ENVISION

Cromer Shoals Chalk Beds MCZ Chalk Impact Assessment

Jun / 2025

Imagery Analysis and Impact Assessment Report

Site

Cromer Shoals Chalk Beds MCZ

Prepared for

EIFCA

Prepared by

ENVISION

PREPARED FOR	EIFCA
TITLE	CSCB MCZ Chalk Impact Assessment
PROJECT REF.	mNCEA
DOCUMENT ID.	2025-161-001

DOCUMENT CONTROL

Version	Originator	Date	Status	Reviewed - Edited	Date
1	Alison Benson	26/03/2025	Draft	Jess Clarke	01/04/2025

Version	Status	Approved	Date
	Draft	Ian Sotheran	01/04/2025

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1. Introduction

The Cromer Shoal Chalk Beds Marine Conservation Zone (CSCB MCZ) along the north Norfolk coast is one of the most ecologically significant Marine Protected Areas for chalk habitats in the UK and Europe. The MCZ was designated for nine chalk, rock, and sedimentary habitats, and one geological feature, for which the conservation objectives were set as 'maintain in favourable condition' based on best available evidence at the time.

The Eastern Inshore Fisheries and Conservation Authority (EIFCA) are undertaking a Natural Disturbance Study over three years to better understand the level of natural degradation of exposed rugged chalk features of the MCZ and compare it to degradation caused by static fishing gear (e.g. pots or creels).

Six experimental areas have been established in areas with rugged chalk features, three where fishing with static gear (hereafter known as potting) is prevented (closed treatment) and three which are open to potting (open treatment). Change will be monitored by completing annual ROV camera surveys and high resolution multibeam bathymetric surveys in each of the six experimental areas. At the time of reporting, multibeam bathymetry surveys were undertaken in May and October 2024 and ROV surveys in July 2024. ROV surveys collected three tows in each experimental area, collecting seabed video footage using a downward facing camera, to observe and quantify chalk impacts.

2. Methodology

The objectives of the current study were to analyse the ROV imagery collected by EIFCA, comprising three ROV transects at each station. Three stations are in areas closed to potting (closed treatment), and three stations are in areas open to potting (open treatment).

Imagery was reviewed, processed and analysed as specified by EIFCA, with reference to the specified guidance (Tibbitt *et al.*, 2020[1]), and chalk impact categories were recorded as described in guidance provided (EIFCA, 2025[2]). Annotations were added to video imagery in BIIGLE annotation software[3] to identify areas of rugged chalk and to identify and quantify all observed chalk impacts.

2.1. Chalk Impacts Imagery Analysis

For the purpose of the analysis, impacts were defined as visible areas/patches of outcropping/exposed chalk which are white and fit into one of the eleven categories described in Tibbitt *et al.*, (2020), shown in Table 1, or the broad impact categories (shown in Table 2).

Where a specific Impact Category from Tibbitt *et al.*, 2020[1] could be assigned (Table 1), only that Impact Category was recorded. If a specific Impact Category could not be assigned, both a Broad

[1] *Tibbitt, F., Love, J., Wright, J., Chamberlain, J. 2020. Human Impacts on Cromer Shoal Chalk Beds MCZ: Chalk complexity and population dynamics of commercial crustaceans. Natural England Research Report number 04412*
[2] *EIFC,A 2025. Cromer Shoal Chalk Beds MCZ Natural Disturbance Study ROV Analysis guidance.*
[3] *https://biigle.de/*

Impact Category (Table 2) AND a Severity (Table 3) was recorded. For each impact the following metrics were recorded:

- Chalk impacts, as described in 'EIFCA, 2025' and Table 2 to Table 5 below, including:
  - Frequency
  - Type
  - Severity
  - Extent
  - Position

- Areas of rugged chalk were identified by adding a label to sections of the video footage (multi-frame annotation) to allow frequency of impact calculations to enable the proportion of the area that is rugged chalk to be calculated. 'Rugged Chalk' was defined as '*elevated and complex chalk features formed by outcropping bedrock*', based on the habitat categories adapted from O'Dell & Dewey (2022)[4]. Small spaces between the outcropping chalk, known as gullies, were included in the multi-frame annotations of 'Rugged Chalk', to capture these features.

- The frequency of impacts was standardised by distance surveyed (per 100m of tow) and tested for statistical differences between closed and open areas.

Details of the impacts recorded include the video timestamp, the corresponding time (BST) and position (WGS84) (taken from the track plot data and ROV position corrected for layback), and the impact category, severity, position, extent as well as presence of gear.

Table 1 Impact Categories from Tibbitt *et al.*, (2020), with associated severity and Corresponding broad impact category.

Impact category (Tibbitt *et al* 2020)	Associated severity (Tibbitt *et al* 2020)	Corresponding broad impact category
Abrasion	Low	Grates
Drag	Low	Grates
Burn	Low	Cuts
Strike	Medium	Strikes
Cut	Medium	Cuts
Lift	High	Strikes
Grating	High	Grates
Angular rubble	High	Rubble
Saw	High	Cuts
Level shear	High	Cuts
Unlevel shear	High	Cuts

[4] *O'Dell, J. and Dewey, S. 2022. Cromer Shoal Chalk Beds MCZ Imagery Analysis Final report. A report to Natural England by Seastar Survey Ltd. 63 pages.*

Table 2 **Broad Chalk Impact Categories**

Broad impact category	Description
Strikes	Areas of localised impact
Grates	Less localised damage or abrasion
Cuts	Impacts caused by ropes cutting into chalk
Rubble	Areas of spread chalk fragments

Table 3 **Severity of Impact from Tibbitt *et al.*, (2020)**

Severity	Definition
Low	Surface layer of chalk removed
Medium	Chalk structure broken but not removed
High	Chalk structure is broken and removed

Table 4 **Impact Extent from Tibbitt *et al.*, (2020)**

Impact extent	Description
Multiple small	Multiple small impacts in an area smaller than 2x2m
Hand	Area of impact estimated to be similar to the area of a hand (roughly <150mm in diameter)
Head	Area of impact estimated to be similar to the area of a head (roughly <200mm in diameter)
Arm	Area of impact estimated to be similar to the area of an arm (roughly <500mm in diameter)
Torso	Area of impact estimated to be similar to the area of a torso (roughly <1m in diameter)
Body	Area of impact estimated to be similar to the area of a body (roughly <2m in diameter)
Severe	Area of impact estimated to be larger than the area of a body (roughly >2m)

Table 5 **Impact Position from Tibbitt *et al.*, (2020)**

Impact position	Description
Seabed	On the seabed (for example if impact is to exposed flat chalk pavement)
Face (Bottom)	Bottom third of the face (generally vertical edge) of an outcropping feature
Face (Middle)	Middle third of the face (generally vertical edge) of an outcropping feature
Face (Top)	Top third of the face (generally vertical edge) of an outcropping feature
Top	On top of an outcropping feature
Multiple (Seabed and bottom)	Impact extends across multiple positions across seabed and bottom of outcropping feature
Multiple (Middle and top)	Impact extends across multiple positions across middle and top of outcropping feature
Multiple (whole face)	Impact extends across the whole face (generally vertical edge) (top, middle and bottom) of outcropping feature

3. Results

A total of 17 video tows were provided for analysis, as one tow was not suitable due to being located outside of the experimental area. For the 17 video samples/tows suitable for analysis, the footage was of 'good' to 'poor' quality. Where quality was assessed as 'poor', this was due the height of the camera system above the seabed, and/or low-resolution imagery with a green hue, which made it difficult to distinguish features. The camera system was positioned in a directly downward facing angle, which made it difficult to assess the elevation of chalk features, and the system had an unstable field of view which made it difficult to identify characteristics of the seabed.

Presentation of results shows the data from the six stations and treatments (Treatment ID) at each of three areas (East Runton – closed treatment (ERC), East Runton – open treatment (ERO); Sheringham – closed treatment (SHC), Sheringham – open treatment (SHO); West Runton – closed treatment (WRC), West Runton – open treatment (WRO)).

3.1. Rugged Chalk

Data were exported from BIIGLE, with the multi-frame 'rugged chalk' annotations including the time (decimal seconds) of the start and end of the frame, enabling the duration of each sample to be calculated. The mean percentage of rugged chalk was then calculated for each area and treatment, with comparison results shown in Figure 1.

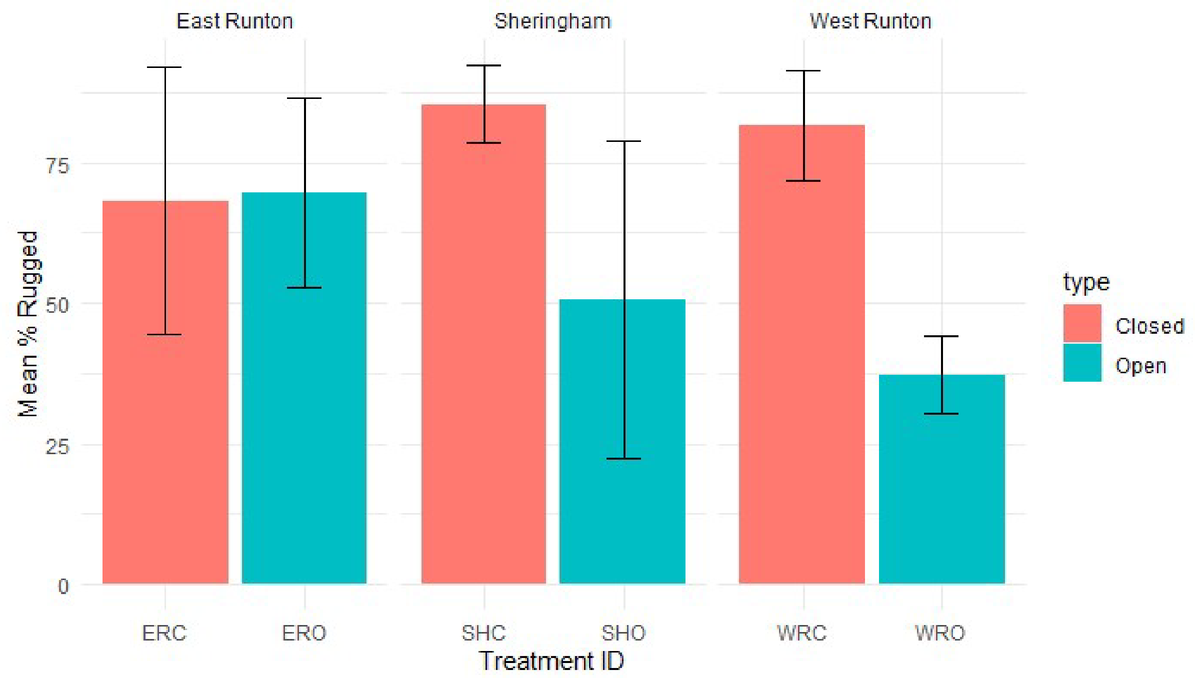


Figure 1.
Comparison of percentage of rugged chalk, averaged for each area and treatment type, with standard deviation.

The mean percentage of rugged chalk was shown to be higher for 'closed' treatments than 'open' treatments in some areas (Figure 1), however standard deviation indicates a high level of variability within the data, and low numbers of replicates reduce the power of statistical tests.

When all areas from this study are grouped together by closed or open treatments, pairwise comparison, using the 'Wilcoxon rank sum exact' test, showed that there was a significantly greater percentage cover of 'rugged chalk' when all closed treatment areas are compared to all open treatment areas (P<0.05: P=0.01).

However, pairwise comparison using the 'Wilcoxon rank sum exact' test showed the difference in percentage cover of 'rugged chalk' between closed and open treatments in individual areas was not significant (P>0.05: for East Runton, P=1.00; for Sheringham, P=0.38; for West Runton, P=0.43).

3.2. Chalk Impact Analysis

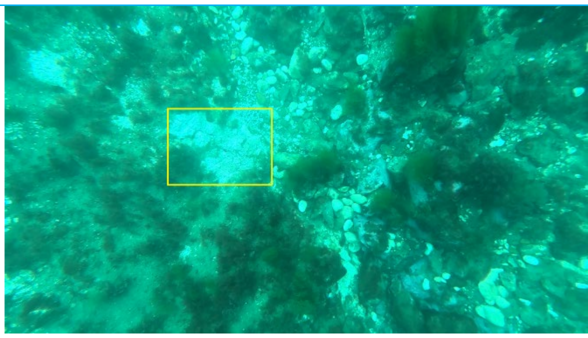
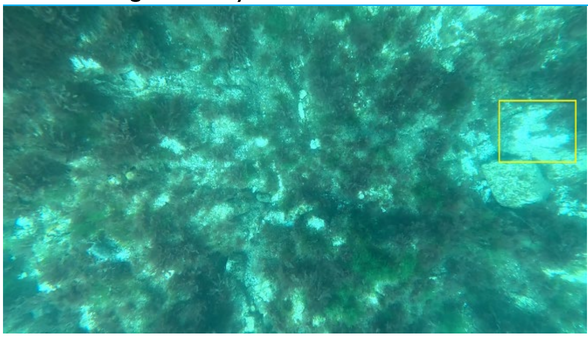
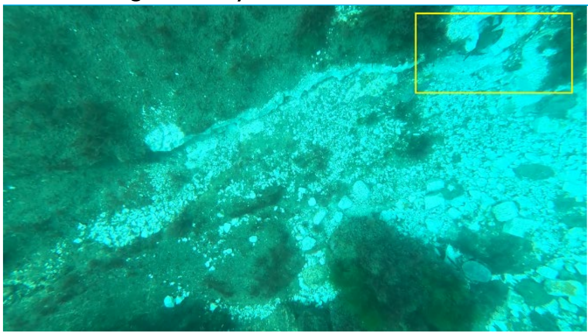
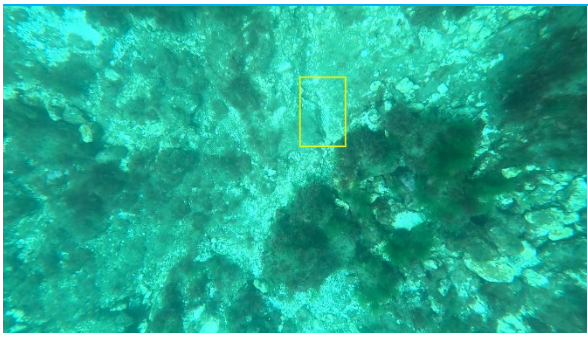
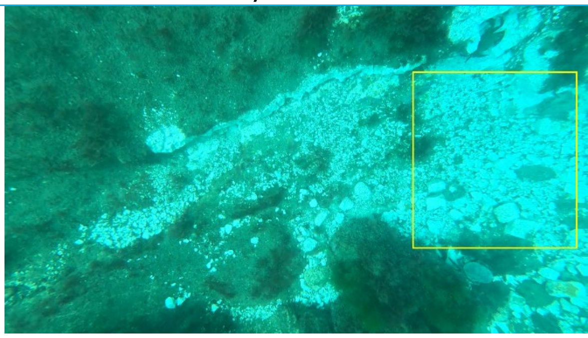
Data were exported from BIIGLE and extracted for input into the accompanying spreadsheet '2024_CSCBMCZ_NDS_ROV_master_data_Envision_20250328.xlsx'.

Tow details include the tow duration, length (calculated from ROV positions) and percentage cover of 'rugged chalk' and a summary of the frequency of impact types and severity, as shown in Table 6. Example images of the Broad Chalk Impact Categories identified and severities for each impact recorded are presented in Table 7.

Table 6 Summary of information recorded for each tow, including dive data, tow details and frequency of impact type and severity.

Dive Data		Tow Details			Impact Type				Impact Severity		
Tow	Dive ID	Duration (mm:ss)	Length (m)	% Rugged	Strikes	Grates	Cuts	Rubble	Low	Medium	High
1	2024_07_31_NDS_1	03:13	129	19	1	38	5	7	26	1	24
2	2024_07_31_NDS_2	04:07	131	62	1	43	3	1	22	0	26
3	2024_07_31_NDS_3	03:34	144	58	0	31	4	5	16	0	24
4	2024_07_31_NDS_4	03:03	148	75	1	41	1	6	27	1	21
5	2024_07_31_NDS_5	02:48	140	80	0	45	2	9	29	0	21
6	2024_07_31_NDS_6	02:43	140	83	2	72	8	3	48	2	35
7	2024_07_31_NDS_7	02:15	121	31	0	40	4	6	22	0	28
8	2024_07_31_NDS_8	02:15	138	43	0	31	3	9	20	1	22
9	2024_07_31_NDS_9	03:18	135	42	0	37	4	4	12	0	33
10	2024_07_31_NDS_10	02:54	134	89	0	41	5	5	18	0	33
11	2024_07_31_NDS_11	02:35	139	75	3	39	3	9	20	3	31
12	2024_07_31_NDS_12	Footage not usable									
13	2024_07_31_NDS_13	03:05	136	89	3	51	2	14	27	1	42
14	2024_07_31_NDS_14	04:25	114	74	1	29	4	29	16	0	27
15	2024_07_31_NDS_15	02:43	137	44	0	28	1	8	16	0	21
16	2024_07_31_NDS_16	02:24	148	71	1	55	8	13	31	1	45
17	2024_07_31_NDS_17	02:41	135	75	0	36	4	5	23	0	22
18	2024_07_31_NDS_18	02:48	127	45	0	25	2	7	13	0	21

Table 7 Example images of Broad Chalk Impact Categories and severities for each impact recorded.

 Strikes – High Severity	 Strikes – Medium Severity
 Grates – High Severity	 Grates – Low Severity
 Cuts – High Severity	 Cuts – Medium Severity
 Cuts – Low Severity	 Rubble – High Severity

3.3. Comparison of Frequency of All Impacts

The frequencies of all impacts (excluding the 'Rubble' category, as specified by the EIFCA) were standardised to 100m of tow and compared statistically and presented for each area and treatment, showing variability of the values recorded in the datasets (see Figure 2).

In Figure 2, values were averaged for each treatment, per area, with the black vertical line representing the minimum to the maximum values, the black horizontal line representing the median value of the data, and the dashed black horizontal line represents the mean value of the data. The coloured area below the median line represents the 25-50th percentile of data, and the coloured area above the median line represents the 50-75th percentile of data.

NB whilst an 'area surveyed' value was completed for each tow, this was based on an average field of view within the imagery of 2.5 square metres, calculated from the known dimensions of fishing gear (pots) observed on occasion throughout the imagery. As the field of view was variable throughout the imagery, it was considered more appropriate to standardise the data to 100m of tow, rather than area.

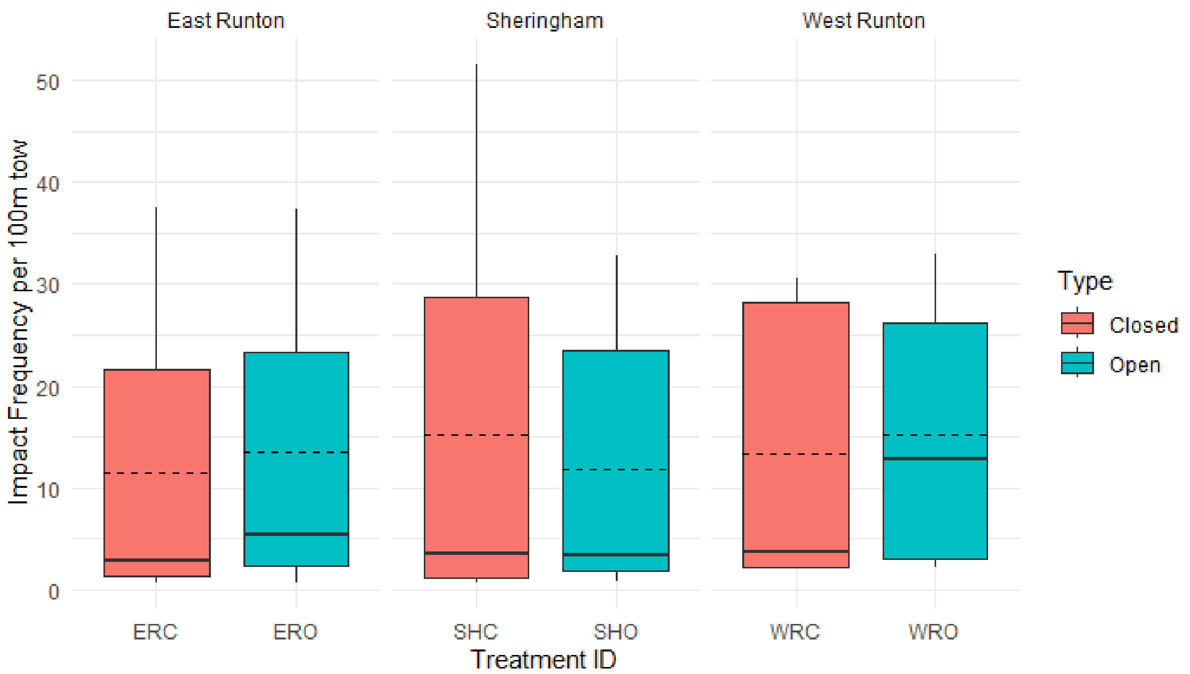


Figure 2.
Chart (box and whisker) comparison of impact frequency per 100m tow, for each area and treatment type, showing the minimum to maximum values (black vertical line), the median value (solid black horizontal line), and the mean value (dashed black horizontal line).

Figure 2 shows that impact frequencies were similar for open and closed treatments in Sheringham, or higher in open areas for East Runton and West Runton compared to closed areas.

However, when all areas were grouped together by closed or open treatments, comparison using a 'Kruskal-Wallis multiple comparison with Dunn' test showed there was no significant difference between the impact frequency in open and closed treatments ($P>0.05$: $P=0.57$).

Similarly, using the 'Kruskal-Wallis multiple comparison with Dunn' test, there was also no significant difference between frequencies of all impacts in open and closed treatments for any individual area ($P>0.05$: for East Runton, $P=0.68$; for Sheringham, $P=0.82$; for West Runton, $P=0.79$).

Again, there was high variability within the data and low numbers of replicates lower the power of statistical tests.

3.4. Comparison of Frequency of Low, Medium and High Severity Impacts

Severity of impacts were split into 'Low', 'Medium' and 'High' and compared between treatments, with the results shown in Figure 3.

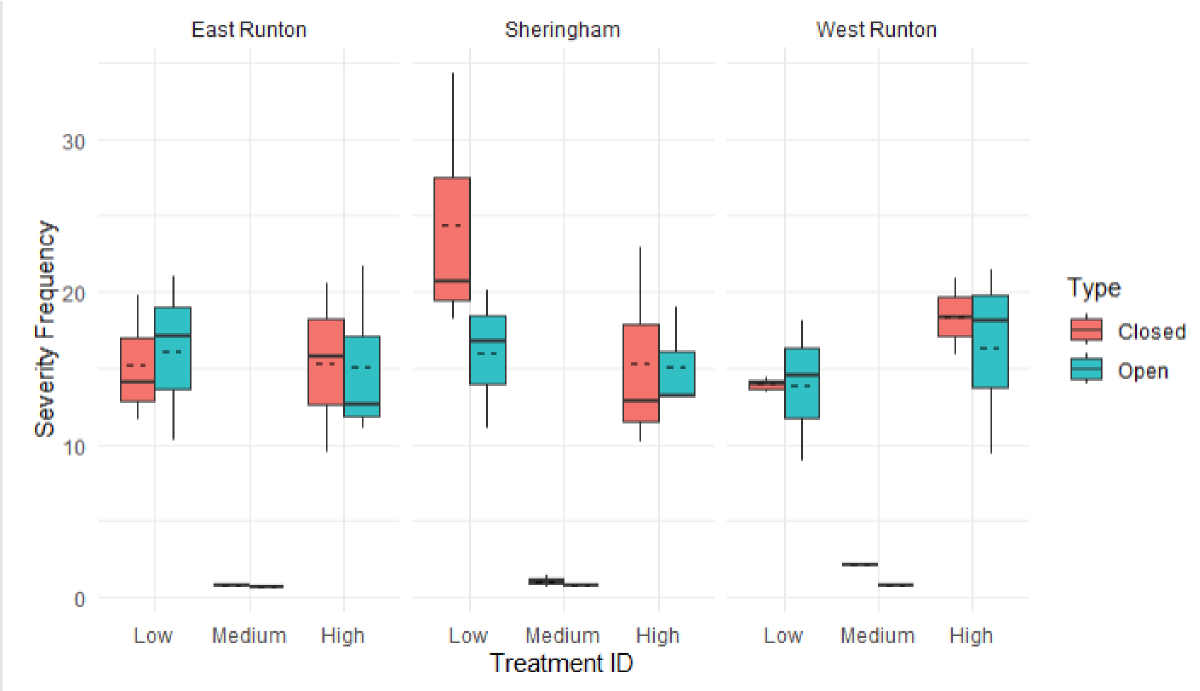


Figure 3.
Chart (box and whisker) comparison of frequency of different severities of impact per 100m tow, for each area and treatment type, showing the minimum to maximum values (black vertical line), the median value (solid black horizontal line), and the mean value (dashed black horizontal line).

Figure 3 shows no consistent trends within the frequency of impacts between areas. The comparison of 'Low' severity impacts differed between areas, with 'Low' severity impacts seen to occur more frequently in open treatments in East Runton and West Runton areas, but less frequently in open treatments in Sheringham.

In general, the medium severity impacts were the least commonly recorded, which may be attributed to the fact that there were fewer categories of 'Medium' severity impact (only 'Strike' and 'Cut' categories), with the qualifier 'Chalk structure broken but not removed', which may have been more difficult to ascertain from analysis of the imagery. Very little difference was observed between open and closed treatments.

'High' severity impacts appeared to occur at similar mean frequencies in open and closed treatments in Sheringham and West Runton, but at lower frequencies in open treatments in East Runton.

Statistical comparison on data from all areas grouped together by closed or open treatments (using a 'Kruskal-Wallis multiple comparison with Dunn' test) showed no significant difference between the severity of impact frequencies in open and closed treatments ($P>0.05$: $P=0.77$). There was also no significant difference between the severity of impact frequencies in open and closed treatments in any individual area (P>0.05: for East Runton, P=0.89; for Sheringham, P=0.77; for West Runton, P=0.75)

Regression plots and ANOVA tests were also undertaken, but these resulted in no significant relationships between severity of impact, ruggedness and open and closed treatments, and a high residual variance was noted.

4. Conclusions

In summary, the chalk impact data do not show any consistent trends between open and closed treatments at all levels (including frequency of all impacts across all areas and all impacts per area, and frequency of different severities of impact for all areas and different severities of impact in each area). This may be due to the limited length of time that treatments have been in place in the first year of this study, reflecting that levels of natural disturbance and potting impacts (both from current time and prior to the start of this study) are present to a similar degree.

Similar comparisons made in subsequent years of the study may detect changes with an increased chance for differences to be observed as treatments have an effect over a longer time period.

As there was a significantly greater percentage cover of ‘rugged chalk’ when all closed treatment areas are compared to all open treatment areas (P<0.05: P=0.01), it is recommended that future comparison of impacts between treatment areas and between years should take this factor into consideration. Future analysis could therefore involve recording impacts only in ‘rugged chalk’ areas, standardising results (e.g. impacts per 100m of video). Records of impacts from the current dataset would require transformation to ensure a comparable dataset.