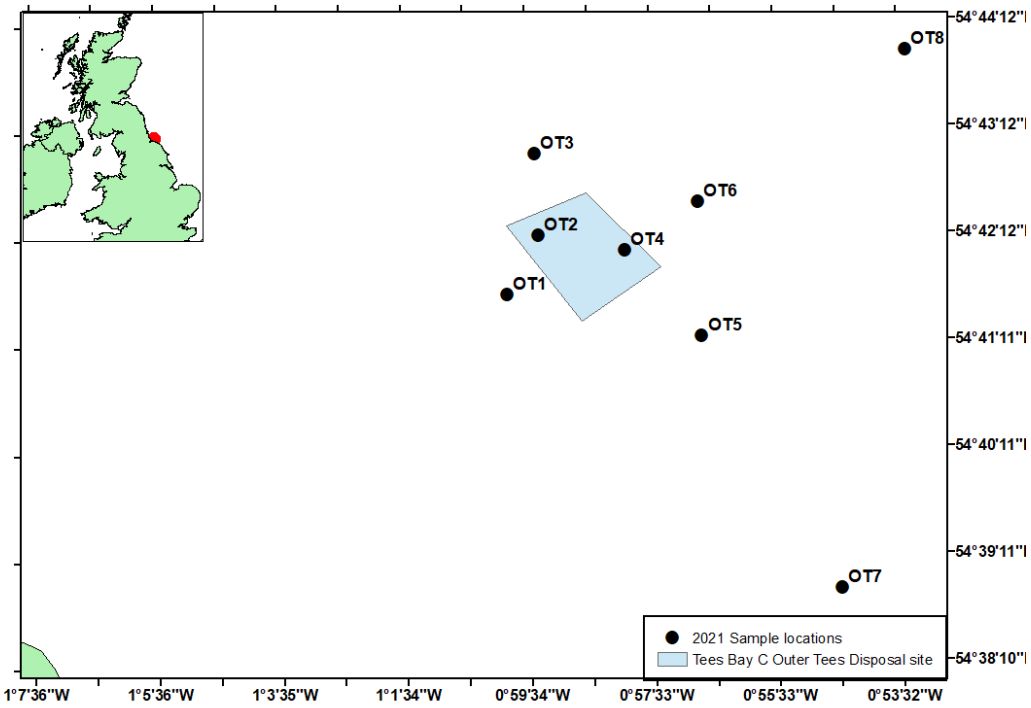

Figure 1. Locations of the eight seabed stations sampled under C6794 during October 2021.

The samples (three replicates at each station) were acquired using a 0.1 m^2 (or 'mini') Hamon grab during October 2021 aboard the Humber Guardian (Briggs Marine). As part of The Crown Estate Licence approval process during the survey planning, it was highlighted that the target locations of stations OT5 and OT6 (outside the disposal site) were within the 250 m exclusion zone of a gas pipeline. Following discussions with the tenant, these two stations were relocated to just outside of the exclusion zone prior to sampling: it is recommended that subsequent surveys of the Outer Tees disposal site take this move into consideration.

All subsequent processing of the particle size analysis (PSA) and macrofaunal samples was conducted in accordance with the National Marine Biological Analytical Quality Control (or NMBAQC) scheme (Mason, 2016; Worsfold et al., 2010). The macrofaunal samples were audited as per the 'own sample' methodology (Worsfold and Hall, 2017).

Outer Tees has been sampled under C6794/SLAB5 in previous years affording the potential for temporal comparisons. However, temporal comparisons are not considered plausible for the sediment PSA data due to different methodologies historically being used during laboratory analyses. That is, a laser-based NMBAQC methodology (Mason, 2016) was adopted during 2021 which contrasts with sieve-based methodology in previous years. Furthermore, different sampling gears (0.1 m^2 Hamon grab in 2021 compared with a 0.1 m^2 Day grab used for previous years) result in fundamental differences in the way PSA sub-samples are acquired. For the macrofauna, temporal assessments are considered possible as the gear differences are less significant (both grabs sample a 0.1 m^2 area of seabed and are subsequently treated in the same manner), although some caution must be used in direct assessments using the data. Furthermore, temporal comparisons must be cognisant of the minor shift in the locations of OT5 and OT6 (see above).

2.1.3 Results

2.1.3.1 Sediment particle size

The sediments sampled at the eight stations at Outer Tees are predominantly slightly gravelly and gravelly muddy sands with some gravelly muds (Table 1, Table 2). The sediments across the whole site are regarded as poorly sorted to extremely poorly sorted. There is a notable spatial variability in sediment granulometric properties, both within station and across stations. Within-station variability is perhaps most evident at one of the two stations within the disposal site boundary (OT2) whose replicates ranged from slightly gravelly muddy sand to muddy gravel (Table 1) with gravel contents ranging from 1.22% to 30.42% (Table 2). The between-station variability is best highlighted by the gravel, sand and mud proportional pie chart map (Figure 2) which shows elevated mud contents at OT1 (nearshore of the disposal site) and OT2, this latter station being the only station showing a notable average gravel content. OT4 (inside the site) and OT6 and OT8 (both east of the disposal site) possessed the lowest mud contents (Figure 3).

Table 1. Sediment descriptions and statistics (derived using Gradistat (Blott and Pye,2001) and modified Folk and EUNIS sediment group classification (Long, 2006) for all replicates sampled at *Outer Tees*, October 2021.

Sample code	Sample Type	Sediment description	MODE 1 (µm):	MODE 2 (µm):	MODE 3 (µm):
OT1_A1	Polymodal, Very Poorly Sorted	Gravelly Mud	150.9	9.4	26.7
OT1_B1	Polymodal, Extremely Poorly Sorted	Gravelly Mud	6.7	26.7	213.4
OT1_C1	Trimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand	213.4	9.4	26.7
OT2_A2	Polymodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand	213.4	6.7	853.6
OT2_B1	Polymodal, Very Poorly Sorted	Gravelly Mud	6.7	26.7	0.4
OT2_C1	Trimodal, Extremely Poorly Sorted	Muddy Gravel	38250.0	26.7	6.7
OT3_A1	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand	213.4		
OT3_B1	Trimodal, Very Poorly Sorted	Slightly Gravelly Sandy Mud	213.4	6.7	26.7
OT3_C1	Polymodal, Very Poorly Sorted	Gravelly Muddy Sand	213.4	853.6	6.7
OT4_A1	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand	150.9		
OT4_B1	Unimodal, Poorly Sorted	Slightly Gravelly Muddy Sand	213.4		
OT4_C1	Trimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand	150.9	6.7	26.7
OT5_A1	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand	150.9		
OT5_B1	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand	150.9		
OT5_C1	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand	150.9		
OT6_A3	Bimodal, Very Poorly Sorted	Gravelly Muddy Sand	150.9	603.6	
OT6_B1	Unimodal, Very Poorly Sorted	Gravelly Muddy Sand	150.9		
OT6_C1	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand	150.9		
OT7_A1	Trimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand	106.7	26.7	6.7
OT7_B1	Trimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand	106.7	6.7	853.6
OT7_C1	Trimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand	106.7	9.4	426.8
OT8_A1	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand	150.9		
OT8_B1	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand	150.9		
OT8_C1	Unimodal, Very Poorly Sorted	Slightly Gravelly Muddy Sand	150.9		

Table 2. Sediment compositions and EUNIS sediment group classification (Long, 2006) for all replicates sampled at *Outer Tees*, October 2021.

Sample code	Gravel (%)	Sand (%)	Mud (%)	Folk	EUNIS sediment group
OT1_A1	6.05	33.96	59.99	gM	mixed sediments
OT1_B1	12.64	20.01	67.34	gM	mixed sediments
OT1_C1	1.07	52.41	46.52	(g)mS	mud and sandy mud
OT2_A2	1.22	58.76	40.01	(g)mS	mud and sandy mud
OT2_B1	6.42	13.62	79.96	gM	mixed sediments
OT2_C1	30.42	11.30	58.28	mG	mixed sediments
OT3_A1	0.67	73.76	25.57	mS	mud and sandy mud
OT3_B1	4.35	45.90	49.75	(g)sM	mud and sandy mud
OT3_C1	6.51	55.41	38.09	gmS	mixed sediments
OT4_A1	0.74	70.77	28.49	mS	mud and sandy mud
OT4_B1	1.02	82.09	16.90	(g)mS	sand and muddy sand
OT4_C1	2.93	68.76	28.32	(g)mS	mud and sandy mud
OT5_A1	1.00	69.85	29.15	mS	mud and sandy mud
OT5_B1	0.22	68.38	31.40	mS	mud and sandy mud
OT5_C1	0.91	64.42	34.67	mS	mud and sandy mud
OT6_A3	5.30	72.60	22.10	gmS	mixed sediments
OT6_B1	6.03	68.94	25.02	gmS	mixed sediments
OT6_C1	3.24	69.55	27.21	(g)mS	mud and sandy mud
OT7_A1	1.14	51.41	47.45	(g)mS	mud and sandy mud
OT7_B1	0.40	53.57	46.03	mS	mud and sandy mud
OT7_C1	0.72	53.17	46.11	mS	mud and sandy mud
OT8_A1	1.92	76.19	21.89	(g)mS	mud and sandy mud
OT8_B1	2.30	75.43	22.27	(g)mS	mud and sandy mud
OT8_C1	0.95	74.27	24.78	mS	mud and sandy mud

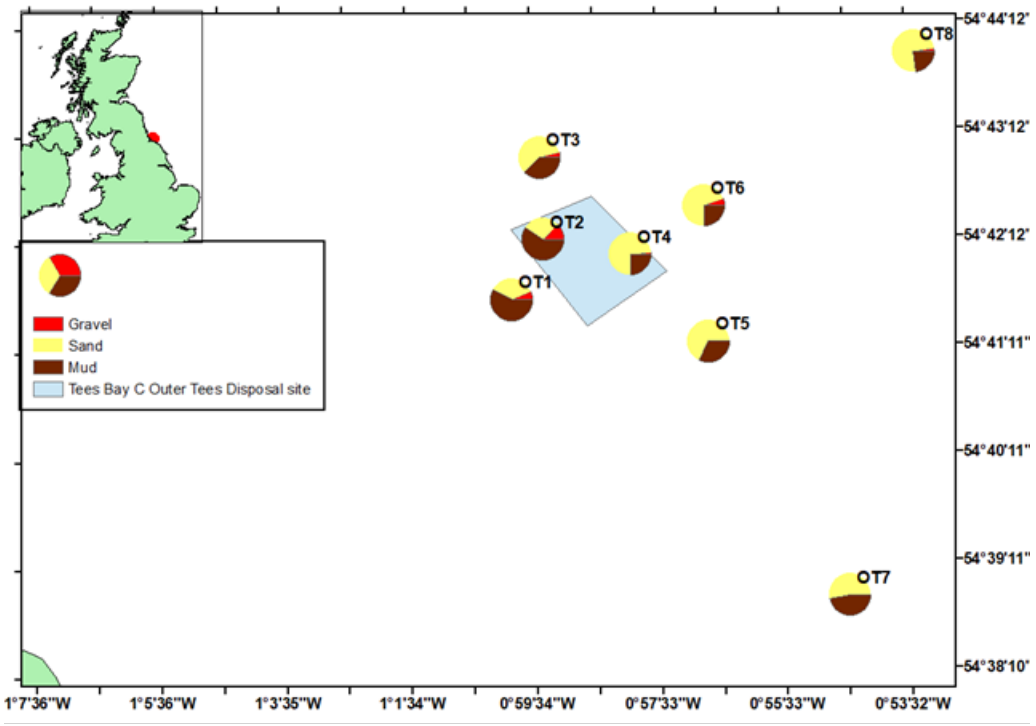

Figure 2. Pie charts of gravel, sand and silt/clay (average of 3 replicates) at Outer Tees, October 2021.

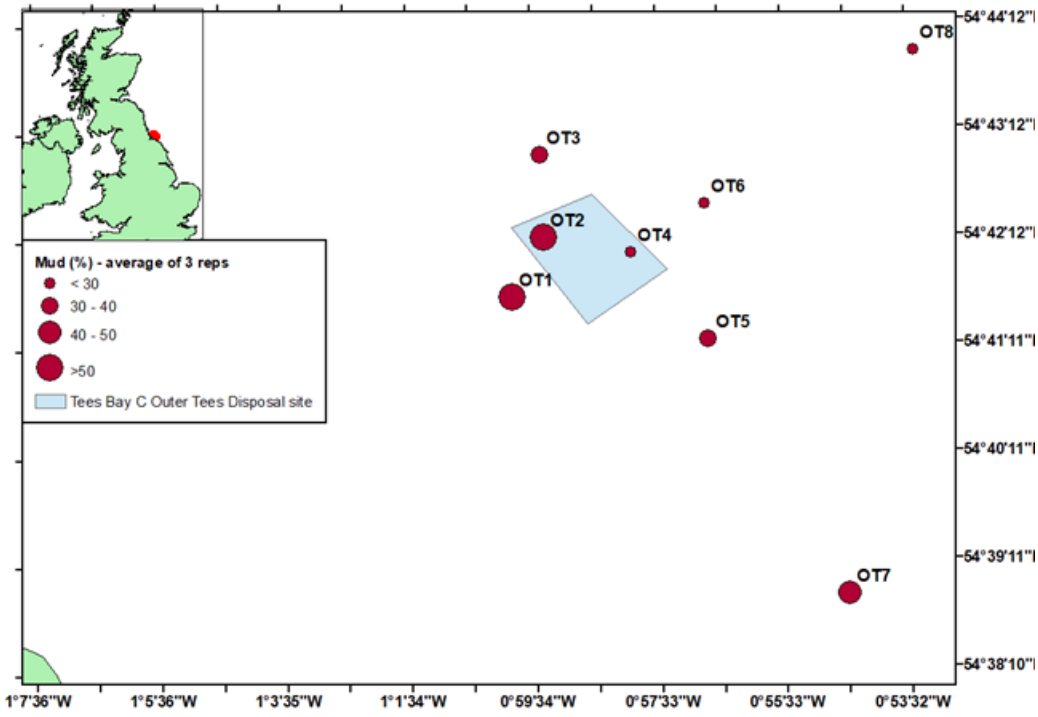

Figure 3. Mud content (%) (average of 3 replicates) of sediments sampled at Outer Tees, October 2021.

2.1.3.2 Sediment macrofaunal assemblages

A total of 202 taxa (including colonial epifauna) were recorded from the 0.1 m^2 Hamon grab samples (three replicates at each of the eight stations) taken at the Outer Tees disposal site during the 2021 survey. One hundred and ninety-seven free living macrofaunal invertebrate taxa were identified (70% identified to species level), the most prevalent taxon being the capitellid worm *Peresiella clymenoides* which was numerically dominant and present in over 80% of samples collected. The annelid worm *Lumbrineris cingulata* (agg.) and the bivalve *Ennucula tenuis* are similarly ubiquitous, being present in 100% and 88% of samples respectively. Five taxonomic groups of colonial epifauna were identified (100% identified to species), with none of these taxa being ubiquitous and all occurring in no more than one sample.

Segmented worms, or annelids, are typically the most abundant macrofaunal invertebrates encountered, with stations within the disposal site (OT2 and OT4) typically having a lower abundance of them than the reference stations (OT3 and OT5) (Figure 4). Only data for OT3 and OT5 are presented for the 'outside' stations in Figure 4 to ensure comparability with the 'inside' data in terms of sampling effort. The elevated abundance of annelids in the reference stations is also mirrored by molluscs, while total abundances of echinoderms, arthropods and the 'other' phyla are comparable for the two areas (Figure 4).

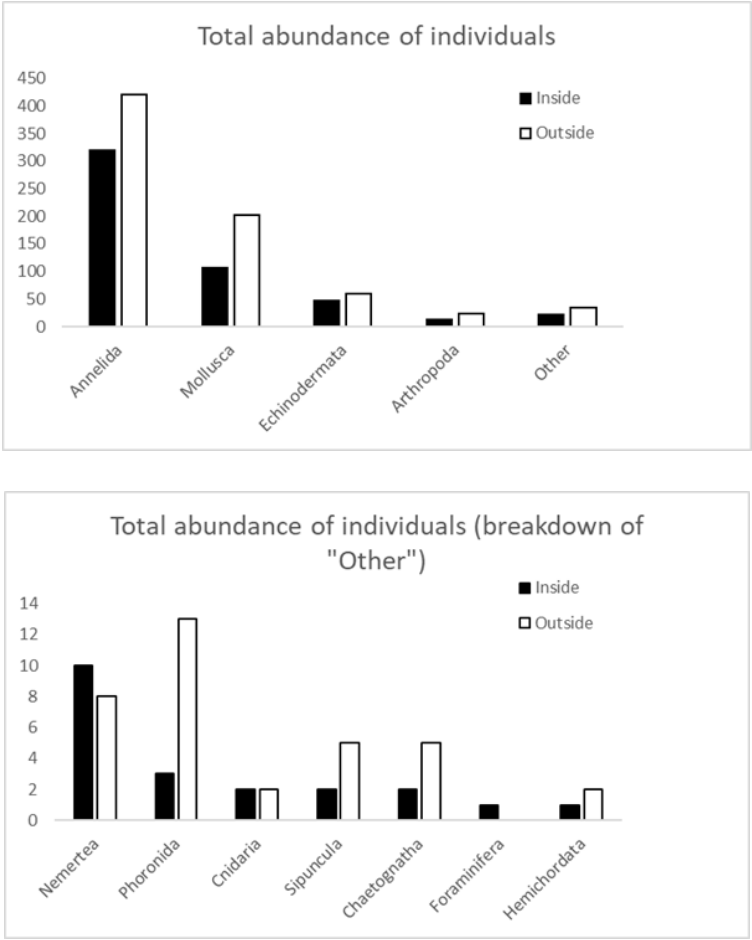

Figure 4. Total number of individuals by major phyla showing the increased abundance of annelids and molluscs at the two stations outside (OT3 and OT5) the Outer Tees disposal site when compared to the two stations (OT2 and OT4) inside the site, October 2021.

The overall assemblage composition is generally comparable among all stations, both numerically and in terms of species diversity (Figure 5). However, samples collected from station OT2, within the disposal site, contained a less diverse benthic assemblage and therefore appear more distant on the nMDS ordination from the other samples collected in 2021 (Figure 6). Bivalves, which were observed in high numbers across most stations, were not evident for two of the three replicates of OT2 (Figure 5). The high variability in the assemblages across the three replicates of OT2 mirrors that observed based on their sediment PSA data (Table 1, Table 2). The results of the Analysis of Similarity (ANOSIM) test (Global R = 0.47, p = 0.001) indicated that the benthic assemblage of OT2 is most like that of the nearby OT1 station, located inshore of the disposal site boundary. However, none of the pairwise comparisons where statistically significant, likely due to the small number of replicates collected from each station during 2021 limiting the maximum number of possible permutations.

A non-hierarchical flat clustering method, whereby group allocation is redefined iteratively and maximised through the ANOSIM R statistic, was performed in PRIMER to identify statistically different faunal groups. In total, six macrofaunal groups (A-F) were identified (R = 0.79). Most of the samples were categorised as faunal group “A” (18 samples) which included all replicates collected from station OT4 within the disposal site.

Samples from station OT2, also within the disposal site, comprised two groups (two replicates assigned to group “B” and one to group “C”).

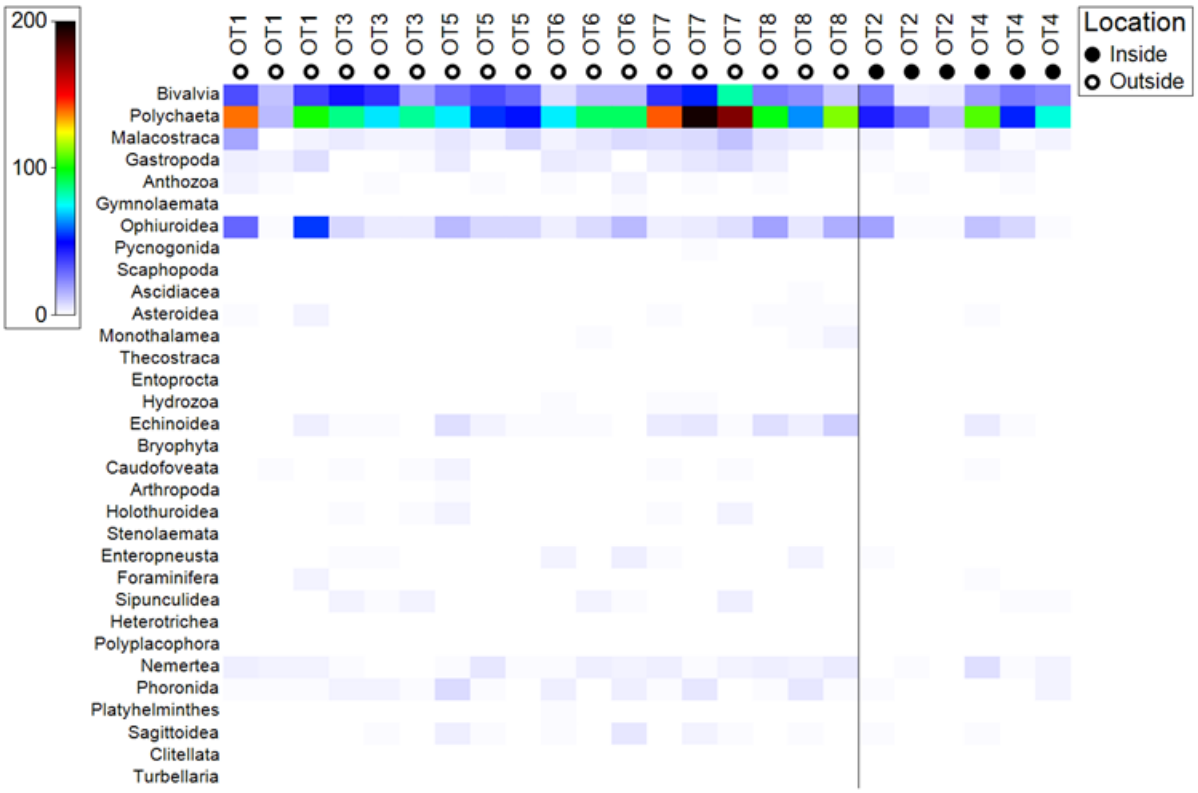

Figure 5. Abundance values (at the taxonomic level of Class) of the macrofaunal assemblages for the stations sampled at Outer Tees during October 2021.

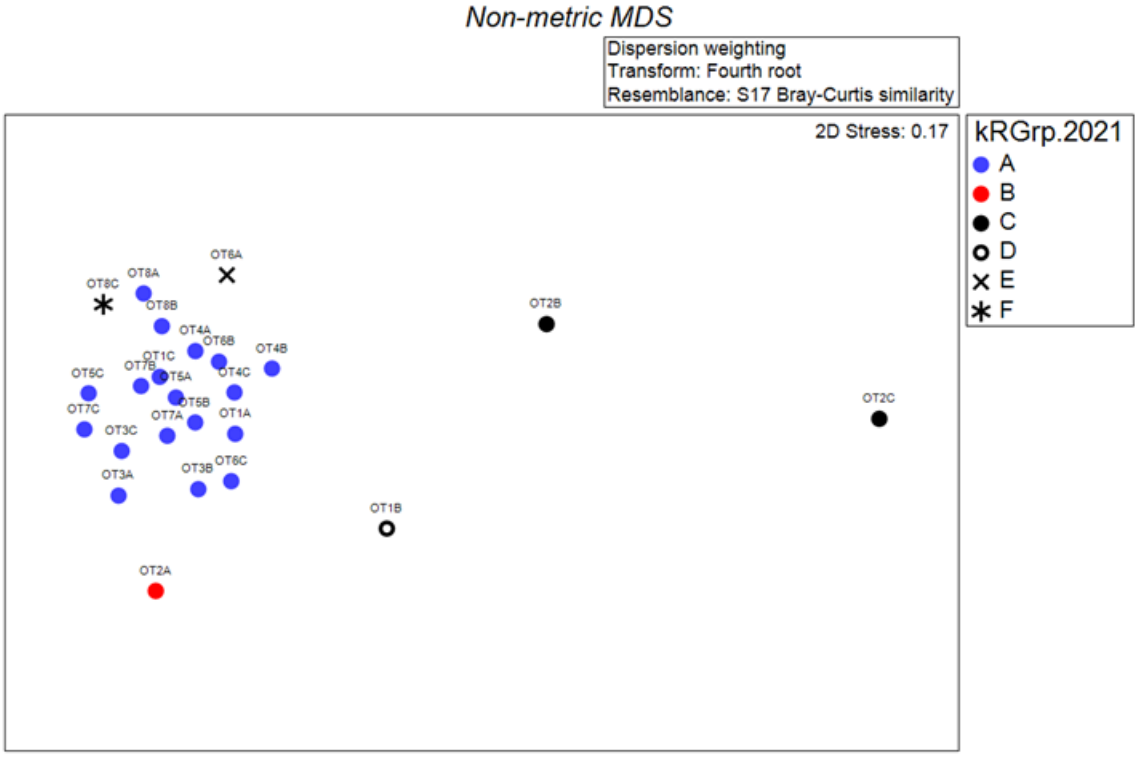

Figure 6. Non-parametric Multi-Dimensional Scaling ordination of the Bray-Curtis similarity scores showing the relative benthic assemblage similarity among samples collected in 2021 and their faunal group allocation (kRGroup).

The 2008, 2009, 2010 and 2021 macrofaunal datasets were analysed together to assess any broad change in community structure over time and determine if any differences among stations persist. Although grab type was not consistent over time, and stations OT5 and OT6 moved slightly in 2021, similar patterns were evident in the comparison of the benthic assemblage within and outside of the disposal site. The diversity, density and biomass of taxa collected from the Outer Tees disposal site, based on the overlap of the 95% confidence intervals for each univariate metric, generally remained consistent over time (Figure 7). However, samples from OT2 collected during the 2021 survey had the lowest diversity and fewest number of individuals recorded, an observation unlike that during previous surveys when this station witnessed the highest values of these metrics. Indeed, mean total density of individuals at OT2 in 2010 was almost double that for the other three stations sampled in that year, although this observation was not evident during 2008 or 2009 when its total densities were more equitable with those of other stations (Figure 7).

The benthic assemblage structure of samples collected from within and outside the Outer Tees disposal site over these years was assessed using the Similarity Percentage routine (SIMPER). There is only a small range (61% to 67%) in the percentage dissimilarity values when comparing inside and outside stations sampled in 2008, 2009, 2010 and 2021. Furthermore, there is a consistent and high degree of overlap on the nMDS ordination among samples collected within and outside of the Outer Tees disposal site in the years surveyed, with little evidence of large interannual variation (Figure 8). A similar pattern is evident based on the 2021 data, although two of the three replicate samples collected at station OT2 appears to be driving differences evident in the overall comparison of inside and outside the disposal site in this year.

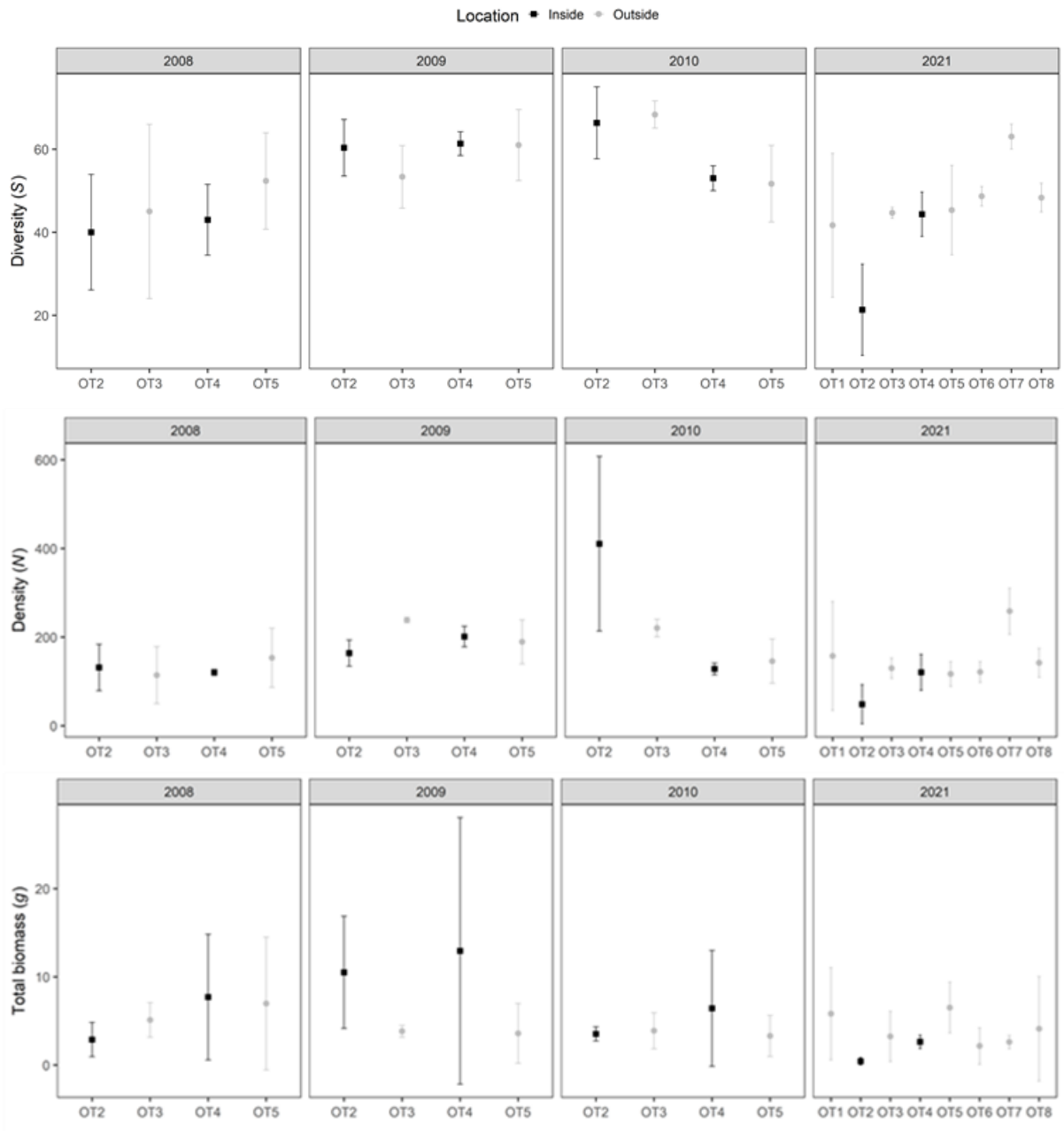

Figure 7. Temporal assessment of the diversity (number of taxa S), density (total abundance of individuals per 0.1m^2 N) and total biomass (g) contained within the samples inside and outside the Outer Tees disposal site in 2008, 2009, 2010 and 2021 showing the 95% confidence intervals of the mean values by station.

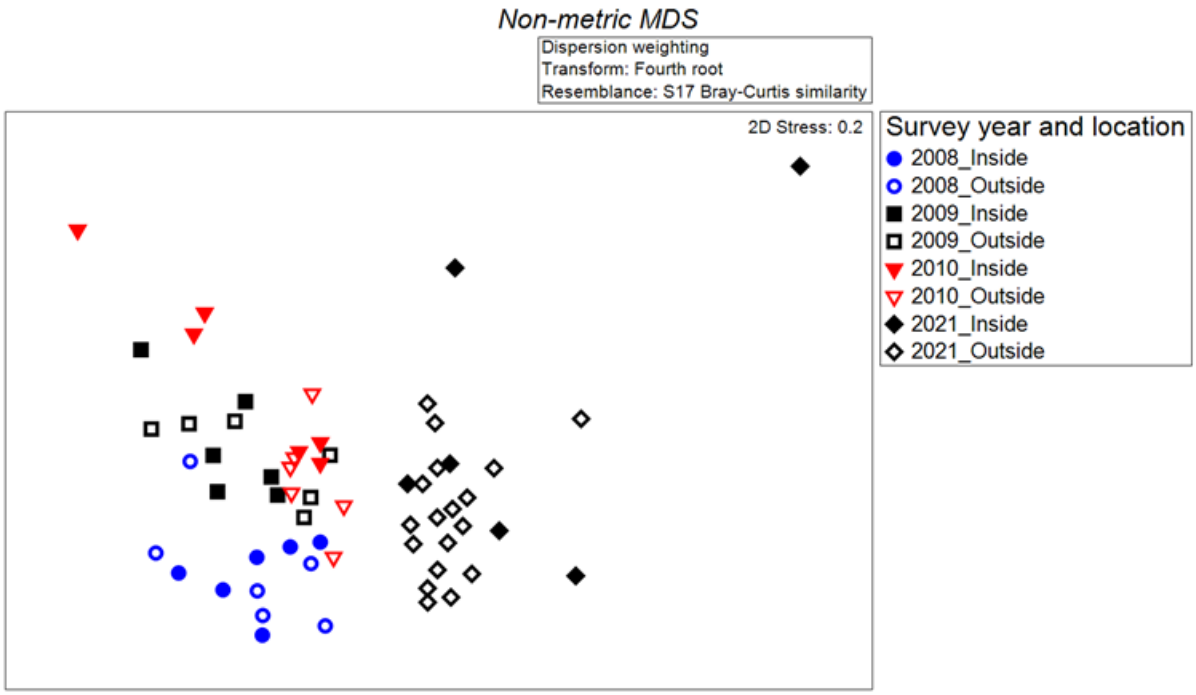

Figure 8. Non-parametric Multi-Dimensional Scaling ordination of the Bray-Curtis similarity scores showing a consistent pattern in the comparison of benthic assemblages inside and outside the Outer Tees disposal site sampled in 2008, 2009, 2010 and 2021.

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