Intertidal Periwinkle Surveys Annual Report 2025

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Summary

Gathering of periwinkles (*Littorina littorea*) occurs on rocky shores throughout the Northumberland IFCA (NIFCA) district both commercially and recreationally, with concerns raised by the public about levels of collection in certain areas.

This report presents the findings of NIFCA's 2025 intertidal periwinkle monitoring programme, assessing changes in periwinkle density, size structure, collection pressure and associated rocky shore communities across key sites on the Northumberland coast. Surveys were undertaken in June 2025 at Berwick, Boulmer, Cresswell, Holy Island and St Mary's, with additional seasonal monitoring at Berwick and Boulmer (South).

The results indicate that differences between sites remain more pronounced than changes over time. Periwinkle densities were consistently low at Berwick and Boulmer, while Cresswell, Holy Island and St Mary's generally supported higher densities; however, no statistically significant changes were detected within individual sites.

Collection pressure remained highest at Berwick, but no clear statistical relationship was found between collection intensity and periwinkle density or wider rocky shore community metrics. Shell size varied by site and shore height, with larger individuals generally recorded lower on the shore, and juveniles present at all sites, indicating continued recruitment.

Overall, the 2025 findings suggest that site-specific environmental factors strongly influence periwinkle populations and that there is limited evidence of sustained population or community change attributable to collection pressure alone. Continued annual monitoring is recommended, particularly at Berwick, where high collection intensity, low density and distinctive size structure remain key areas of concern.

Introduction

The periwinkle (*Littorina littorea*), known as the common or edible periwinkle, is commonly found around the coast of the United Kingdom (Moore, 1937; Smith & Newell, 1955). *L. littorea* is found in a variety of intertidal habitats including rocks, mud and sand however is most abundantly found on rocky shores (Smith & Newell, 1955; Storey et al., 2013). They prefer more complex rugose shore offering increased protection against predation and pressures of exposure at low tide (Carlson, 2006) and are often found in clusters in crevices or rockpools (Newell, 1958).

Periwinkle gathering occurs both recreationally and commercially on rocky intertidal areas up and down the Northumberland Coast. It is difficult to accurately assess the size of periwinkle fisheries as they are unregulated, under reported, and can be black market in nature (Cummins et al., 2002; Crossthwaite et al., 2012). There is a peak in price and demand at Christmas with more intense harvesting, however periwinkles are harvested year-round with summer demand from restaurants in France (Crossthwaite et al., 2012).

A PhD study was conducted by Tinlin-Mackenzie (2018) on intertidal collection within the Berwickshire and North Northumberland Coast (BNNC) SAC which covers a significant proportion of the NIFCA district from Alnmouth to north of the Scottish border. Overall, Tinlin-Mackenzie estimated that over 3 million periwinkles are removed from the BNNC SAC every year and the estimated economic value of the fishery was £133,982 in 2017.

Potential impacts of periwinkle gathering on rocky shores are reductions in their abundance, altered size structures of the population as a result of targeting the largest individuals, as well as altering community structure. Removal of *L. littorea* has the potential to reduce grazing pressure, increase algal cover, enhance sedimentation, and control the recruitment of sessile organisms (Petraitis, 1989; Crossthwaite et al., 2012). Physical disturbance of the habitat and organisms can also have negative effects, from trampling and stone turning (Fowler, 1999; Berthelon et al., 2004; Tyler-Walters, 2008; JNCC and Natural England, 2011).

NIFCA have noted intertidal collection on patrols since 2016 and conducted periwinkle surveys since 2020 to assess the impacts of this collection across various hotspots throughout the district. Initially, surveys were completed every 2 months between June 2020 until April 2021 at Berwick-Upon-Tweed, Boulmer Haven, Cresswell, Holy Island and St Mary's Island to understand more about differences in periwinkle density between shores and in relation to collection pressure over time, any impacts of periwinkle gathering on rocky shore communities, and periwinkle size at maturity.

From 2022 onwards, annual surveys have been completed in June at each of the five sites in addition to another site at Boulmer to the north of the bay, where Natural England had previously conducted monitoring assessments. Further to this, periwinkle densities were monitored quarterly at Berwick and Boulmer (south of the bay) due to concerns about potential impacts of collection at Berwick and the similar nature of the two sites. In 2025, surveys were conducted in June across all sites and at Berwick and Boulmer in November to capture any variations between summer and winter.

This report presents the outcomes of the 2025 surveys, as well as the changes since baseline surveys (June 2020) to feed into annual monitoring and control plans for periwinkle collection.

Methods

Site selection

Study methodology broadly followed Tinlin-Mackenzie (2018) in comparing communities impacted by different levels of periwinkle collection. The five sites included in the periwinkle surveys were identified based on known hotspots and areas where periwinkle collection had been observed during officer patrols between 2016-2020. From these activity sightings, the number of patrols, number of collectors involved, proportion of patrols where collection was observed and subsequent average number of collectors observed per patrol allowed for these sites to be ranked based on the intensity of periwinkle collection. In 2022, a new survey site was added, to the north of Boulmer Bay (called Boulmer N from now, compared to Boulmer S, the original survey site at Boulmer). This site was only surveyed in 2022 and has not been surveyed since then.

Survey methods

For the annual monitoring that took place in June 2025 across all five sites, 15 0.25m^2 quadrats were placed on the intertidal rocky shore randomly along set transects perpendicular to the shore, with five each in the lower, middle and upper shore zones. Within each quadrat, all periwinkles were counted and shell height measured using Vernier callipers. Macroalgae (seaweed) and other faunal (animal) taxa was recorded to species level where possible. Count data were recorded for most faunal taxa, while percentage cover was used for sessile invertebrates (e.g. barnacles), macroalgae and encrusting algae or lichen. Within the same quadrats, percentage cover of substrates was recorded (exposed bedrock, boulders, cobbles, pebbles, gravel and sand).

Timed searches were also carried out where officers manually searched for periwinkles for five minutes to include areas unsuitable for quadrat surveys such as within rockpools, in crevices and under boulders. Density (number found per minute) was calculated.

The surveys in November 2025 at Berwick and Boulmer used the same quadrat survey technique across the lower, middle and upper shore zones and timed search methodologies, however only periwinkle density and sizes were recorded.

Analysis

Only surveys in June where all sites were surveyed were included in analysis. All months and survey sites were used to analyse changing periwinkle density over time. Median densities of periwinkles were calculated per quadrat for quadrat surveys, and per minute for timed searches, and compared between locations using the Kruskal-Wallis and pairwise post-hoc Dunn tests.

Total abundance of faunal counts and summed percentage cover of algae, faunal (count and percentage) and algal species richness (number of species), and faunal and algal Shannon Weiner diversity (H) index were calculated for each quadrat. The median values were compared between sites using the Kruskal-Wallis and pairwise post-hoc Dunn tests. Community structure was analysed using Bray-Curtis Similarity index on log(x+1)-transformed averaged data to down-weigh dominant species abundances and bring out the signals of less common species. Average percentage cover of sediment types was compared between shores and Bray-Curtis index on averaged data used to analyse similarity between sites in terms of sediment composition.

Correlations between periwinkle density and substrate types in addition to community measures of abundance/cover, species richness and Shannon diversity in each quadrat were analysed using a negative binomial GLM to take account of the over-dispersion in the count data.

In 2021 surveys the number of small periwinkles (<11mm shell length) was being underestimated (Figure 1) therefore when comparing quadrat periwinkle density over time, and periwinkle sizes over time, periwinkles smaller than 11mm were removed from the analysis. All sizes were included in the analysis of timed search densities over time since not all periwinkles were measured.

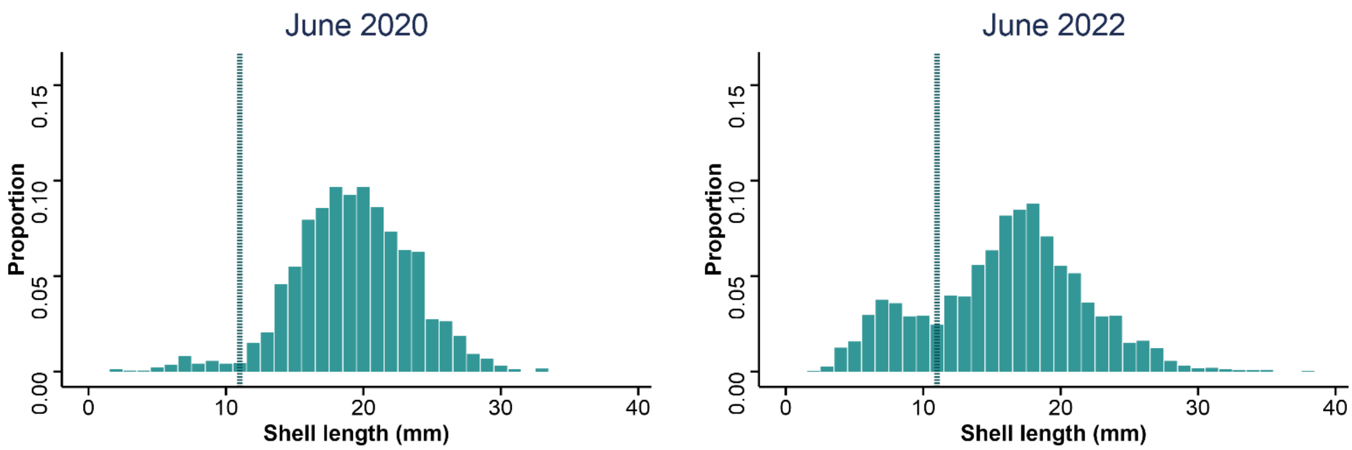

Figure 1: Periwinkle sizes measured in June 2020 and 2022, showing fewer small periwinkles identified in 2020.

Results

Collection intensity

Sites were ranked by collection pressure based on data from NIFCA patrols between 2016-2020 and 2021-2025 (Table 1). Due to the close proximity of Boulmer N and Boulmer S and the location of the car park at Boulmer, sightings have been combined for the Boulmer site. The location of the Boulmer N site is further to the north and partially obscured from view from the car park, therefore the amount of collection is probably underestimated in this area.

The overall ranked order of the sites remained unchanged between the 2016-20 and 2021-25 sightings data (Table 1). Collection intensity, average number of collectors seen per patrol, remained the same at Berwick between the years, however declines were seen across the remaining four sites. The largest percentage decline was observed at St Mary's, which saw a decline in the average number of collectors seen per patrol of 21%. The average decline across the five sites was 11%, showing a widespread decline in collection intensity throughout the district. Boulmer was the only site where the intensity of collection changed between years, moving from a medium intensity to low.

There has been a significant increase in overall patrol effort between 2016-20 and 2021-25, with a greater number of patrols undertaken to target the areas of high intertidal collection activity.

The maximum number of collectors at each site did seem to increase in 2021-25 across three of the five sites, with the largest increase seen at Boulmer, increasing by 50%. Across all sites, the maximum number of collectors witnessed at any one time increased by 18%, although it is worth noting that these percentage changes only reflect a small number of collectors.

Table 1: Collection pressure classifications of each site, from NIFCA intertidal patrols between 2016-2020 and 2021-2025. Showing total number of patrols, the proportion of patrols periwinkle harvesting was sighted on, the average number of collectors per sighting of periwinkle harvesting, the average number of collectors per patrol (proportion of patrols x average number per sighting), the maximum number of collectors sighted on a single patrol, and collection intensity based on average number of collectors per NIFCA patrol (<0.1 = Very Low, 0.1-0.5 = Low, 0.5-1 = Medium, >1 = High). Sites were then ranked against one another based on the average number of collectors per NIFCA patrol.

Location	Year	Number of patrols	Proportion of patrols activity sighted	Average no. of collectors per sighting	Average no. of collectors per patrol	Max. no. collectors	Collection Intensity Rank	Collection Intensity
Berwick	2016-20	36	0.72	2.77	2.00	7	1	High
	2021-25	119	0.67	2.98	2.00	8	1	High
Boulmer N	2016-20	54	0.15	2.77	0.33	4	-	Low
	2021-25	156	0.12	2.67	0.31	6	-	Low
Boulmer S	2016-20	9	0.67	3.00	2.00	4	-	High
	2021-25	25	0.60	2.67	1.60	4	-	High
Boulmer Combined	2016-20	63	0.22	2.57	0.57	4	5	Medium
	2021-25	181	0.18	2.67	0.49	6	5	Low
Cresswell	2016-20	28	0.32	1.89	0.61	4	4	Medium
	2021-25	100	0.27	1.93	0.52	4	4	Medium
Holy Island	2016-20	17	0.35	2.83	1.00	7	2	Medium
	2021-25	41	0.41	2.29	0.95	7	2	Medium
St Mary's	2016-20	47	0.30	2.79	0.83	4	3	Medium
	2021-25	184	0.26	2.55	0.65	5	3	Medium

Site Characteristics

Analysis of dissimilarity in substrates across the surveyed sited identified clear patterns in similarity between locations. Berwick and Cresswell, and Boulmer N and Boulmer S shared the highest similarities between sites, at 87%, with very similar high proportions of exposed bedrock and the remainder mostly sand, with very little intermediate sized mixed sediment (Figure 2a & Figure 2b). St Mary's displayed moderate dissimilarity to other sites, highlighting some differences in sediment composition whilst also sharing some similar characteristics. Holy Island showed the lowest similarity to any of the other sites. Holy Island and St Mary's displayed more mixed sediment types of different sizes, though only shared 39% similarity with each other. St Mary's had very little sand while Holy Island was almost 50% sand cover and had the lowest proportion of exposed bedrock.

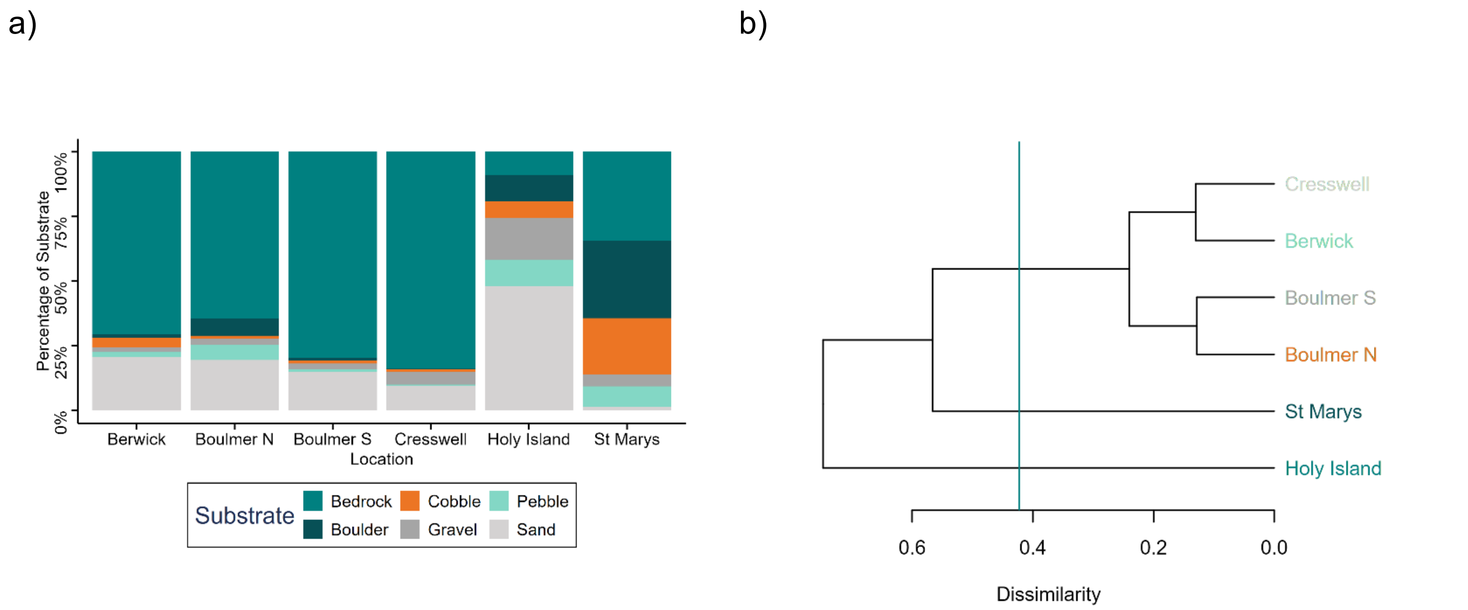

Figure 2: Comparison between survey sites of a) substrate composition in terms of the mean percentage cover from quadrat surveys, and b) Bray-Curtis dissimilarity matrix showing the similarity of sites in terms of their sediment composition. Line shows the mean dissimilarity score for all sites.

Periwinkle Density

Quadrat

Median periwinkle density from quadrats varied significantly across the surveyed sites, with Berwick and Boulmer (both North and South) consistently lower than other sites (Figure 3 & Figure 4), and the remaining sites largely similar. The densities at Berwick and Boulmer have not significantly fluctuated across the survey period. These sites also display reduced intra-site variation compared to the other sites surveyed across the same period, with significantly smaller confidence intervals. Conversely, whilst no clear trend in median periwinkle density at Holy Island was identified across the survey period, there was significant intra-site variation, particularly in June 2020 where confidence intervals were larger than those for any other site, for any year. Both Cresswell and St Mary's have also fluctuated over the years and displayed some intra-site variation, with densities at both site appearing to reduce in 2023 and 2024 before increasing in 2025, most notably at St Mary's. Cresswell however does appear to display an overall declining trend in density since the peak in 2022. Across all surveys at all sites, there was no statistically significant difference between surveys within the same site.

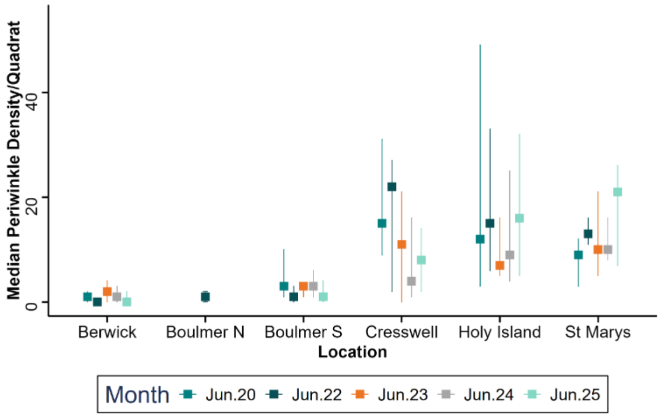

Figure 3: Median periwinkle density (above 11mm) at survey locations between June 2020 and 2025, measured as count per quadrat, separated by location. Error bars denote 95% confidence intervals.

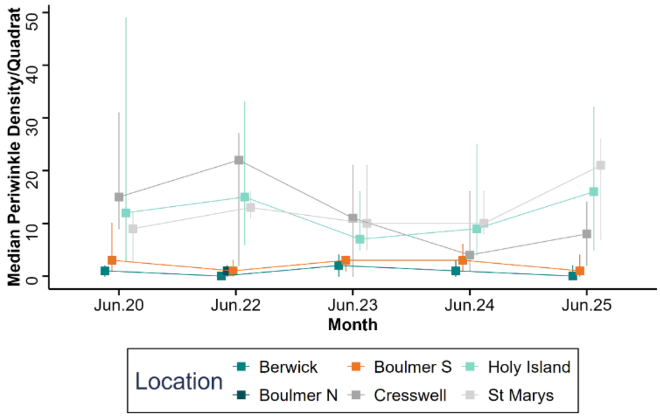

Figure 4: Median periwinkle density (above 11mm) at survey locations between June 2020 and 2025, measured as count per quadrat, separated by month. Error bars denote 95% confidence intervals.

Timed Searches

As observed in the quadrat density data, the sites at Berwick and Boulmer displayed consistently lower densities than other locations surveyed (other than Boulmer in 2024) (Figure 5 & Figure 6). Densities at Cresswell have declined over time, Holy Island and St Mary's have fluctuated but are stable over time. Intra-site variation at Cresswell was particularly high with large confidence intervals at both Cresswell and Holy Island. The data indicates that site-specific differences dominate over temporal trends. Across all surveys at all sites, there was no statistically significant difference between surveys within the same site.

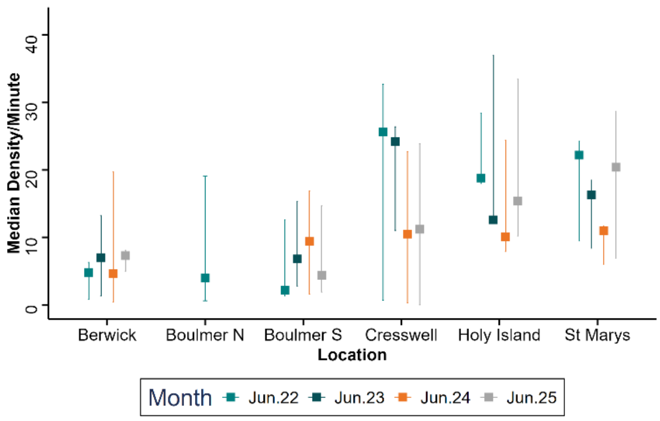

Figure 5: Median periwinkle density at survey locations between June 2022 and 2025, measured as count per minute, separated by location. Error bars denote 95% confidence intervals.

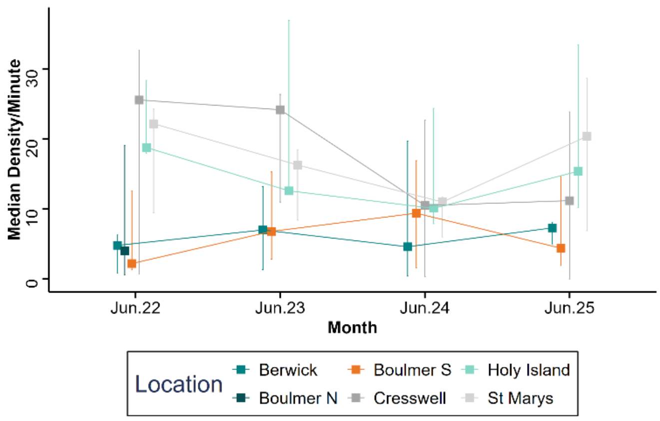

Figure 6: Median periwinkle density at survey locations between June 2022 and 2025, measured as count per minute from timed searches, separated by month. Error bars denote 95% confidence intervals.

Density and Collection Pressure

Whilst clear differences in collection intensity can be seen between surveyed sites, it is difficult to identify any meaningful relationships between collection intensity and periwinkle density in both quadrat and timed search surveys (Figure 7 & Figure 8).

Spearman's rank correlation was used to assess the relationship between collection pressure and periwinkle density across sites. No significant relationship was found between the average number of collectors per patrol and periwinkle density, either for quadrat density ($\rho = -0.143$, $p = 0.496$) or timed density ($\rho = -0.059$, $p = 0.806$). Although both measures of density showed a weak negative relationship with collection intensity, these trends were not statistically significant.

These results suggest that collection pressure does not influence periwinkle density across the sites.

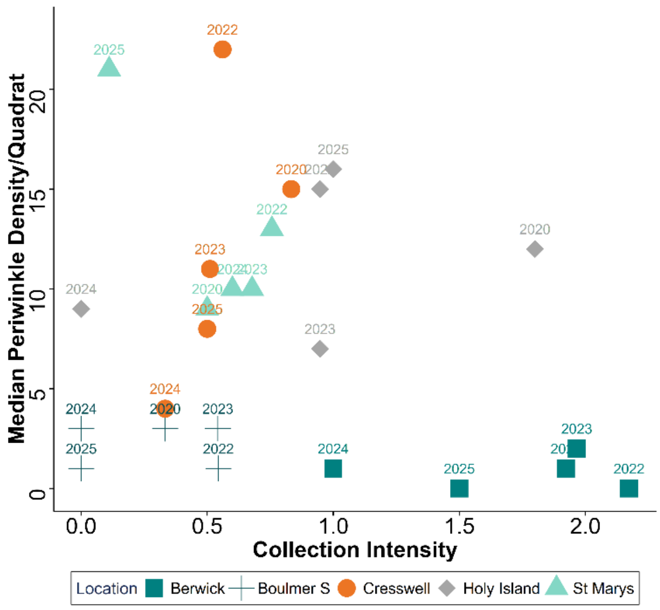

Figure 7: Median quadrat periwinkle density from the June surveys plotted against the collection intensity (average number of collectors per NIFCA patrol) across all surveyed years.

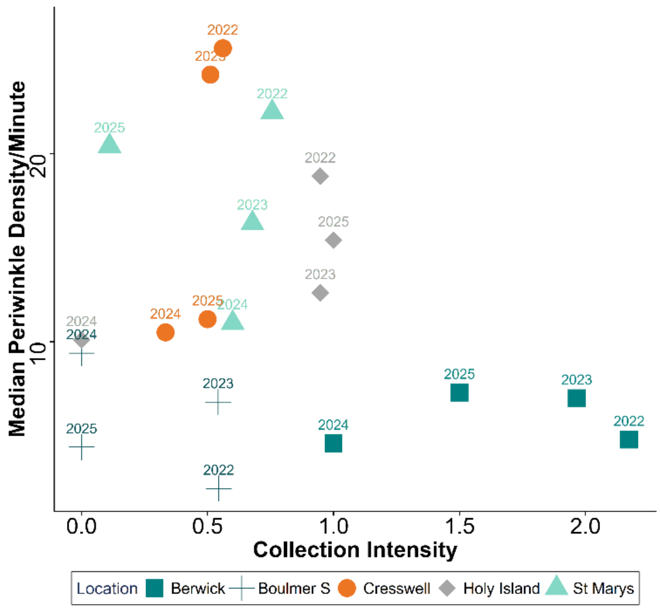

Figure 8: Median timed search periwinkle density from the June surveys plotted against the collection intensity (average number of collectors per NIFCA patrol) across all surveyed years.

Periwinkle size

Median periwinkle size variations over time were highly site-specific with pairwise post hoc comparisons of shell length between survey years showing that temporal patterns differed among locations (Figure 9).

There were no significant differences in shell length over time at any site apart from at Berwick in 2024, and St Mary's in 2020 (all adjusted $p < 0.001$). At Berwick median periwinkle size was typically higher than any of the other survey sites. Multiple years shared groups of significance upon review of the compact letter displays, with June 2024 sharing similarities with both June 2020 and June 2023, while differing from June 2022 and June 2025. This pattern suggests that June 2024 occupied a position where its values overlapped statistically with those of some years but differed significantly from others.

At St Mary's, shell length has decreased since the 2020 survey, it has remained stable across subsequent years with no significant temporal variation.

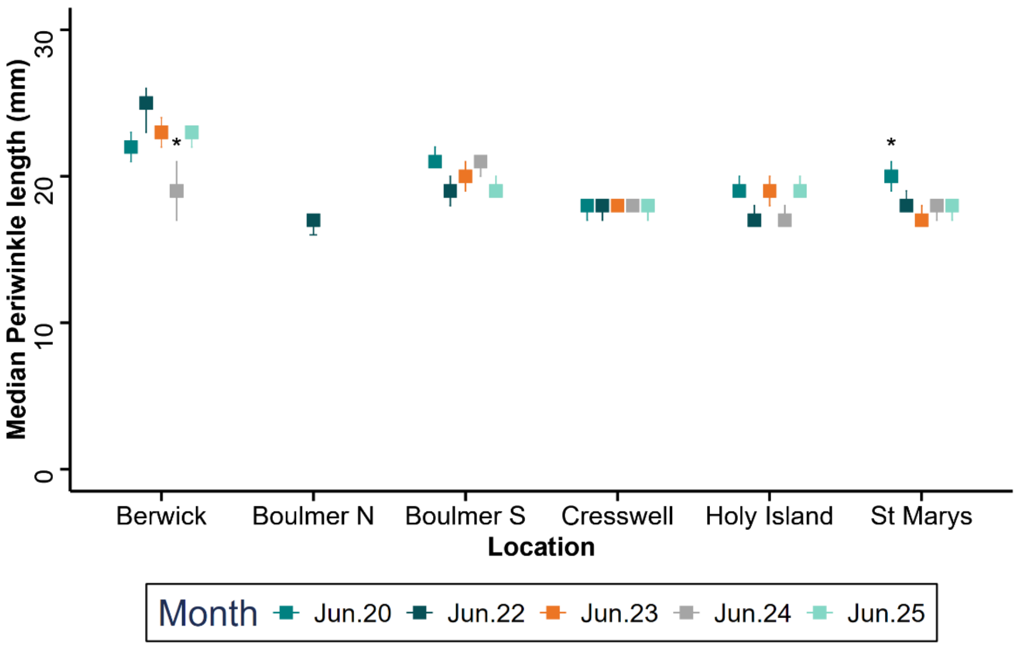

*Figure 9: Median periwinkle shell length (mm) from quadrat and timed searches compared between locations for periwinkles over 11mm. A significant difference is denoted by *. Error bars denote 95% confidence intervals.*

Proportional shell length frequencies across the sites surveyed in 2025 varied between sites (Figure 10), however all sites showed unimodal distributions, indicating predominantly single cohorts of adult individuals rather than distinct recruitment pulses. Juveniles (<10mm) were present at every location but formed only a small proportion of each population, although they were relatively more common at Holy Island and Cresswell than at Berwick. Overall, the distributions suggest a north-to-south gradient in shell size. Berwick contained the largest individuals, with the modal size around 23–24mm, whereas St Mary's was dominated by smaller individuals around 16mm. Holy Island and Cresswell were intermediate, with peaks at 19–20mm and 18mm, respectively, while Boulmer S was around 20mm.

Overall, the data indicates a weak positive relationship between average numbers of collectors per patrol and median periwinkle size, but this relationship was not statistically significant (Spearman's rank correlation: $\rho = 0.355$, $p = 0.081$). Whilst not statistically significant, the median periwinkle size at Berwick when plotted against collection intensity is notably distant from the other sites (Figure 11).

Median periwinkle shell size decreased significantly with increasing shore height (Spearman's rank correlation: $\rho = -0.778$, $S = 135{,}257$, $p < 0.001$). The strong negative correlation indicates that larger periwinkles were generally found lower on the shore, while smaller individuals occurred at higher shore heights (Figure 12).

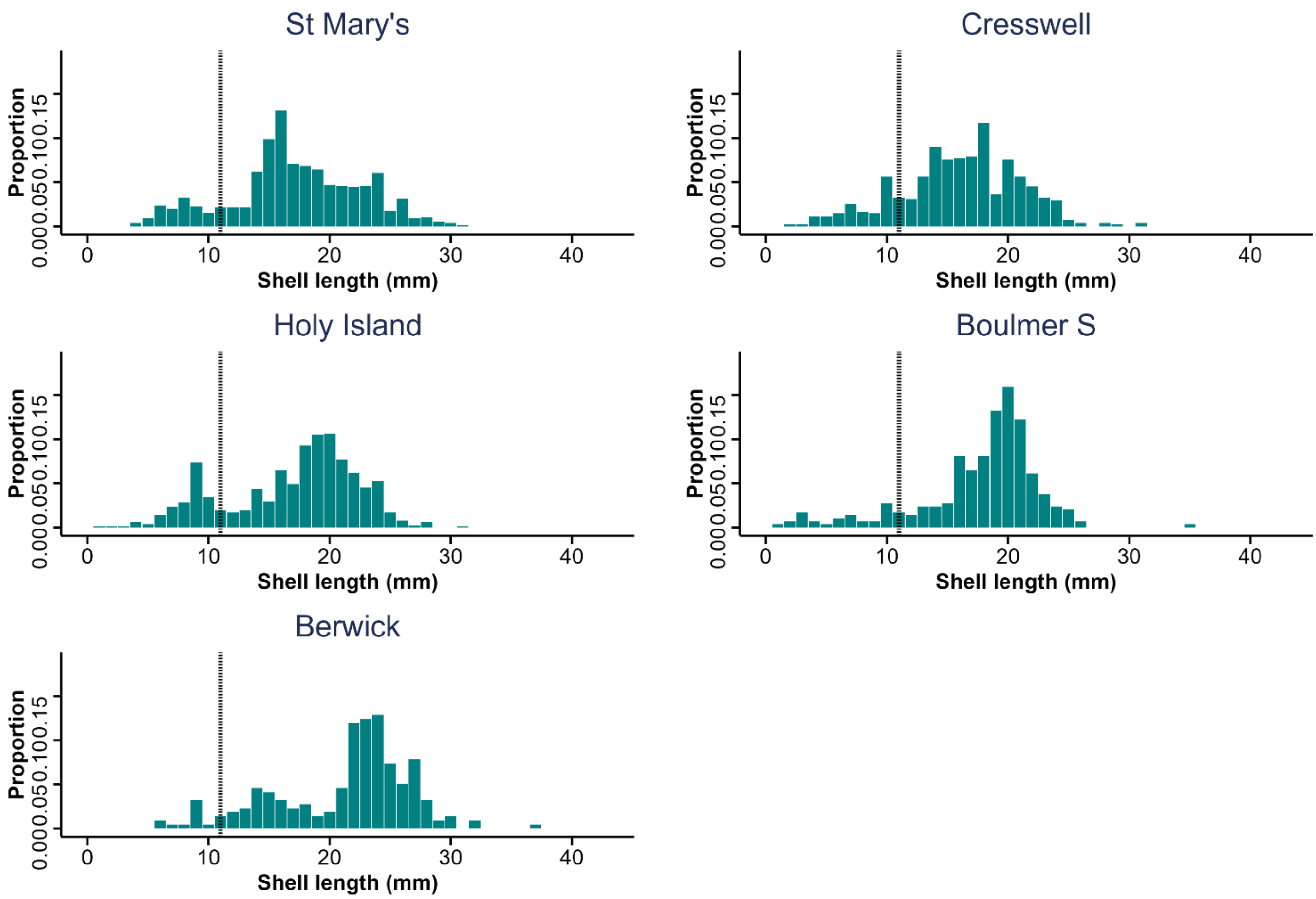

Figure 10: Periwinkle shell length proportional frequencies at different survey locations in June 2025, showing each shell length as a proportion of the total number of periwinkles at that location. The dashed line denotes a shell length of 11mm.

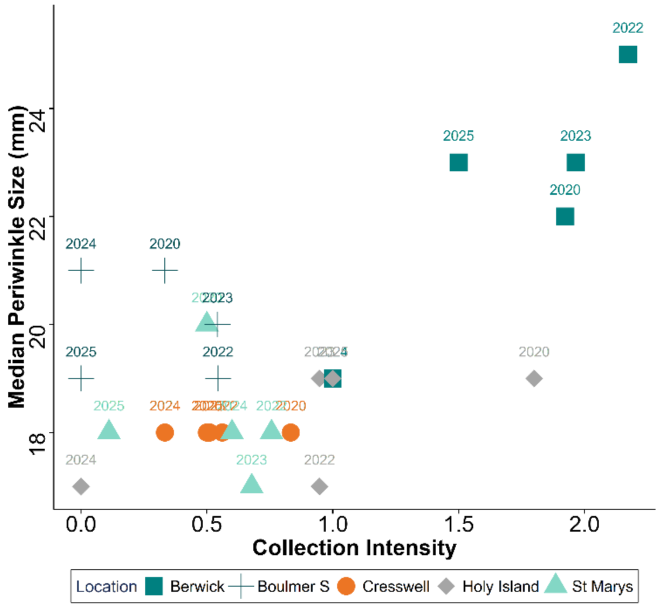

Figure 11: Median periwinkle size from the June surveys plotted against the collection intensity (average number of collectors per NIFCA patrol) across all surveyed years.

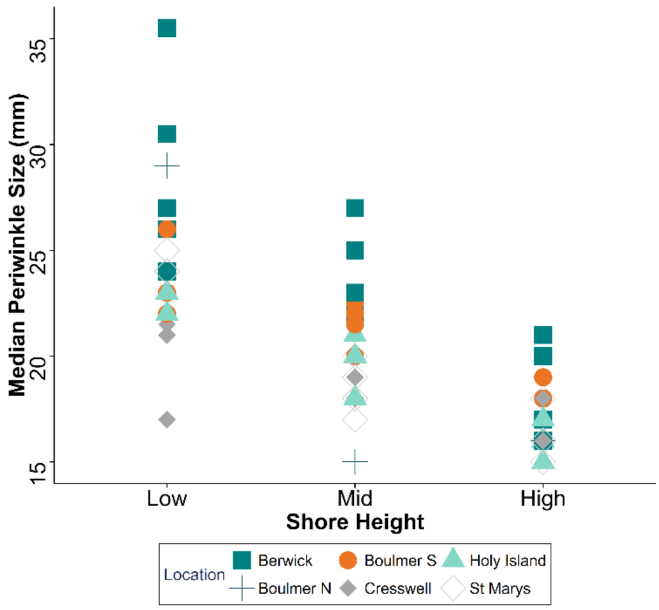

Figure 12: Median periwinkle size plotted against shore height for each survey site across all surveyed years.

Berwick and Boulmer

Median periwinkle densities from timed searches varied over time at both Berwick and Boulmer S, with wide confidence intervals indicating substantial within-site variability (Figure 13). Densities at Berwick ranged from approximately 1.1 to 7.3 individuals per minute, while Boulmer S generally supported similar or lower densities, although occasional higher values were recorded. Despite this variability, no significant temporal differences in periwinkle density were detected at either site (Berwick: $\chi^2 = 10.4$, df = 19, p = 0.942; Boulmer S: $\chi^2 = 10.4$, df = 18, p = 0.919). Post-hoc Dunn's tests identified no significant pairwise differences between sampling periods, indicating no detectable seasonal or interannual trends. Apparent peaks in density, including at Berwick in November 2025, were associated with wide confidence intervals and were not statistically significant.

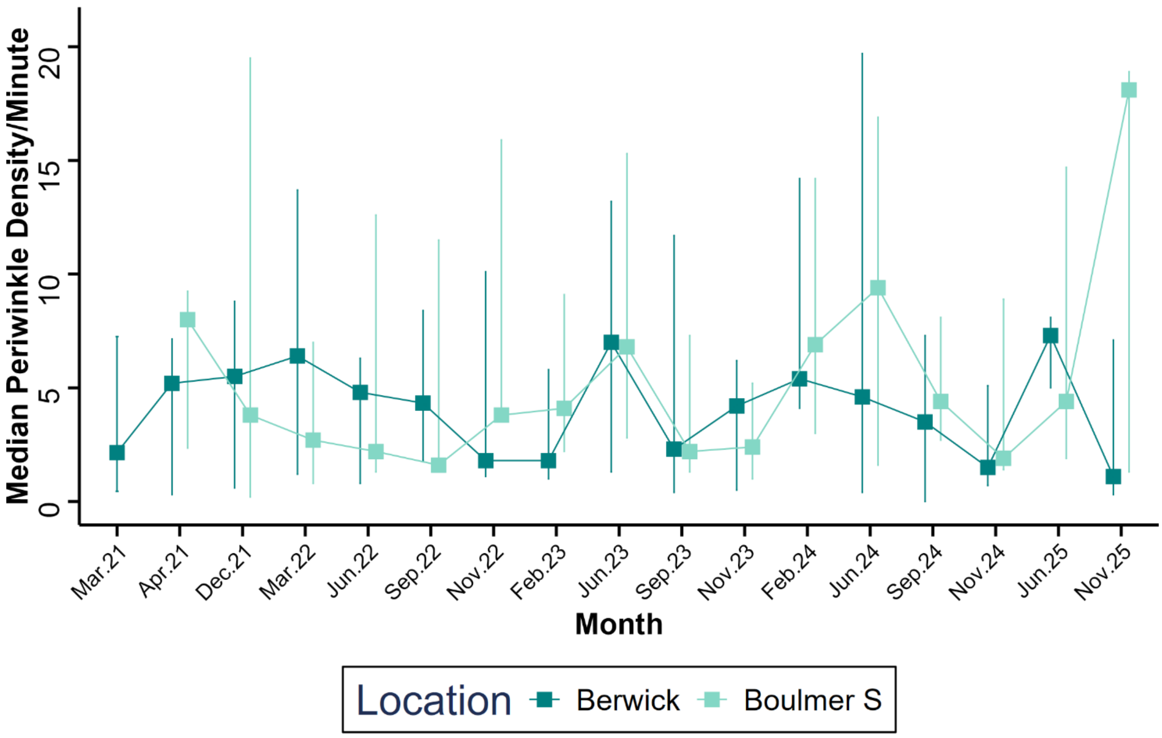

*Figure 13: Periwinkle densities (count per minute) at Berwick and Boulmer S in spring, summer, autumn and winter. A significant difference is denoted by *. Error bars denote 95% confidence intervals.*

Rocky shore community

Fauna

Median abundance of fauna (excluding periwinkles) varied between locations and survey years, with large confidence intervals reported consistently across multiple years (Figure 14), highlighting intra-site variability. Whilst all sites displayed interannual variability, a clear trend of decline is exhibited at St Marys, where median abundance showed a gradual decline throughout the study, from 20 individuals per quadrat in 2020 to 8 in 2025. Across all years, Holy Island consistently reported the lowest faunal abundance.

Across most sites, no trends or statistically significant changes in faunal species richness were observed there was high intra-site and interannual variability across most sites and large confidence intervals. Significant changes between years were observed at Holy Island and St Mary's in 2024, with both sites showing a decline from 2020 to 2024 and an increase in 2025 (Figure 15). Faunal diversity declined at St Marys across the survey years, although not significantly (Figure 16), and still maintains a higher diversity than all other sites.

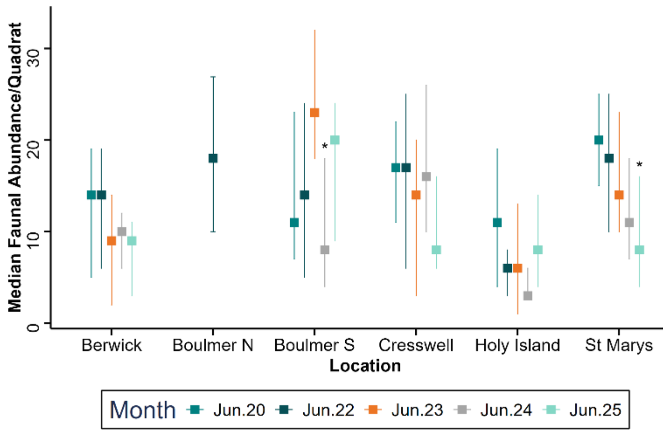

*Figure 14: Median faunal abundance from the June surveys across all sites. A significant difference is denoted by *. Error bars denote 95% confidence intervals.*

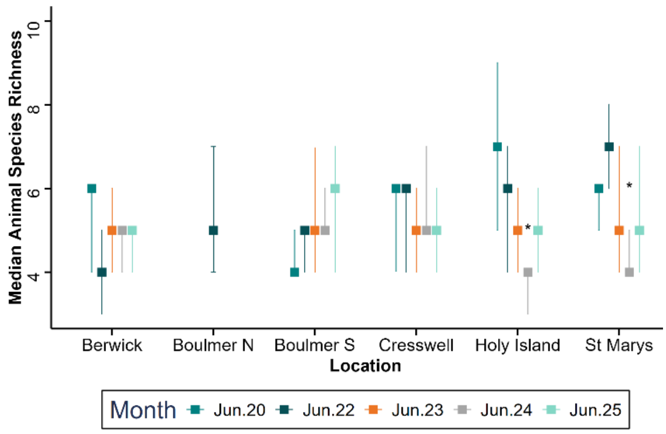

*Figure 15: Median faunal richness from the June surveys across all sites. A significant difference is denoted by *. Error bars denote 95% confidence intervals.*

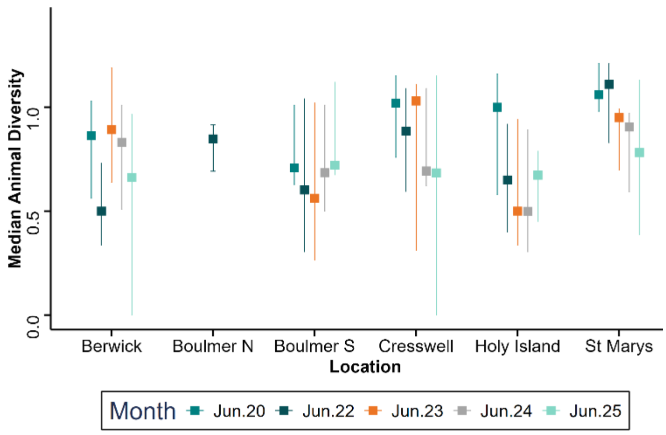

*Figure 16: Median faunal Shannon Weiner diversity index from the June surveys across all sites. A significant difference is denoted by *. Error bars denote 95% confidence intervals.*

Flora

Median floral percentage at all sites showed interannual variability, although the only statistically significant change was reported at Berwick (Figure 17), where median cover fell significantly to 91% in 2023 but then recovered in 2024 suggesting that this decline was a short-term event rather than a sustained shift in the floral community. Although other sites showed fluctuations in median cover, the variability among quadrats meant that these changes were not statistically significant. Across the remaining sites, year-to-year fluctuations in cover were insufficient to demonstrate significant long-term changes. Percentage cover remained consistently lower at both the Holy

Island and St Marys sites across all years. The greatest intra-site variability was detected at Cresswell, with the broadest confidence intervals, most notably in 2024 and 2025.

Median species richness also remained lowest at Holy Island across all years, with only 2–3 algal taxa recorded throughout the study period compared with 5–7 taxa at most other sites (Figure 18). Although richness remained persistently low, there was no evidence of significant interannual change following correction for multiple comparisons (all adjusted $p > 0.05$), indicating a stable but species-poor algal community. Berwick consistently supported richer algal communities, with 6–7 algal taxa present each year.

Algal diversity was generally stable across the survey years at all survey locations with no significant temporal differences were detected at Berwick, Cresswell, Holy Island or St Mary's (Figure 19). Holy Island consistently reported the lowest diversity across all years, reflecting the low percentage cover and algal species richness also reported at that site. Boulmer S had significantly higher algal diversity in 2025, indicating an increasing trend in diversity.

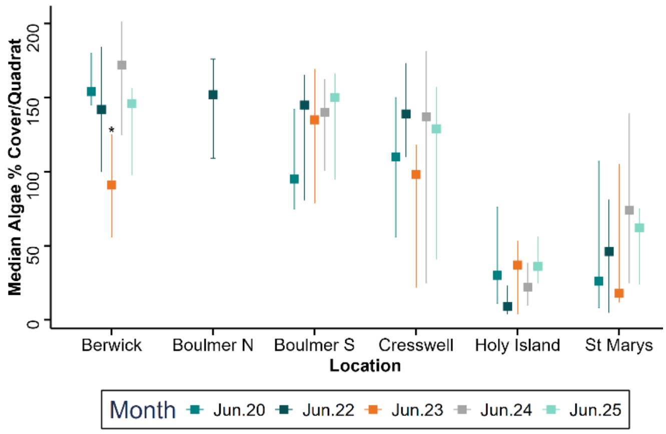

*Figure 17: Median floral percentage cover from the June surveys across all sites. A significant difference is denoted by *. Error bars denote 95% confidence intervals.*

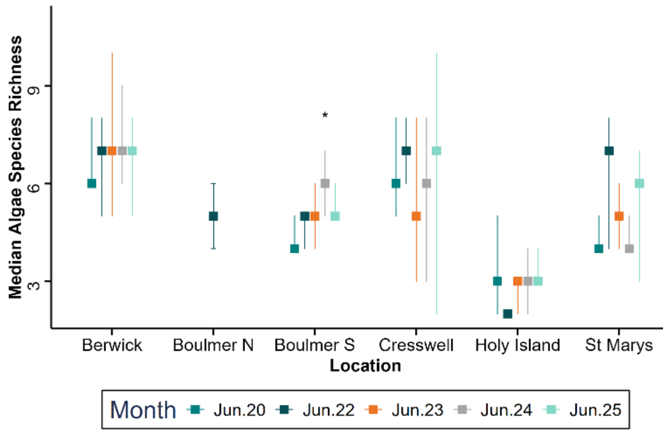

*Figure 18: Median floral richness from the June surveys across all sites. A significant difference is denoted by *. Error bars denote 95% confidence intervals.*

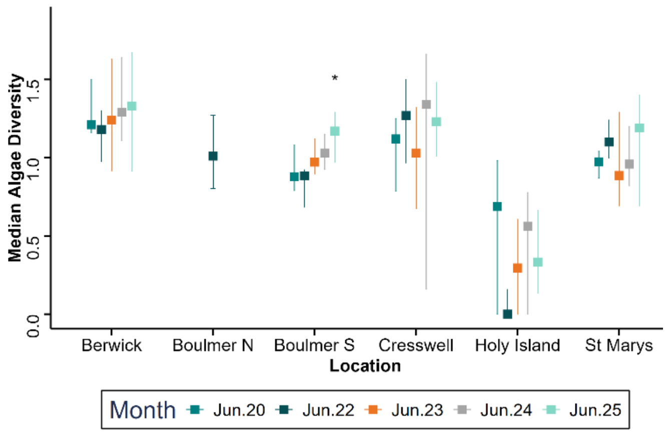

*Figure 19: Median floral Shannon Weiner diversity index from the June surveys across all sites. A significant difference is denoted by *. Error bars denote 95% confidence intervals.*

Discussion

Collection intensity

Collection intensity remained spatially consistent across the monitoring period, with Berwick continuing to represent the site subject to the greatest collection pressure and the relative ranking of sites remaining unchanged between the 2016–2020 and 2021–2025 patrol datasets. This consistency suggests that the main collection hotspots identified during the baseline surveys remain relevant for ongoing monitoring. Although average collection intensity declined at most locations, interpretation should be cautious because patrol effort increased substantially in 2021-2025, which may have increased the number of patrols where no activity was recorded and therefore reduced the average number of collectors per patrol.

The increase in maximum numbers of collectors observed at some sites indicates that occasional higher-intensity gathering events still occur, even where average collection pressure has declined. These peak events may be ecologically important if they are concentrated in small areas or coincide with periods when larger marketable periwinkles are most accessible. Continued patrol recording is therefore important, particularly at Berwick, St Mary’s and Boulmer, to distinguish between genuine reductions in collection activity and changes caused by survey effort or reporting frequency.

Site characteristics

The survey sites differed markedly in substrate composition, and these differences are likely to be an important driver of the variation observed in periwinkle density and rocky shore communities. Berwick, Cresswell and the Boulmer sites were characterised by high proportions of exposed bedrock and relatively simple substrate structure, whereas Holy Island and St Mary’s had more mixed sediment profiles. The strong similarity between Boulmer N and Boulmer S supports the view that the two Boulmer sites represent comparable habitat types, while the isolation of Holy Island and St Mary’s in the substrate analysis indicates that they should be interpreted cautiously when drawing comparisons to patterns displayed at other sites.

These habitat differences make it difficult to attribute variation in periwinkle abundance solely to collection pressure. Periwinkles are strongly influenced by habitat complexity, shore height, refuge availability, exposure, algal resources and sediment cover. The low densities recorded at both Berwick and Boulmer, despite contrasting collection intensity, suggest that environmental factors may have a substantial influence on local abundance. This does not rule out an effect of collection at Berwick, but it indicates that collection pressure should be considered alongside site-specific habitat characteristics rather than as a single explanatory factor.

Periwinkle density

Periwinkle density showed clear and persistent differences between sites, but little evidence of statistically significant change within sites over time. Quadrat and timed search data indicated consistently low densities at Berwick and Boulmer compared with Cresswell, Holy Island and St Mary's. The consistency between quadrat and timed-search results strengthens the interpretation that site-level differences are real, with timed searches more likely to capture individuals within cryptic habitats that are typically missed by quadrats.

There was no statistically significant relationship between collection intensity and periwinkle density using either quadrat or timed-search data. This suggests that, across the surveyed sites, collection pressure alone does not explain the observed differences in density. However, the small number of sites limits statistical power and reduces confidence in detecting subtle relationships. Berwick combines the highest recorded collection intensity with consistently low periwinkle density, but similar low densities at Boulmer indicate that naturally low-density habitat conditions may also occur independently of high collection pressure.

The decline in density observed at some higher-density sites in 2024, followed by increases in 2025, suggests that short-term fluctuations may reflect natural variability, sampling conditions, or local-scale patchiness rather than sustained population change. This is particularly relevant for species such as periwinkles, which can occur in highly aggregated distributions across the shore. Continued annual monitoring is therefore needed to distinguish short-term variation from genuine trends, especially at Cresswell where quadrat and timed-search data both suggest a possible longer-term decline from the 2022 peak.

Periwinkle size structure

Periwinkle shell size varied between sites and shore heights, with larger individuals generally found lower on the shore. This pattern is consistent with ecological expectations, with lower shore areas typically providing longer immersion periods, greater access to food resources and reduced desiccation stress. The strong relationship between shell size and shore height therefore indicates that position on the shore is a key factor influencing size structure and should be considered when interpreting differences between sites or years.

The weak positive relationship between collection intensity and median shell size was not statistically significant and should not be interpreted as evidence that collection increases average size. Instead, it is likely influenced by Berwick, where median shell size was comparatively high despite low density and high collection pressure. This may reflect the persistence of larger individuals on the lower shore, targeted removal of mid-sized individuals, habitat conditions that favour faster growth, or a combination of these factors. The proportional size-frequency data show that Berwick differs from other sites and should remain a focus of monitoring, particularly if mid-size classes continue to be under-represented. Such distribution of animal size may indicate a higher pressure on mid-sized individuals from collectors, as they are more accessible than the larger periwinkles found on the low shore, yet also more easily identifiable than smaller individuals.

The presence of juveniles at all sites indicates continued recruitment across the survey network. Although juveniles formed a relatively small proportion of most populations, their presence suggests that populations are not currently recruitment limited, although may be underrepresented due to sampling methods and the ability of surveyors to locate the smallest of individuals on the shore. At Berwick, the occurrence of smaller individuals alongside larger adults indicates potential for population replenishment, but continued low density and an altered size structure could indicate collection impacts if the pattern persists or intensifies in future surveys.

Berwick and Boulmer seasonal monitoring

The additional seasonal monitoring at Berwick and Boulmer S did not identify significant seasonal or interannual variation in timed-search periwinkle density. Although densities fluctuated between survey months, wide confidence intervals and non-significant statistical tests indicate that these changes are best interpreted as natural variability or sampling variation rather than clear seasonal trends. This supports the wider annual-survey findings that periwinkle density at both sites has remained broadly stable over the monitoring period.

Berwick and Boulmer are particularly useful comparison sites due to similar habitat compositions yet are subject to differing intensities of collection pressure. The absence of a clear divergence in seasonal density trends suggests that differences in collection pressure have not produced detectable short-term changes in overall density. However, the continued low density at Berwick, combined with high collection intensity and distinctive size structure, highlights its importance as a key monitoring site.

Rocky shore community

Rocky shore community metrics were generally stable across the monitoring period, with most changes in faunal abundance, floral cover, richness and diversity falling within the range of interannual and intra-site variability. This indicates that there is no clear evidence of broad-scale community change associated with periwinkle collection across the surveyed sites. Where significant changes were detected, they were typically site-specific and not consistently repeated across multiple metrics, suggesting localised variability rather than widespread community-level impacts.

Faunal abundance and diversity showed some evidence of decline at St Mary’s, while Holy Island consistently supported lower faunal and algal metrics than most other sites. These patterns are likely influenced by the distinctive habitat characteristics of these shores, particularly their mixed sediment composition and lower similarity to the other sites. The partial recovery of faunal richness at Holy Island and St Mary's in 2025 suggests that earlier reductions may not represent sustained declines, although both sites should continue to be monitored because they appear more variable and less directly comparable with the bedrock-dominated sites.

Floral community results suggest that algal cover, richness, and diversity are primarily site dependent. Berwick continued to support high algal cover and richness, while Holy Island remained species-poor with low percentage cover. The high algal cover at Berwick may be consistent with reduced grazing pressure where periwinkle densities are low, although the absence of a clear relationship between density and community metrics means this should be interpreted cautiously. The significant increase in algal diversity at Boulmer S in 2025 may indicate local change in community composition, but further years of data are needed to determine whether this represents a sustained trend.

Overall interpretation

Overall, the 2025 results support the conclusions of previous monitoring: differences between sites are more pronounced than changes through time, and environmental variation appears to play a major role in shaping periwinkle density, size structure and rocky shore communities. There is no clear statistical evidence that collection pressure is driving changes in periwinkle density or wider community structure across the district. Nevertheless, Berwick remains an area of concern because it combines high collection intensity, consistently low density and a distinctive size distribution. Continued monitoring should focus on detecting whether these patterns persist, intensify, or begin to affect recruitment and community structure.

Conclusions

Overall, the 2025 monitoring results indicate that differences between survey sites remain more pronounced than changes through time. Periwinkle densities, sizes and rocky shore community metrics were generally stable within sites, with no clear statistical evidence that collection pressure alone is driving changes in periwinkle abundance or wider community structure across the NIFCA district. Site-specific environmental factors, particularly substrate composition, shore height, refuge availability and habitat complexity, appear to play an important role in shaping periwinkle populations and associated rocky shore communities.

Collection intensity rankings remained broadly consistent between the 2016–2020 and 2021–2025 patrol datasets, with Berwick continuing to experience the highest recorded collection pressure. Average collection intensity declined at most sites, although this should be interpreted with caution due to increased patrol effort and potentially greater recording of no-activity patrols. The occurrence of occasional higher-intensity collection events means continued patrol recording remains important, particularly at Berwick, St Mary's and Boulmer.

Berwick remains the principal site of concern because it combines high collection intensity, consistently low periwinkle density and a distinctive size structure compared with other sites. Although juvenile periwinkles were present, indicating continued recruitment, the continued under-representation of some size classes should be monitored closely. The comparison with Boulmer suggests that low densities can also occur in similar bedrock-dominated habitats with lower recorded collection pressure, so collection impacts at Berwick should continue to be interpreted alongside habitat conditions.

Additional seasonal monitoring at Berwick and Boulmer S found no significant seasonal or interannual changes in periwinkle density, supporting the conclusion that populations at these sites have remained broadly stable over the monitoring period. Rocky shore community results also provided limited evidence of sustained change, although Holy Island and St Mary's continued to support distinctive and more variable faunal and algal assemblages. These sites should remain in the monitoring programme because they are less directly comparable with the more bedrock-dominated shores and may respond differently to environmental or anthropogenic pressures.

Future work intends to continue the broader annual June surveys, as well as the periwinkle focussed surveys at Berwick and Boulmer in November.

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