

Periwinkle surveys 2022

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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. In June 2020 NIFCA surveyed five known collection sites (Berwick-Upon-Tweed, Boulmer Haven, Cresswell, Holy Island and St Mary's Island), ranking them in terms of collection intensity from NIFCA patrol sightings of intertidal activity.

Surveys measured periwinkle densities and sizes in addition to faunal and algal assemblages and substrate cover. In June 2022 all five sites were re-surveyed and an additional site to the north of Boulmer Haven was added which is a previous site for Natural England condition monitoring. Periwinkles densities were also surveyed quarterly at Berwick and Boulmer, as Berwick was identified as a potential area of concern in the 2021 report and Boulmer is a relatively similar site in terms of substrate composition and low periwinkle densities compared to other sites. The newly surveyed site to the north of Boulmer was the most similar to the existing Boulmer survey site, as expected.

Neither periwinkle density or collection pressure varied significantly over time at any site, including Berwick and Boulmer when comparing different times of year. Periwinkle shell lengths also remained similar on average over time, although Berwick exhibited a different pattern of shell length frequencies to other sites, with much lower proportions of mid-sized periwinkles found which could indicate these sizes are being targeted for collection. There were high proportions of smaller (<11mm) periwinkles at Berwick however, indicating good potential for population recovery.

There were also few changes to rocky shore faunal and algal communities over time, though percentage cover and diversity of algae decreased at Holy Island from 2020-22. There was no corresponding increase in periwinkle densities or changes in other metrics, so this should be monitored in future surveys to identify if a trend or an anomaly.

Overall, environmental variation in terms of substrate cover and other factors likely have a greater impact on periwinkle densities than collection pressure, although Berwick is still an area where collection may be impacting on periwinkle densities and size structure of the population.

Periwinkles are a generally resilient species due to their wide ranging larval dispersal enabling populations to be maintained even when locally depleted. Periwinkle gathering and populations will continue to be monitored by NIFCA, particularly at Berwick, to ensure sustainable levels of collection and populations are maintained in the future.

Introduction

Periwinkle gathering occurs both recreationally and commercially on rocky intertidal areas up and down the Northumberland Coast. NIFCA have noted intertidal collection on patrols since 2016 and conducted periwinkle surveys since 2020 to assess impacts. Please refer to previous reports for information on the Northumberland periwinkle fishery, periwinkle biology and size of maturity, and the 2021 survey report which compared collection intensity and periwinkle densities, as well as other rocky shore community characteristics^{1,2,3}.

The 2021 report found no relationship between collection intensity and periwinkle densities or sizes at different locations. Neither faunal nor algal abundance/percentage cover, species richness or diversity were correlated with collection pressure. However, Berwick, which had the highest levels of collection, had the lowest periwinkle densities in addition to the highest macroalgal abundance and diversity which could be due to lower grazing pressure from periwinkles compared to other sites.

From 2021 onwards, NIFCA continued annual surveys in June of the five locations in addition to another site at Boulmer to the north of the bay, where Natural England had previously conducted monitoring assessments. Additionally, periwinkle densities were monitored quarterly at Berwick and Boulmer (south of the bay) due to concerns about potential impacts at Berwick and the similar nature of the two sites.

This report presents changes since baseline surveys (June 2020) to feed into annual monitoring and control plans for periwinkle collection.

Methods

Survey methods and analysis are described in the 2021 report², including site selection, methodology and analysis. Five sites (Berwick-Upon-Tweed, Boulmer Haven, Cresswell, Holy Island and St Mary's Island) were surveyed and 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).

All sites were surveyed in June of 2020 and 2022, conducting full quadrat surveys counting all abundance of all faunal (animal) taxa and percentage cover of all macroalgae (seaweed) species in addition to measuring and counting all periwinkles from quadrats in addition to timed searches. Timed searches were carried out for five minutes per surveyor, so normally for 10 minutes per

¹ NIFCA report: *Description of the Northumberland IFCA Periwinkle Fishery*. Aitken & Harvey, 2021

² NIFCA report: *Periwinkle surveys 2020-12*. Harvey, 2021

³ NIFCA report: *Periwinkle Ecology and Size of Maturity Study*. Harvey, 2021

survey height (mid/low/high shore), although this varied occasionally with extra surveyors available, which was taken into account as periwinkle density was measured as the count per minute.

Additional surveys were conducted quarterly at Berwick and Boulmer S for periwinkle density and sizes only, for both quadrat surveys and timed searches.

After April 2021 surveys it was realised 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, so counts based on the number measured are inaccurate.

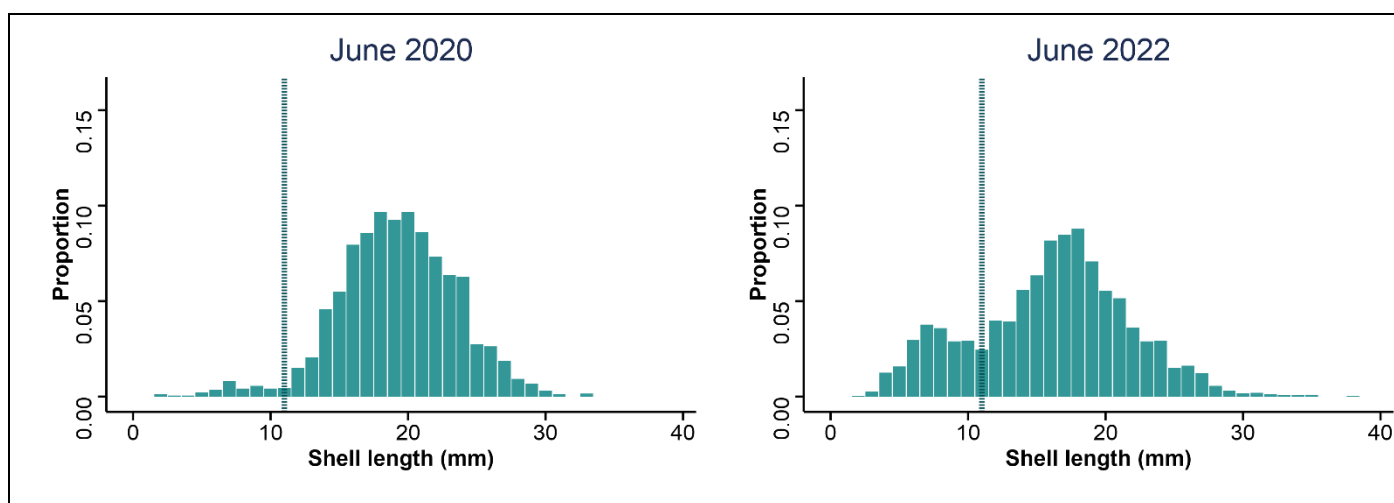


Figure 1. Periwinkle sizes measured in June 2020 and 2022, showing fewer small periwinkles identified in 2020.

Results

Collection intensity

Sites were ranked in terms of collection pressure based on data from updated NIFCA patrols (Table 1). Collection intensity had changed little since 2020 in terms of average number of collectors seen per patrol, and the overall ranked order of sites. Cresswell and St Mary's swapped rankings as the proportion of patrols periwinkle collection was sighted on decreased at Cresswell, while the average number of collectors seen increased at St Mary's. The average number of collectors per patrol decreased slightly at Holy Island, though the proportion of patrols activity was sighted on increased and the average number of collectors decreased. Berwick remained the highest collected site while Boulmer N, the new site, had the lowest amount of periwinkle collection recorded.

Due to the close proximity of Boulmer N and Boulmer S and the location of the car park at Boulmer, the number sightings at Boulmer S may be overestimated, and the number at Boulmer N may be underestimated.

Table 1. Collection pressure classifications of each site, from NIFCA intertidal patrols between 2016-2022, with previous results from 2016-2020 shown in brackets. 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 the ranking of collection intensity based on average number of collectors per NIFCA patrol (1= high, 5=low).

Location	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 ranking
Berwick	52 (23)	0.71 (0.70)	2.57 (3.00)	2.17 (2.09)	8 (7)	1 (1)
Boulmer N	67	0.13	2.40	0.36	6	6
Boulmer S	12 (10)	0.58 (0.40)	2.71 (2.75)	1.58 (1.10)	4 (4)	2 (2)
Cresswell	41 (12)	0.29 (0.50)	1.77 (1.67)	0.56 (0.83)	4 (3)	5 (4)
Holy Island	19 (11)	0.37 (0.27)	2.00 (4.00)	0.95 (1.09)	7 (7)	3 (3)
St Mary's Island	74 (15)	0.28 (0.27)	2.24 (2.00)	0.76 (0.53)	5 (2)	4 (5)
Boulmer total	79	0.20	2.69	0.54	10	

New survey site

Boulmer N had not been surveyed before 2022. In terms of substrate composition, the site is most similar to Boulmer S and Berwick with a majority of bedrock and high proportion of sand (21%), though with more boulders (Figure 2a). The community composition of animals and algae was most similar to Boulmer S, and these were the most similar sites to one another with 40% dissimilarity (Figure 2b). Both of these sites shared similarities with Berwick, while Cresswell and St Mary's also shared similarities. Holy Island was the most distinct site.

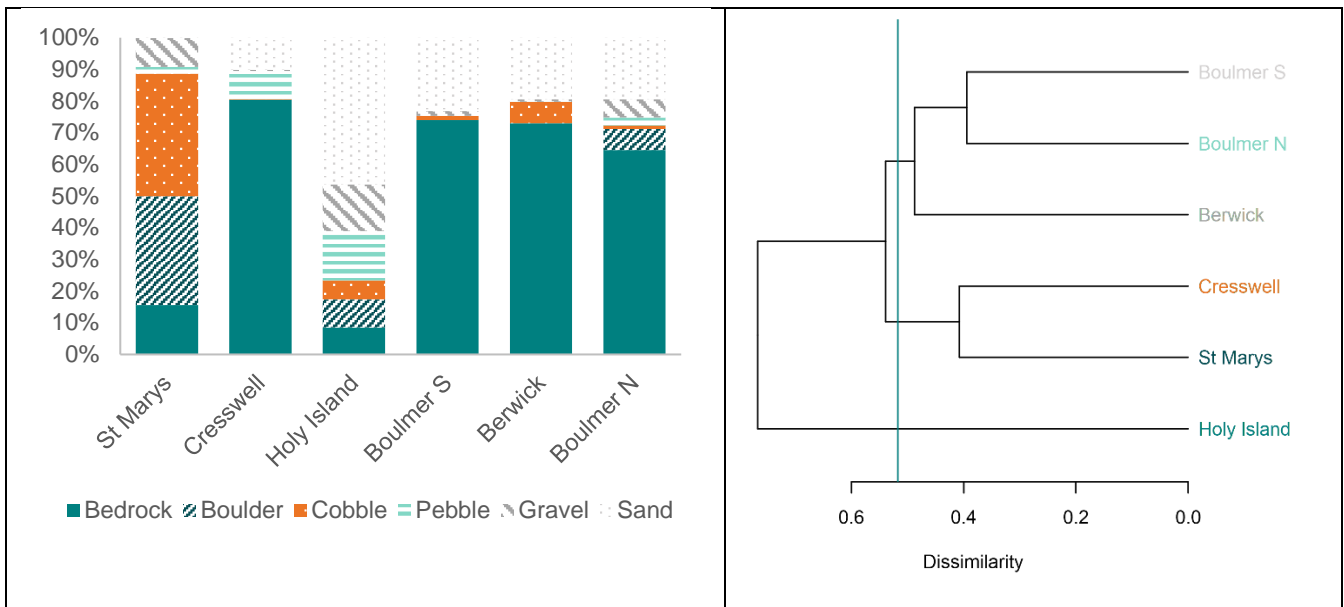
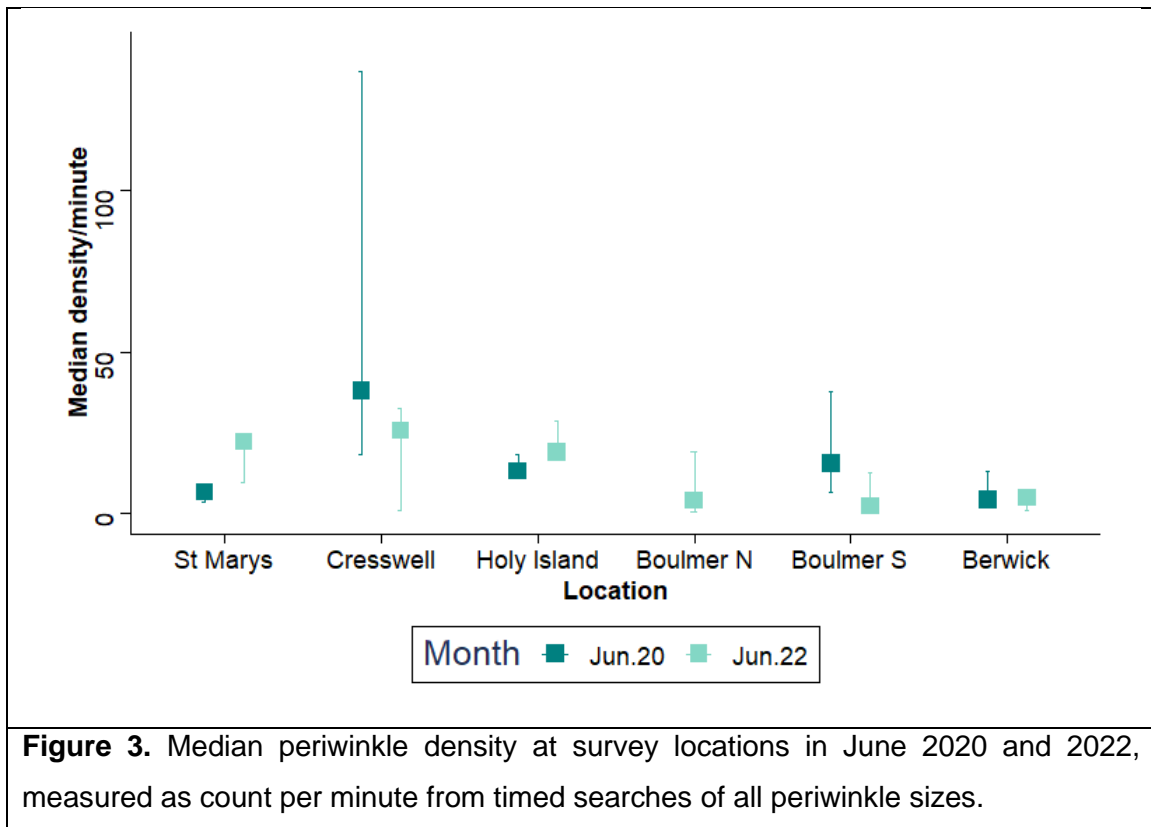


Figure 2. Comparison between survey sites of a) substrate composition in terms of the mean percentage cover from quadrat surveys, and b) Bray-Curtis dissimilarity matrix showing the similarity of sites in terms of their community composition.

Periwinkle density

Periwinkle density (for over 11mm shell length) did not change significantly from June 2020-22 for either quadrat surveys (>11mm shell length) or timed searches (all sizes; Figure 3) at any site other than St Mary's where density increased slightly in quadrat surveys (Wilcoxon test: $W = 64.5$, $P = 0.048$). Therefore, the same differences between sites are present, with Cresswell and Holy Island having the highest densities, followed by St Mary's, and Berwick and Boulmer S having low densities. The newly surveyed site, Boulmer N, also had a low density of periwinkles similar to at Boulmer S.



Berwick and Boulmer (S)

Periwinkle density remained relatively similar at both Berwick and Boulmer (S) over time, in both quadrat and timed searches, although in the summer of 2020 higher number of periwinkles were found than in any other month at Boulmer. There were no significant changes in periwinkle density over time at Berwick or Boulmer, when comparing timed searches in the same or similar survey months each year (Figure 4). For both quadrat surveys and timed searches, periwinkle density at Berwick was relatively stable, though remaining the lowest density site.

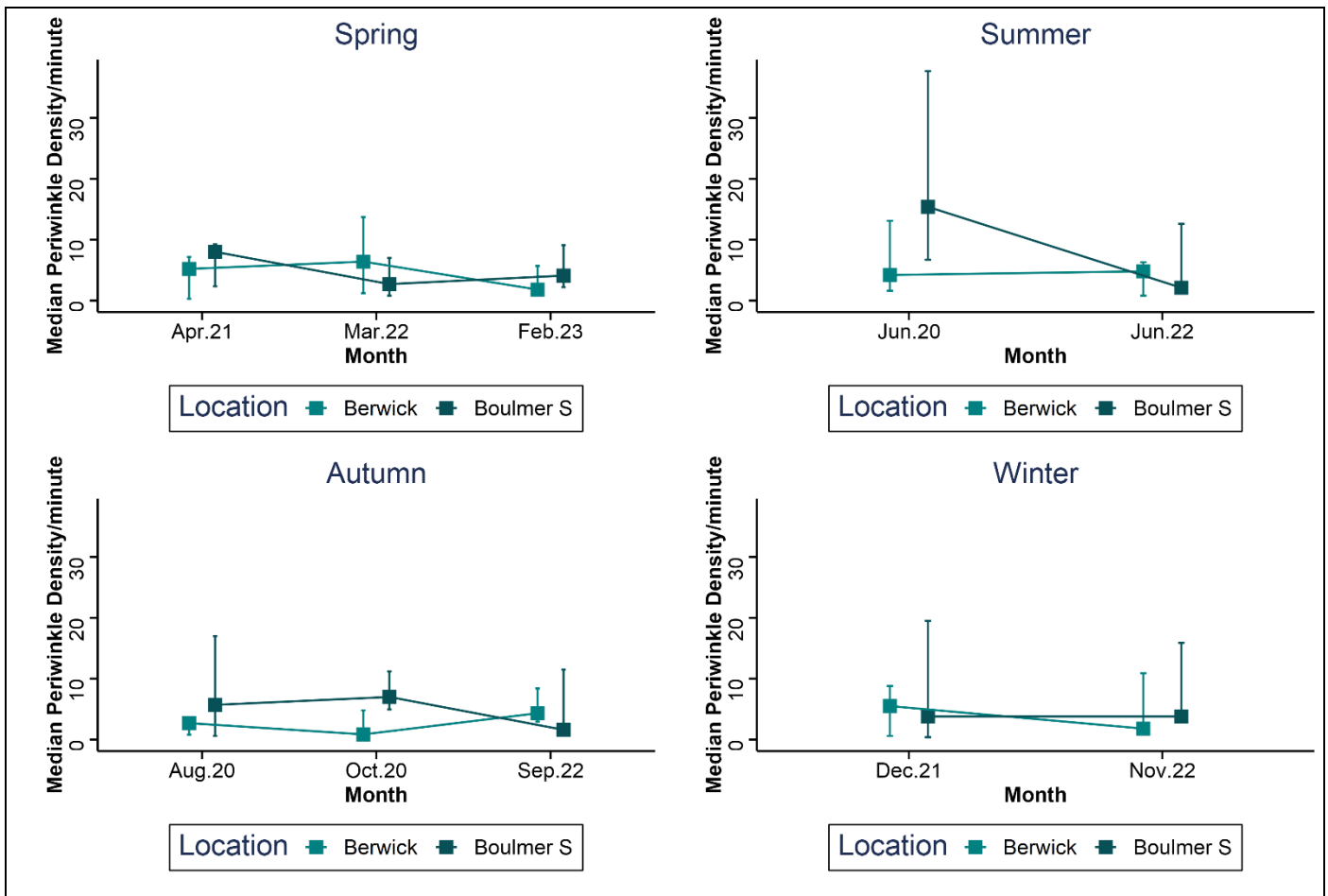


Figure 4. Periwinkle densities (count per minute) at Berwick and Boulmer S in spring, summer, autumn and winter. A significant difference is denoted by *.

Periwinkle size

Periwinkle size varied between locations, with the largest average sizes at Berwick and Boulmer, and the lowest at Boulmer N, the new site (Figure 5). Although the overall differences between sites remained the same, there were small but significant decreases in periwinkle size at St Mary's, Holy Island and Boulmer S (Wilcoxon tests: all $P < 0.0001$) when periwinkles under 11mm were removed.

Size distributions also varied between sites, as did the proportion of juveniles and adults (Figure 6). Most sites showed similar patterns, with a peak of juvenile shell sizes at roughly below 10mm, and the majority of periwinkles found at between 10-25mm. Cresswell had a particularly high proportion between 16-19mm and very few above 21mm which differed slightly to other sites which had more even distributions. Berwick had a different pattern, with the highest proportion of periwinkles under 11mm of any site and fewer between 10-25mm where the other sites had the greatest proportions. Berwick also had relatively high proportions of larger (>25mm) periwinkles.



Figure 5. Median periwinkle shell length (mm) from quadrat and timed searches compared between locations. Periwinkles under 11mm were removed from the analysis to enable comparison over time.

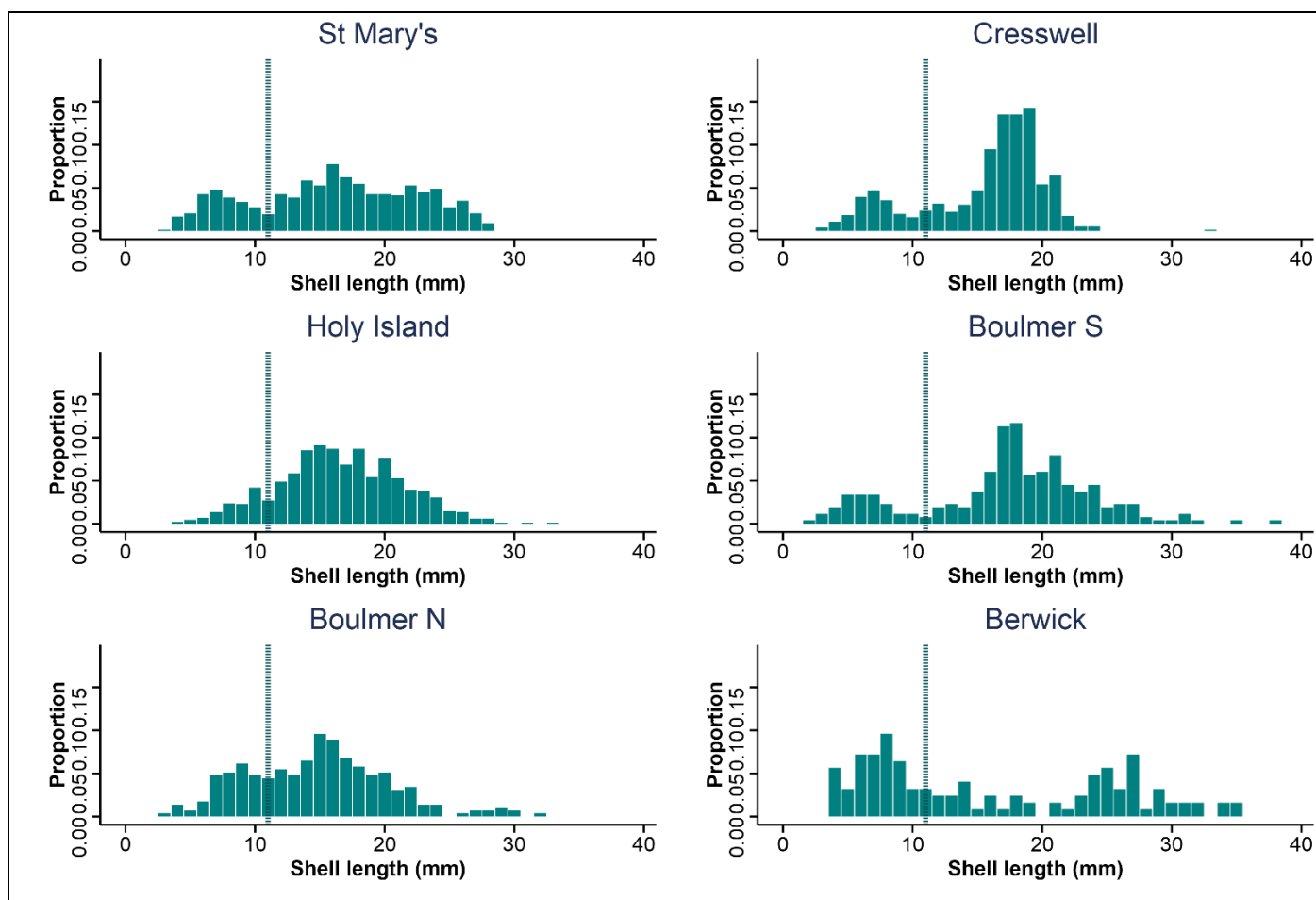


Figure 6. Periwinkle shell length frequencies at different survey locations in June 2022, showing each shell length as a proportion of the total number of periwinkles at that location.

The maximum sizes of periwinkles did not vary much from 2020 to 2022 in June surveys at any location (Table 2). Larger periwinkles were found at Holy Island, Boulmer S and Berwick in 2022 and 2020.

Table 2. Maximum periwinkle shell lengths found in June surveys at each survey site.

Location	2020	2022
St Mary's Island	29	28
Cresswell	31	33
Holy Island	29	33
Boulmer S	33	38
Boulmer N	-	32
Berwick	33	35

Rocky shore community

The occurrence and abundances of all taxa were recorded at each site for all quadrats, in addition to the species richness and diversity. There was no significant change to most metrics from 2020 to 2022 (Table 3). The largest changes were in algae percentage cover, species richness and diversity which decreased at Holy Island. Animal diversity also decreased at Holy Island while animal species richness declined at Berwick. An increased in algae species richness was seen at St Mary's.

Table 3. Median faunal abundance (count species only, not including periwinkles), algal abundance (sum of % cover), faunal (all organisms) and algal species richness and Shannon's diversity per quadrat for each site in June 2022 (bold) and 2020. Significant differences between years are denoted by *.

Location	Animals			Algae		
	Abundance	Richness	Diversity	% cover	Richness	Diversity
St Mary's	18	7	1.06	46	7*	1.10
	20	6	1.11	26	4	0.97
Cresswell	17	6	0.82	125	7	1.25
	17	6	1.02	110	6	1.12
Holy Island	6	6	0.65*	9*	2*	0.00*
	11	7	1.00	30	3	0.69
Boulmer S	18	5	0.60	152	5	0.88
	11	4	0.71	95	4	0.88

Berwick	14	4*	0.50	145	7	1.18
	14	6	0.86	154	6	1.21
Boulmer N	18	5	0.85	152	5	1.01

Discussion

Neither periwinkle density or collection pressure varied significantly over time at any site between 2020 and 2022. Signs of potential increased collection at Boulmer S and St Mary's Island may be a function of the increased number of patrols to the areas and should therefore continue to be monitored. In particular, St Mary's saw an increase in the number of intertidal hand gatherers (for shellfish as well as periwinkle) in the summer of 2022 which might explain the increased average number of collectors seen per sighting.

The highest collection remained at Berwick, in addition to the lowest periwinkle densities. There was no overall correlation between periwinkle density and collection pressure between sites however, similar to the results in 2020⁴.

Berwick and Boulmer did not exhibit significant changes in periwinkle densities over time when comparing similar months in different years, confirming the overall lack of change from 2020-22 at Berwick, the highly collected site. Periwinkle shell lengths also remained similar on average, although at Berwick there was a different pattern of shell length frequencies compared to other sites with the mid-sizes (10-25mm) absent compared to other locations. This is partly due to an increase in the number of small (<10mm) periwinkle seen at the site, especially in the low shore where the number of small periwinkles was noticeable in comparison to other sites. The lack of mid-size periwinkles however could be a sign that these are targeted for collection and this part of the population is missing compared to less collected sites.

There are however still larger-size periwinkles at Berwick which are found on the low shore, which could suggest less collection occurring at that shore height, or an abundance of resources (seaweed) enabling faster growth and larger sizes. The large numbers of small periwinkles suggests the population could be capable of replenishing itself. Periwinkle larvae can travel long distances from their source population therefore populations can be replenished from afar making periwinkles resilient to local depletion. However, if this size distribution and low densities remains, or density reduces in the future, this is a sign that collection is negatively impacting periwinkles at Berwick.

⁴ NIFCA report: *Periwinkle surveys 2020-12*. Harvey, 2021

Overall periwinkle size remained similar at most sites, with slight declines in the average sizes at St Mary's, Holy Island and Boulmer S from 2020. Decreases in average size could be an indication that the larger size classes are being targeted for collection, although the shell length distributions show there are still the highest proportions of periwinkles at over the minimum size accepted by wholesalers, 12mm. This should be monitored in future years to ensure it is not a long-term trend which could indicate impacts of collection.

Changing maximum shell length over time could be indicative of periwinkle collection removing the largest sizes. Maximum sizes have remained consistent from 2020 to 2022 or increased. Tinlin-Mackenzie measured a maximum shell length of 33mm in 2018 at Boulmer S, while these surveys found sizes of 38mm at Boulmer S and 35mm at Berwick.

The newly surveyed site, Boulmer N, was most similar to Boulmer S in terms of community composition, which is expected considering their proximity and similar substrate composition. Periwinkle density was also most similar to Boulmer S in the June 2022 surveys. The site has the lowest recorded amounts of periwinkle collection, which could indicate the population is naturally low in that type of habitat and other environmental conditions play more of a role in influencing periwinkle abundance. However, often patrols to Boulmer will not target this area for observations since it is further to the north and obscured from view, therefore the amount of collection is probably underestimated in this area. Anecdotally, there are regular collectors in this area and so there may be similar collection levels, and therefore impacts, as to the south of the bay.

There was little change in rocky shore communities at most sites from 2020-22, with faunal and algal abundance, species richness and diversity remaining similar for most metrics. The main change was a reduction in algae percentage cover, richness and diversity at Holy Island when compared to 2020 surveys. Previous surveys found an inverse relationship between algae percentage cover and periwinkle densities, however there was no corresponding change in periwinkle densities at Holy Island from 2020-22. In 2020 there were only nine quadrats surveyed at Holy Island due to logistical constraints (compared to the 15 in 2022 and at other sites) therefore trends are less reliable than other sites. The 2022 survey likely provides a more accurate estimate of community richness and diversity. This should be monitored in future surveys, however.

Conclusions

Overall, there was little change in collection pressure, periwinkle density and sizes, and rocky shore communities from surveys in June 2020 and 2022. Differences between survey locations were maintained and the new survey site, Boulmer N, was the most similar to Boulmer S which it

is in proximity to. Environmental variation in terms of substrate cover and other factors likely have a greater impact on periwinkle densities than collection pressures.

The high levels of collection at Berwick and the low periwinkle density at the site remain a concern, and this year's surveys showed the site has different size distributions to the other less collected sites, with lower amounts of mid-size periwinkles. The high amounts of smaller periwinkles offer hope that the population is able to sustain itself into the future, although further monitoring to ensure declines in density or changes in the rocky shore community are detected is recommended.

References

Tinlin-Mackenzie A.R. (2018) Intertidal collection within the Berwickshire and North Northumberland Coast European Marine Site: investigating the scale, locale, and ecological impacts of harvesting *Arenicola marina*, *Arenicola defodiens*, and *Littorina littorea*, PhD thesis, University of Newcastle, 2018.

Please refer to previous NIFCA reports for further information:

NIFCA report: *Description of the Northumberland IFCA Periwinkle Fishery*. Aitken & Harvey, 2021

NIFCA report: *Periwinkle surveys 2020-12*. Harvey, 2021

NIFCA report: *Periwinkle Ecology and Size of Maturity Study*. Harvey, 2021