Somerset Shoresearch: Report on Patterns of Distribution and Abundance of Some Key Middle Eulittoral Taxa 2020-2022.

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Introduction: Somerset Shoresearch

Shoresearch is The Wildlife Trust's national citizen science project started in 2003 that aims to record the distribution and abundance of the intertidal fauna and flora of Britain's shores [1]. As part of its **Somerset's Brilliant Coast** (2018-2022) and **Somerset's Wilder Coast** (2022-2025) projects funded HPC Community Funds and National Lottery Climate Action Fund, the **Somerset Wildlife Trust** (SWT) has been carrying out regular Shoresearch surveys since March 2020 during which time over 30 **biodiversity quadrat surveys** and **walkover surveys** have been undertaken at various locations and at various shore levels along the Somerset and North Somerset coast.

Although Somerset Wildlife Trust manages 67 nature reserves none are located anywhere along the 53 miles of Somerset's coastline. This has historically meant that the Trust and its associated **Somerset Environmental Record Centre** have far fewer records of marine and intertidal taxa and habitats than for terrestrial and freshwater ecosystems. Beyond SWT, there has also been a general paucity of scientific reports or data sets on the abundance and distribution of intertidal taxa along the Somerset coast since a series of surveys carried out in the 1970s and 1980s [2][3].

The need for more data was recently addressed by SWT through an intertidal biotope mapping project [4] carried out between 2016-2018 funded by the Peter DeHaan Trust. The results of this mapping can be viewed on the Explorer Map on the SWT website[4].

This mapping gives an excellent overview of many different intertidal habitats along the Somerset coast, but does not give a more fine-tuned picture of the taxa found within each of these biotopes. SWT has been able to begin to build up these more detailed data sets using the Shoresearch methodology[1].

Data collected by volunteers as part of the Somerset Shoresearch programme can be used, both locally and nationally, as a much needed and updated baseline of the distribution and abundance of species. These data can also be used to monitor any changes as surveying continues into the future. Any data trends can indicate the effects of global issues such as climate change as well as local issues such as pollution, impacts on water temperature and disturbance around coastal industrial areas and water quality from freshwater sources entering the Bristol Channel. The surveys can also monitor the distribution of invasive species such as the pacific oyster (*Magallana gigas*) which has found to be far more prevalent in this area than had previously been thought and the now naturalised Australian star barnacle (*Austrominius modestus*) which is the dominant intertidal barnacle on Somerset shores.

Over the duration of surveys carried out since March 2020, Somerset Shoresearch volunteers have identified over 95 intertidal taxa. Although surveys have been carried out at various shore levels within the intertidal zone, this report will focus on those taxa recorded exclusively in the middle eulittoral zone where most of the quantitative **biodiversity quadrat surveys** were done. Surveys in the lower eulittoral zone usually employed a 'walk-over' method[5] which only recorded presence and absence of different taxa.

Methodology[1][5]

Two key methods are used for data collection during Shoresearch surveys. The first being a **walkover survey**. This method involves a team of volunteers forming an evenly spaced line along a section of representative pre-selected shore and then slowly moving in a straight line within a defined sample area recording the presence of every taxa identifiable. On Somerset shores sample areas are usually set at 15 metres wide and are walked until no new species are observed – usually after around 20 metres. The size

of these sample areas varies depending on the overall abundance and density of organisms on a particular shore. The boundaries of the sample area are recorded with GPS co-ordinates.

The other method of data collection is the **biodiversity quadrat survey**. This report exclusively deals with data collected by this method undertaken in the middle eulittoral zone. This method involves the survey leader selecting an area in the intertidal zone which is deemed representative of the particular shore being surveyed. Two tape measures are then placed at right angles across this sample area with a 10 metre tape forming the 'x' axis running parallel to the tideline and 30 metre tape forming the 'y' axis and running down the shore at a right angle starting at the 5 metre mark on the 'x' axis. Pre-determined pairs of random number co-ordinates (e.g.: 2, 14; 9, 23; 7, 6; etc) are then used to place down a number of 0.5m x 0.5m gridded quadrats. A total number of 12 quadrats are placed down randomly in the selected sample area, although depending on the number of volunteers and other factors on the day for some surveys smaller or larger sample sizes (no. of quadrats) are taken varying from 6 to 36. The boundaries of the sample area are recorded with GPS co-ordinates.

For both methods, location information for the whole sample area is recorded with notes on, substrate type and composition, percentage of standing water, tidal and weather data for the day and presence of human influence. For each quadrat the abundance of every identifiable taxon (identified to the highest taxonomic level possible within the confidence of the surveyors) is recorded. Units of abundance are either percentage cover (algae, lichens, barnacles etc.) or counts of individual specimens (snails, anemones etc.) depending on the taxon. The data are then collated to produce mean abundance values per quadrat for each taxa.

Scope of this Report

This report looks at the abundance and distribution of 13 selected taxa that have been recorded in the middle eulittoral zone at 15 shore locations between March 2020 and November 2022. They are taken from a larger data set of over 30 surveys which recorded the presence of over 95 taxa. The complete data sets are stored on the national Shoresearch data portal.

The taxa selected for this report are those with a high enough overall occurrence and abundance across the survey data sets for them to show possible significant trends and patterns:

- *Ascophyllum nodosum*
- *Fucus serratus*
- *Fucus vesiculosus*
- *Corallina spp.*
- *Ulva lactuca*
- *Ulva intestinalis*
- *Austrominius modestus*
- *Patella spp.*
- *Littorina obtusata/fabalis*
- *Littorina littorea*
- *Littorina saxatilis agg.*
- *Steromphala umbilicalis*
- *Phorcus lineatus*

The taxa in the left-hand column were recorded as a percentage cover of total area of the quadrat. Taxa in the right-hand column were counted as individuals per quadrat.

Results

For each of the selected taxa mean quadrat percentage covers or mean quadrat individual counts were calculated from repeat quadrats at the same shore level (middle eulittoral) for each location. For some locations means have been calculated from more than one survey (on different dates).

For each taxon the mean data values are represented as bars placed on a map of the Somerset coast at the 15 locations (Table 1) surveyed between Porlock and Clevedon.

No.	Location	Sample size **n =** no. of quadrats	Survey date(s)	WGS84 Decimal Degrees
1.	Gore Point, Porlock	**n = 12**	30/03/21	51.22514, -3.63453
2.	Minehead Beach West	**n = 24**	28/04/21 (n = 12) x2	51.21134, -3.47114
3.	Minehead Beach East	**n = 24**	19/09/20 (n = 12) x2	51.21181, -3.45619
4.	Dunster Beach	**n = 12**	11/08/21	51.19546, -3.4207
5.	Blue Anchor East	**n = 12**	26/06/21	51.18497, -3.37986
6.	West St. Beach, Watchet	**n = 36**	18/09/20 (n = 24) 19/03/22 (n = 12)	51.18355, -3.33353
7.	Helwell Bay, Watchet	**n = 12**	29/05/21	51.18227, -3.31912
8.	St Audries Bay	**n = 36**	18/10/20 (n = 12) x3	51.18231, -3.28608
9.	East Quantoxhead Beach	**n = 12**	19/10/22	51.19187, -3.23759
10.	Kilve Beach	**n = 12**	25/11/22	51.19366, -3.22921
11.	Lilstock Beach	**n = 12**	11/09/22	51.20357, -3.19378
12.	Hinkley Point Jetty	**n = 6**	10/09/21	51.20873, -3.15592
13.	Stolford Beach	**n = 12**	22/08/20	51.209754, -3.104170
14.	Brean Down Beach	**n = 24**	14/03/20 (n = 12) 9/10/21 (n = 12)	51.32333, -3.02382
15.	Clevedon Pier*	**n = 12**	21/10/21	51.44232, -2.86237

Table 1. Survey location details. No.s for each location relate to no.s on maps
**Clevedon Pier is North Somerset*

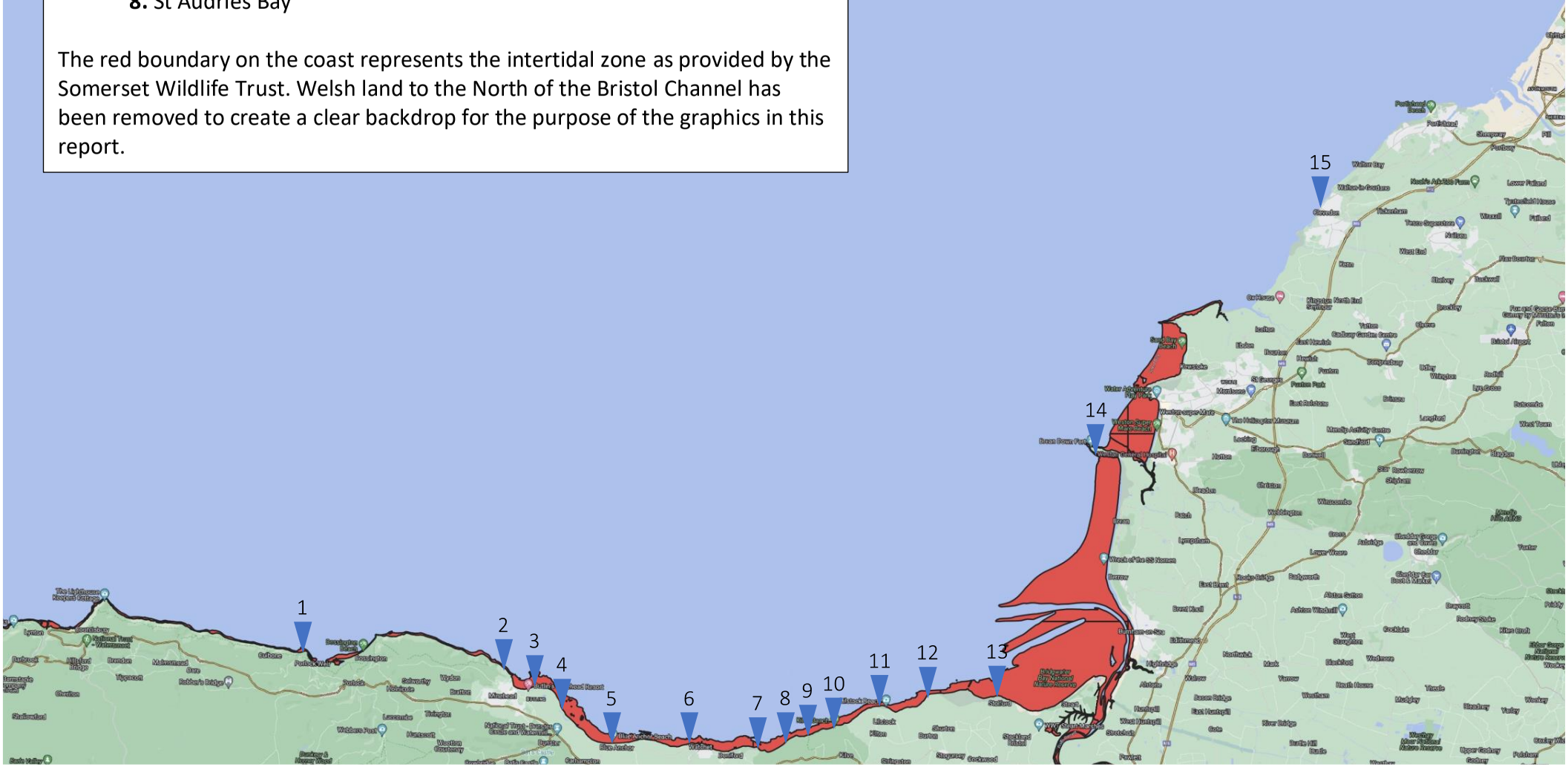
Each bar on the map shows the mean quadrat abundance of each taxon at each location. The bars are proportionally sized in relation to the largest bar for that taxon. This means that bars cannot be compared directly from taxon to taxon between the maps. The value above each bar is the mean quadrat count or mean quadrat percentage cover for that taxon at that location.

The map below (Fig 1) is the template upon which the bars were added to show change in relative abundance of each taxon at the 15 survey locations (Table 1).

Fig 1. Locations of Somerset Shoresearch survey locations 2020 – 2022.

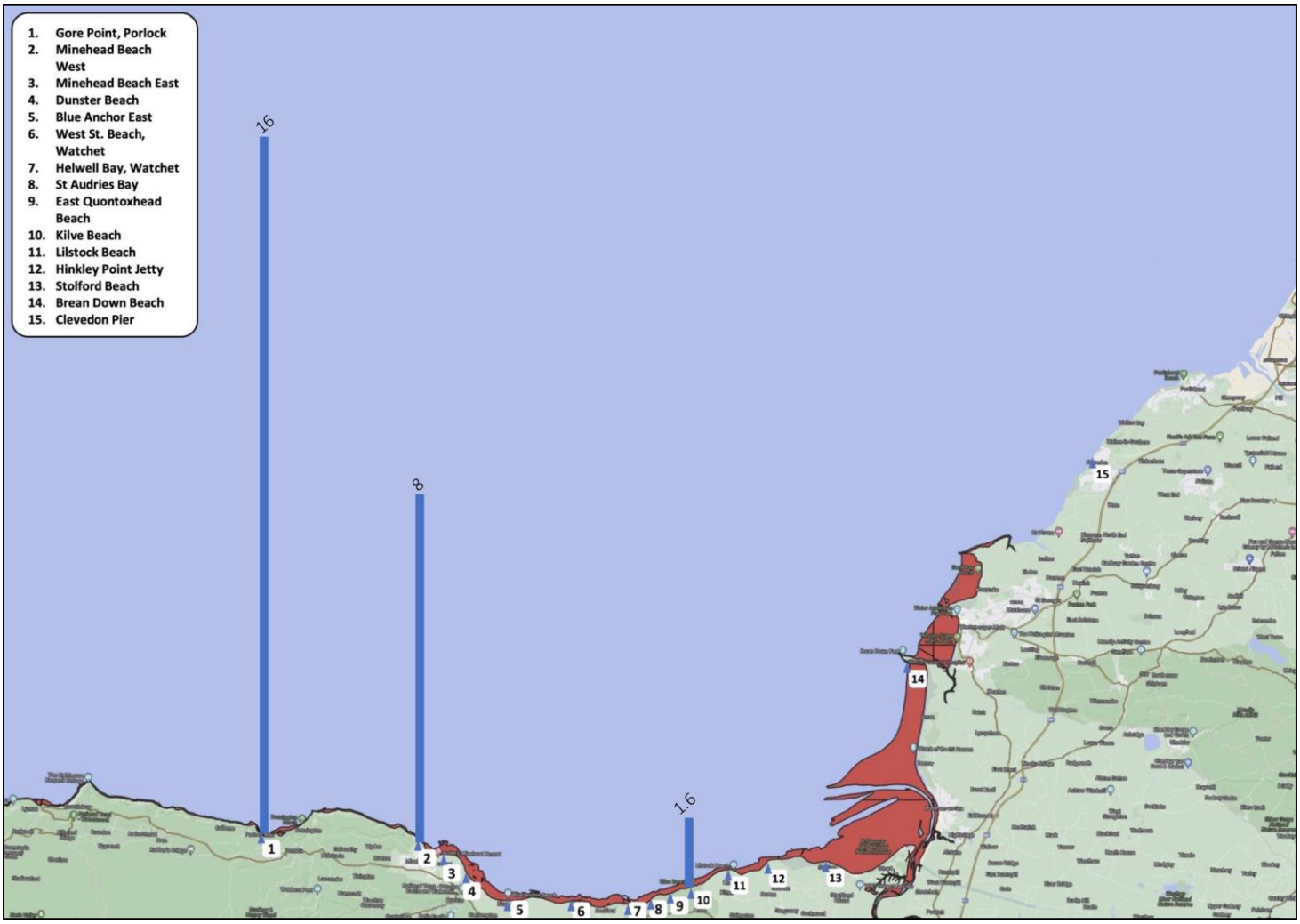
1. Gore Point, Porlock
2. Minehead West
3. Minehead East
4. Dunster Beach
5. Blue Anchor East
6. West St. Beach, Watchet
7. Helwell Bay, Watchet
8. St Audries Bay
9. East Quantoxhead Beach
10. Kilve Beach
11. Lilstock Beach
12. Hinkley Point Jetty
13. Stolford Beach
14. Brean Down Beach
15. Clevedon Pier

The red boundary on the coast represents the intertidal zone as provided by the Somerset Wildlife Trust. Welsh land to the North of the Bristol Channel has been removed to create a clear backdrop for the purpose of the graphics in this report.



Example Graphics

Fig 2. The map below (using hypothetical data) has been provided to help explain the graphics for the following maps for each of the selected taxa.



Depending on the taxon, for some maps the bars represent mean quadrat percentage cover while for others these represent mean quadrat counts.

For maps of a COUNT taxon (e.g., *Patella spp.*), the numbers above the bars indicate the mean quadrat count (number of individuals) recorded at that location.

In the hypothetical example above (Fig 2), the largest mean of 16 individuals was recorded at Gore Point, Porlock. Kilve Beach recorded a mean of 1.6 individuals so the bar is a tenth of the length of that at at Gore Point, Porlock. Equally, the bar for Minehead Beach West with a mean of 8 individuals is half the length of the bar for Porlock.

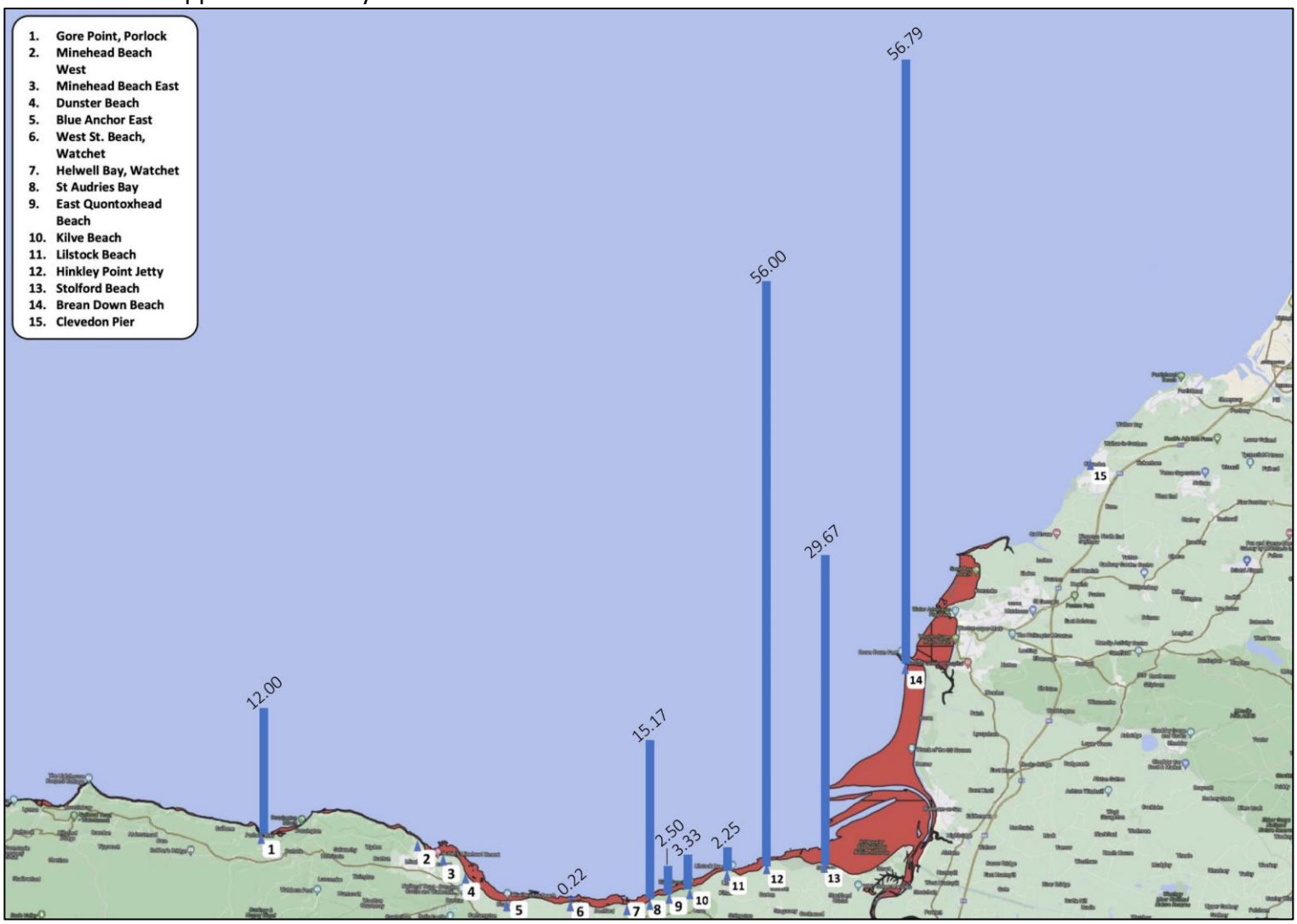
For maps of a PERCENTAGE COVER taxon (e.g., *Fucus serratus*), the numbers above the bars indicate the mean quadrat percentage cover at that location. If this were the case, a mean of 16% quadrat cover was recorded at at Gore Point, Porlock. As with count species, bars are scaled in relation to the location with the highest value so, just as with the count example previously provided, Kilve Beach recorded a mean percentage cover of 1.6% and as such the size of the bar is a tenth of the length of that at Porlock.

It should be noted that the scale of bars should not be compared from taxon to taxon. Bar length purely provides a visual demonstration of abundance in relation to the data recorded for that taxon alone.

Ascophyllum nodosum

Percentage Data

A. nodosum, known as egg wrack or knotted wrack, is found on all coasts around the British Isles and is found commonly in the middle eulittoral attached to rocky substrates [6]. Characterised by long ribbons with large egg-like bladders at regular intervals along their fronds, *A. nodosum* provides a habitat for many other intertidal species such as *Vertebrata lanosa* (Siphon Weed) with which it has an epiphytic relationship. *A. nodosum* is known to dominate sheltered shores but struggles on more exposed locations with strong wave action [6]. It has also been suggested that this species prefers shores with less turbid water and even appears subtidally on such shores [7].



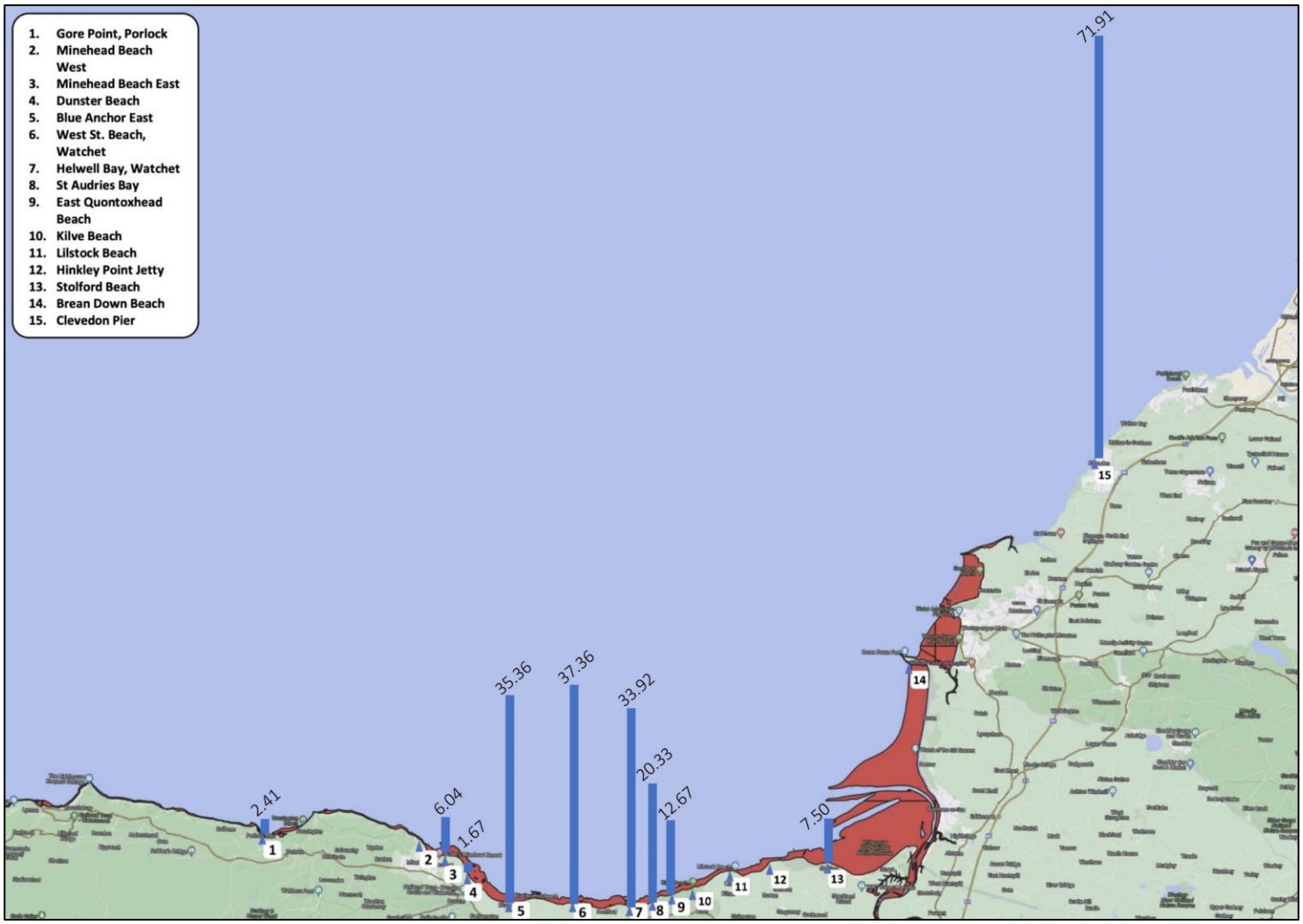
A. nodosum & V. lanosa.
Photographer: Judith Oakley.
Copyright: Judith Oakley.

A. nodosum might be expected to more common on less wave exposed shores to East, however if turbidity has a negative impact it might be better suited to clearer water to the West. The data does not show any clear pattern from West to East but this species appears to be absent or rare at several locations and especially common at others. The three locations where it is much more abundant are all towards the East (Hinkley Point Jetty, Stolford Beach and Brean Down Beach). However it was not common at Clevedon Pier (the most easterly location) and was also relatively abundant at some more westerly locations such as St Audries Bay and Gore Point , Porlock. Local factors such as shore topography, substrate stability and competition from other wracks may all contribute to these variations. This species can be approximately aged by counting bladders[8] and so studies measuring size, age and growth at different locations might be interesting in determining its relative success.

Fucus serratus

Percentage Data

F. serratus, known as saw wrack, toothed wrack or serrated wrack, is a brown seaweed found on all British and Irish coasts [9]. It favours the lower eulittoral and generally won't be found anywhere higher than the middle eulittoral [9] as it is vulnerable to desiccation and temperature stress. It also doesn't survive well at really wave exposed locations. As with many other seaweeds found on the Somerset coast, *F. serratus* is almost always only found on hard/rocky substrates.



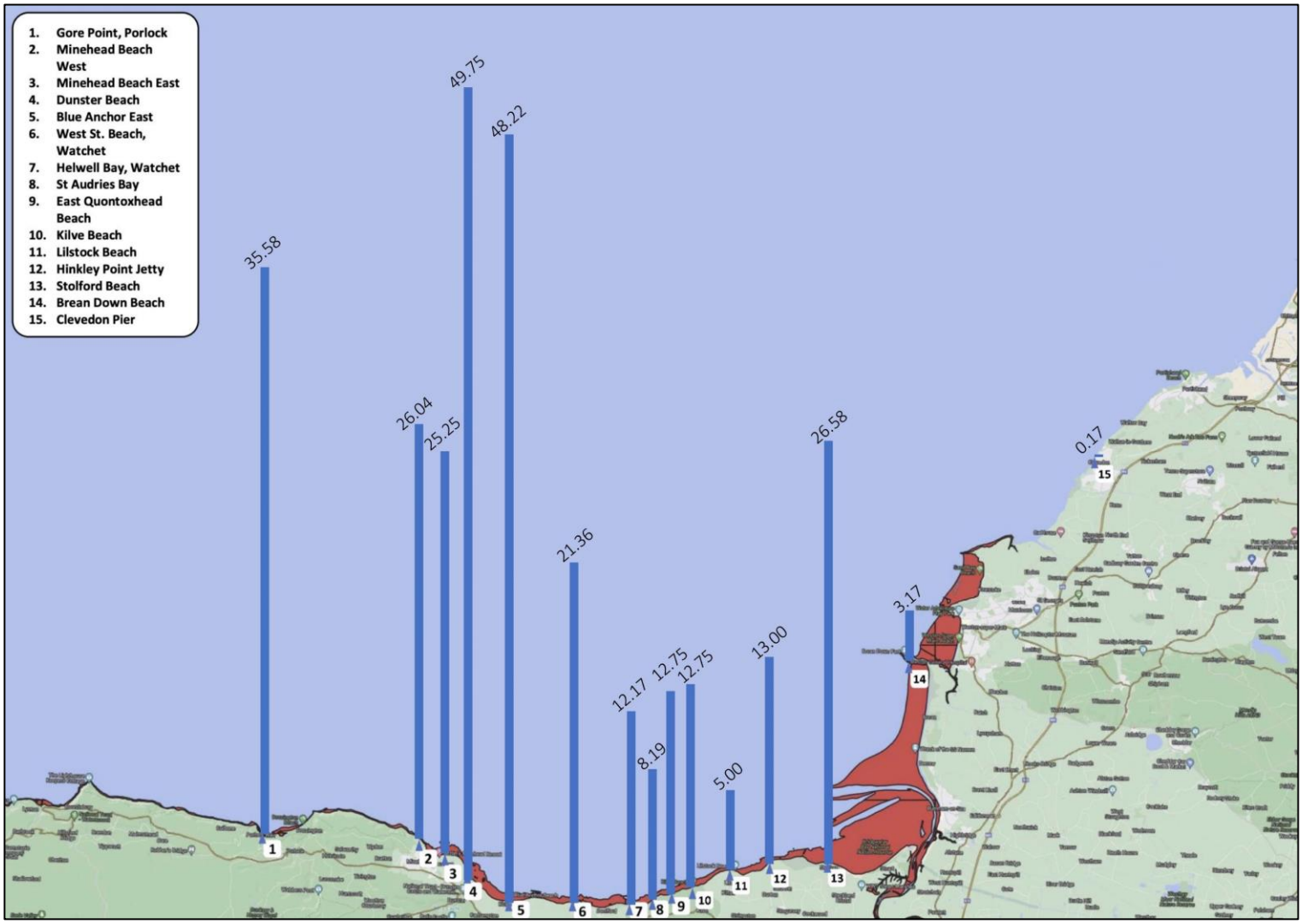
F. serratus.
Photographer: Judith Oakley.
Copyright: Judith Oakley.

F. serratus shows no obvious geographical distribution along the Somerset coast. At most locations *F. serratus* is less abundant than other wracks in the middle eulittoral, but may still be present in the lower eulittoral where hard substrata is available. However, it does seem to be particularly abundant at Clevedon Pier with almost double the percentage cover than that at the second most abundant location. Hard substrate at this location is mainly restricted to the middle eulittoral with the lower eulittoral being soft substrate (mud). With no rocks lower down to settle it on it appears to dominate here rather than other wrack species which it seems to outcompete. At some other locations (such as between Dunster Beach and Helwell Bay, Watchet), this species may be able to survive relatively abundantly in the middle eulittoral where shallow pools or the topography of the shore (with shady, damp sides of ledges) create cooler, wetter microhabitats for this desiccation intolerant species.

Fucus vesiculosus

Percentage Data

Recorded on all coasts around the British Isles[10], *F. vesiculosus,* known as bladder wrack, has a characteristically prominent midrib and is often identifiable by its bladders which are almost always found in pairs, although these can be absent in younger specimens or on wave exposed shores. This species creates a home and food sources for intertidal species of snail – notably the flat periwinkles (*Littorina obtusata and Littorina fabalis*) which mimics the shape of the seaweed's bladders for camouflage. This species is found most predominantly at the middle eulittoral, along with *A. nodosum* and usually higher up the shore than *F. serratus*.



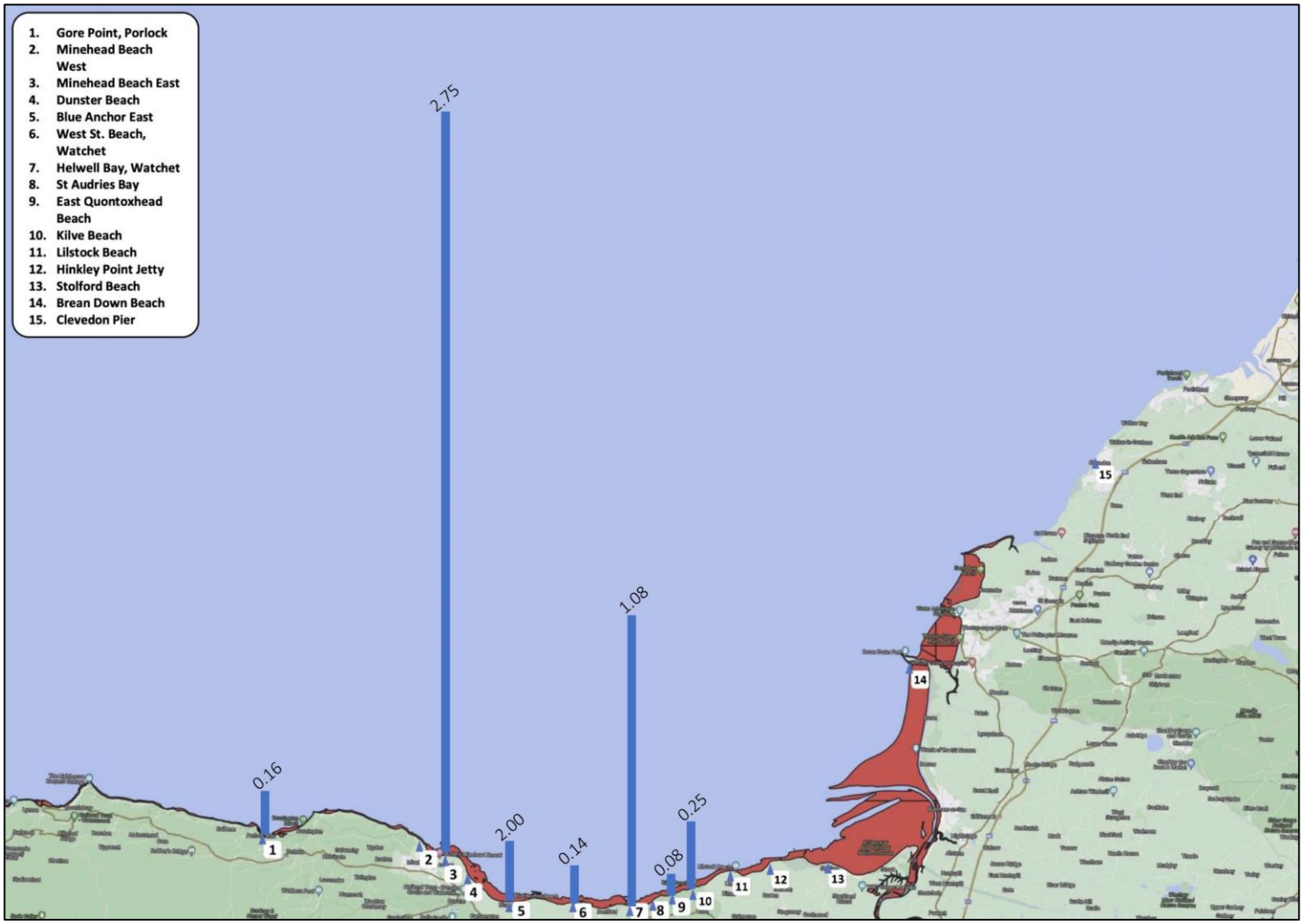
F. vesiculosus.
Photographer: Judith Oakley.
Copyright: Judith Oakley.

F. vesiculosus is the most common brown seaweeds found on the Somerset middle eulittoral in this survey. The species is found at all 15 locations with a generally even distribution. Sites 14 and 15 did, however, display lower quadrat percentage cover which may be due to differing abiotic conditions of the west-facing beaches compared to the north-facing locations of Porlock to Stolford. *F. vesiculosus* is a generalist in relation to wave exposure, being able to dominate the middle eulittoral on both exposed and on sheltered shores where fronds can grow up to 2 metres. It is noted that the results of our survey show high abundance of *F. vesiculosus* at locations where the abundance of *A. nodosum* was relatively low. This may indicate a competitive relationship between the species or reflect their differing tolerance to factors such as wave exposure or turbidity.

Corallina spp.

Percentage Data

Ranging in colour though usually identifiable from its red-pink colour, this genus of calcareous red algae is found in the middle/lower eulittoral all around the UK. It tends to be confined to more permanent rock pools in the middle eulittoral and is easily bleached and dies if exposed too long at low tide. Several species are likely to exist in Somerset and they are difficult to separate in the field. The commonest species is likely to be *Corallina officinalis*. It has been suggested that two other species *Corallina caespitosa and Corallina elongata* may also be found in shallow waterfalls between large longitudinal rockpools at Hinkley Point Jetty [11]. Coral Weed is made up of segmented fronds that are often feather-like in appearance and bond to the rocks with a circular crustose holdfast[12]. The calcareous tissues make the genus hardy in wave exposed conditions however, it may also leave them vulnerable to ocean acidification (lower pH)[12].



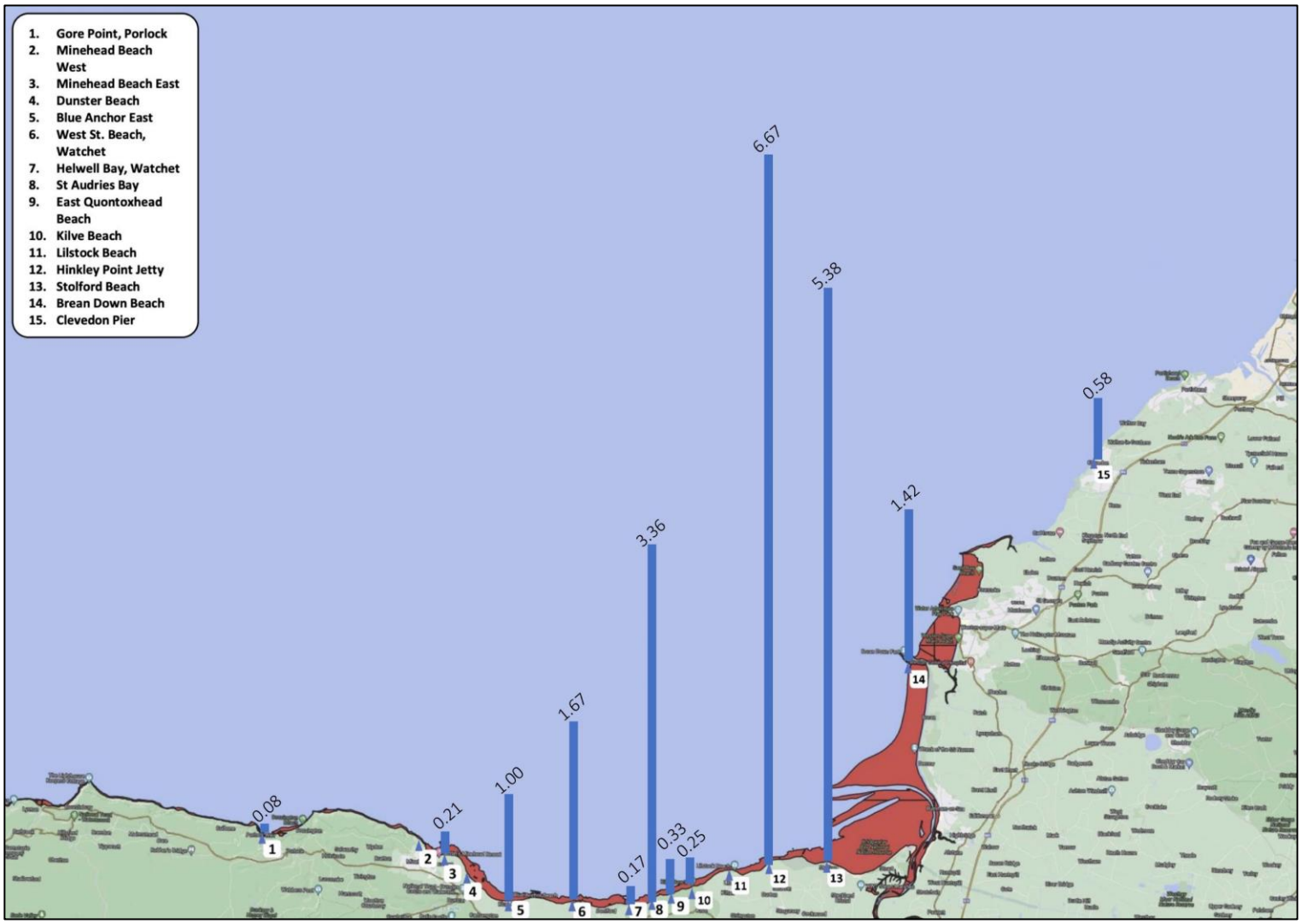
C. officinalis.
Photographer: Judith Oakley.
Copyright: Judith Oakley.

C. spp. were only found at 7 out of the 15 middle eulittoral locations surveyed. As it tends to usually be found forming clumps and turfs, binding to rocks in rockpools. It is likely that this species is found at many more of the locations, but since Shoresearch protocol is to reject any quadrat with over 25% water, this pool-dwelling species will have been under-surveyed. Understanding the distribution of coral weed across the Somerset coast will require separate surveys of the rockpools and gullies in which they are generally found. The relatively large abundance at Minehead Beach East may reflect the fact that in the middle eulittoral at this location there is a large amount of standing water at low tide although in any one location slightly less than 25%.

Ulva lactuca

Percentage Data

U. lactuca, known as sea lettuce, is a membranous, small green algae that can be found on most rocky shores across the UK [13]. Generally found living on rocks to which they attach via a small holdfast this plant favours sheltered conditions on the coast. This small, broad sheet-like algae is fragile and can often break off the rocks they inhabit after which they can continue to grow in floating communities [13]. They are also resilient to brackish water and so can be found on suitable substrates around river estuaries and where freshwater runs across a shore.



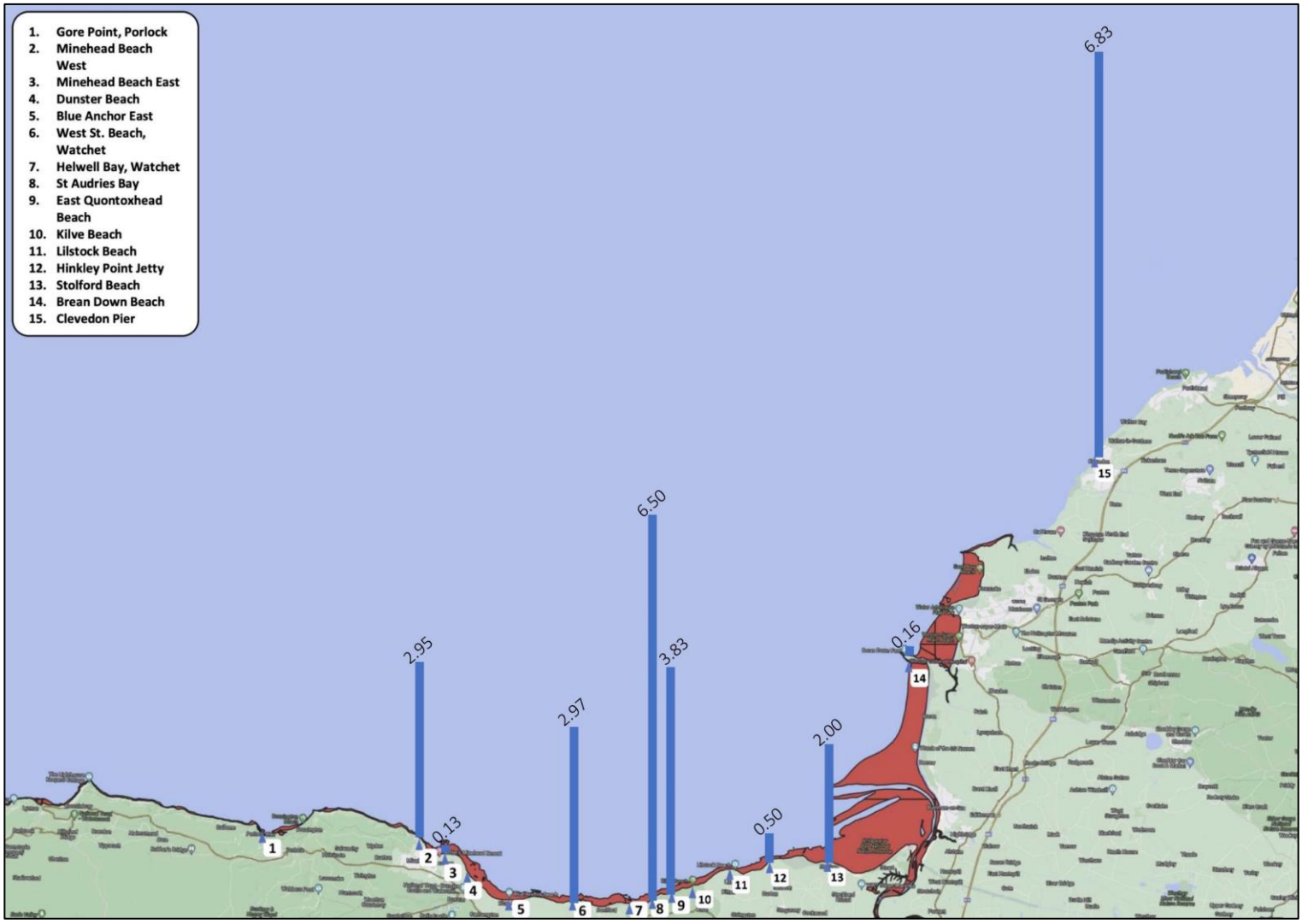
U. lactuca.
Photographer: Judith Oakley.

U. lactuca was identified at most locations surveyed though they only made up a maximum mean of approximately 7% of a survey quadrat. They are clearly prolific though do not dominate the intertidal ecosystem. Notable spikes in abundance appear in locations near substantial freshwater input such as those at Stolford Beach and Hinkley Point Jetty which are downstream of the river Parrett estuary. This could be due to the species' ability to tolerate lower salinity than many other marine algae.

Ulva intestinalis

Percentage Data

Distributed on many shores globally and generally on all coasts in the United Kingdom [14], *U. intestinalis*, known as gut weed, shares a similar appearance to that of *U. lactuca* although it appears in more string-tube-like fronds growing from a clumped base. This species will grow on many substrates from mud, to sand, to rock and is very tolerant of less saline brackish waters. Like *U. lactuca,* when detached from its substrate it is able to float to the surface of calmer waters and continue to grow [14].



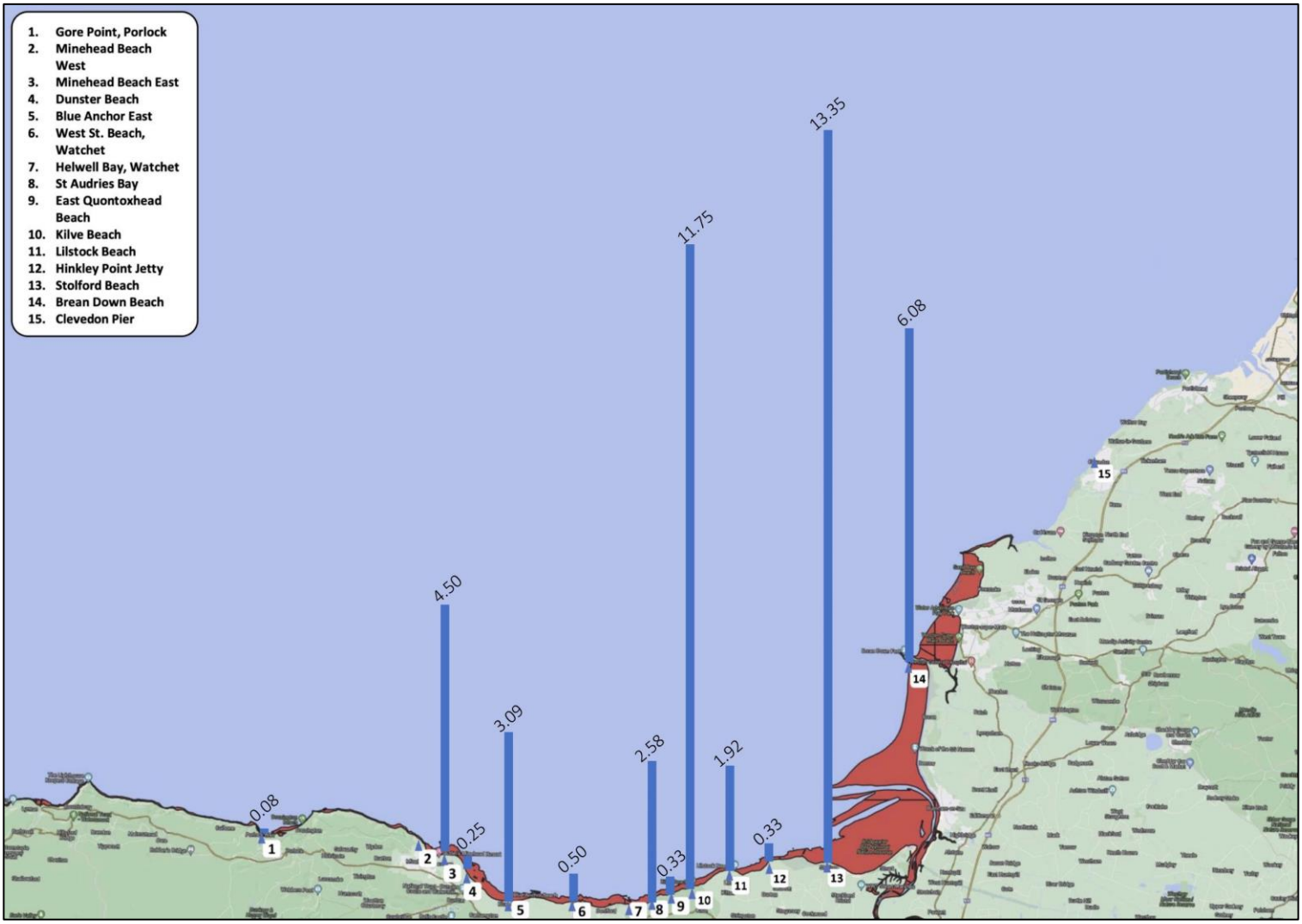
U. intestinalis.
Photographer: Keith Hiscock.
Copyright: Dr Keith Hiscock.

U. intestinalis has been identified at many locations along the Somerset coast. Though not as broadly distributed as *U. lactuca* this species shows similar abundance in that it has a relatively low percentage cover within quadrats compared to other algae species. While this species is evidently a generalist, it never seems to dominate any one particular location. At some locations it is much more abundant than *U lactuca* (e.g. Clevedon Pier), at others it is less abundant (e.g Hinkley Point Jetty) and at other locations both species thrive (e.g. East Quantoxhead Beach).

Austrominius modestus

Percentage Data

A. modestus, known as the Australian star barnacle or modest barnacle, is found all around English and Welsh coastlines and to a lesser extent in Scotland and Ireland [15]. This invasive species originates from Australasia and is thought to have been introduced into British waters in the bilge water of shipping vessels. First reported in the 1940s and now widespread [15], this barnacle has a much broader ecological niche than native intertidal barnacle species, such as *Semibalanus balanoides*, allowing it to survive at a wider range of shore heights and in waters with lower salinity.



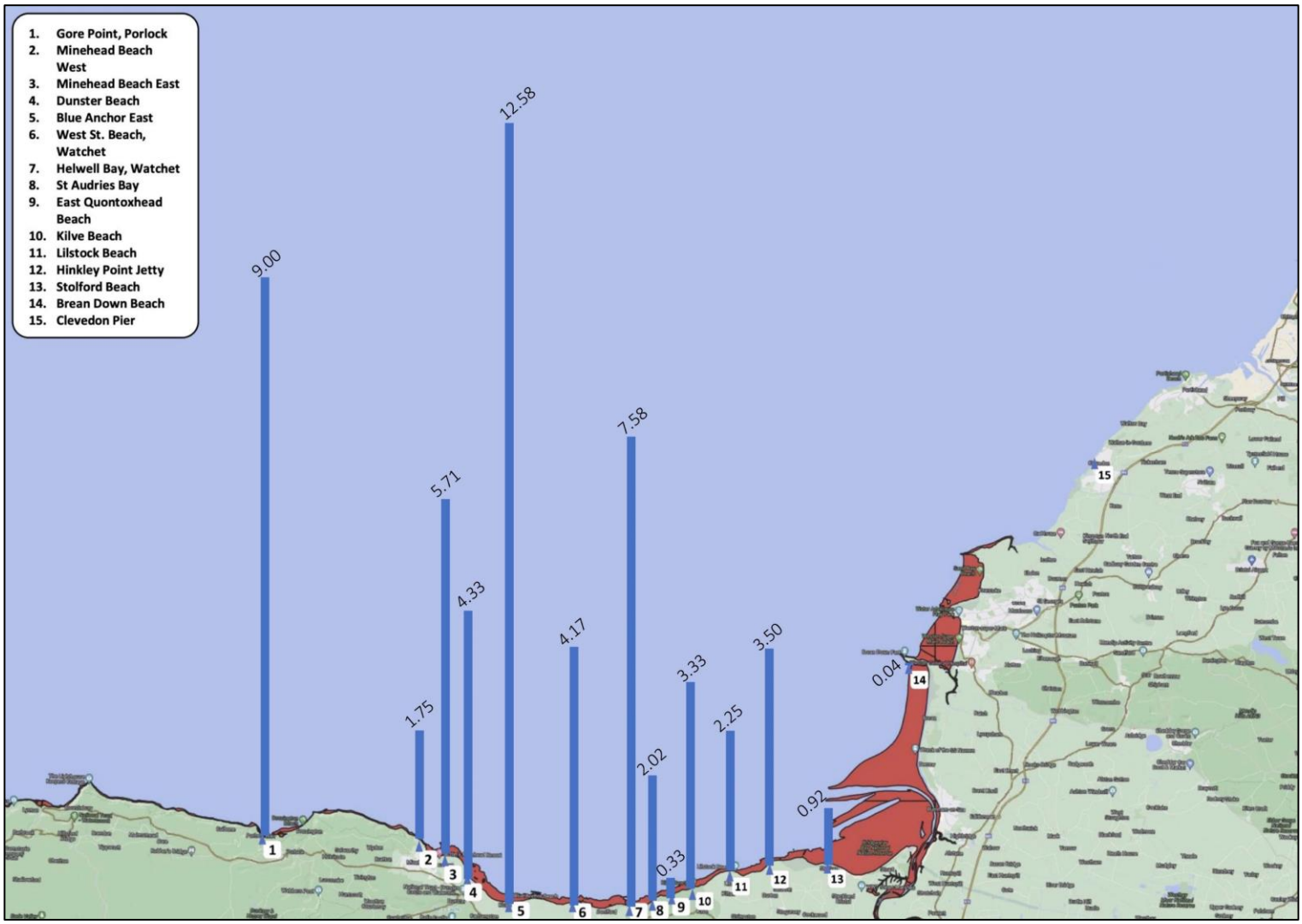
A. modestus.
Photographer: Keith Hiscock.

A. modestus doesn't show any obvious geographical trends in distribution West to East. Instead, it is more likely that varying abundance at different locations is dependent on habitat-specific factors such as substrate type and the abundance of extensive wrack cover which may deter them from settling. It should be noted that the location with the highest recorded abundance was Stolford Beach which sits down-stream of the river Parrett estuary. The native barnacle species *S. balanoides* is found on most Somerset beaches but is much less common than *A. modestus*. It is unknown if its abundance is affected by competition from this more robust invasive species.

Patella spp.

Count Data

Extremely common in the intertidal zone on all coasts over the British Isles wherever there is suitable substrate upon which they live [16], limpets of *Patella* genus are one of the most easily identifiable gastropods on the British coast. Species identification within this genus is more difficult without prying the specimin off the substrate. It is likely most specimens in the middle eulittoral are *Patella vulgata*, but *Patella ulyssiponensis*[17] and *Patella depressa*[18] may also be present on many UK shores. For the purpose of this survey all specimens are recorded as *Patella spp.*. Limpets are prolific grazers on microalgal film and on the sporelings of many intertidal algal species and their presence and relative abundance can be major determinants of the overall species composition and structure of rocky shores. *Patella spp*. are well adapted to wave action and desiccation and can survive at all shore levels.



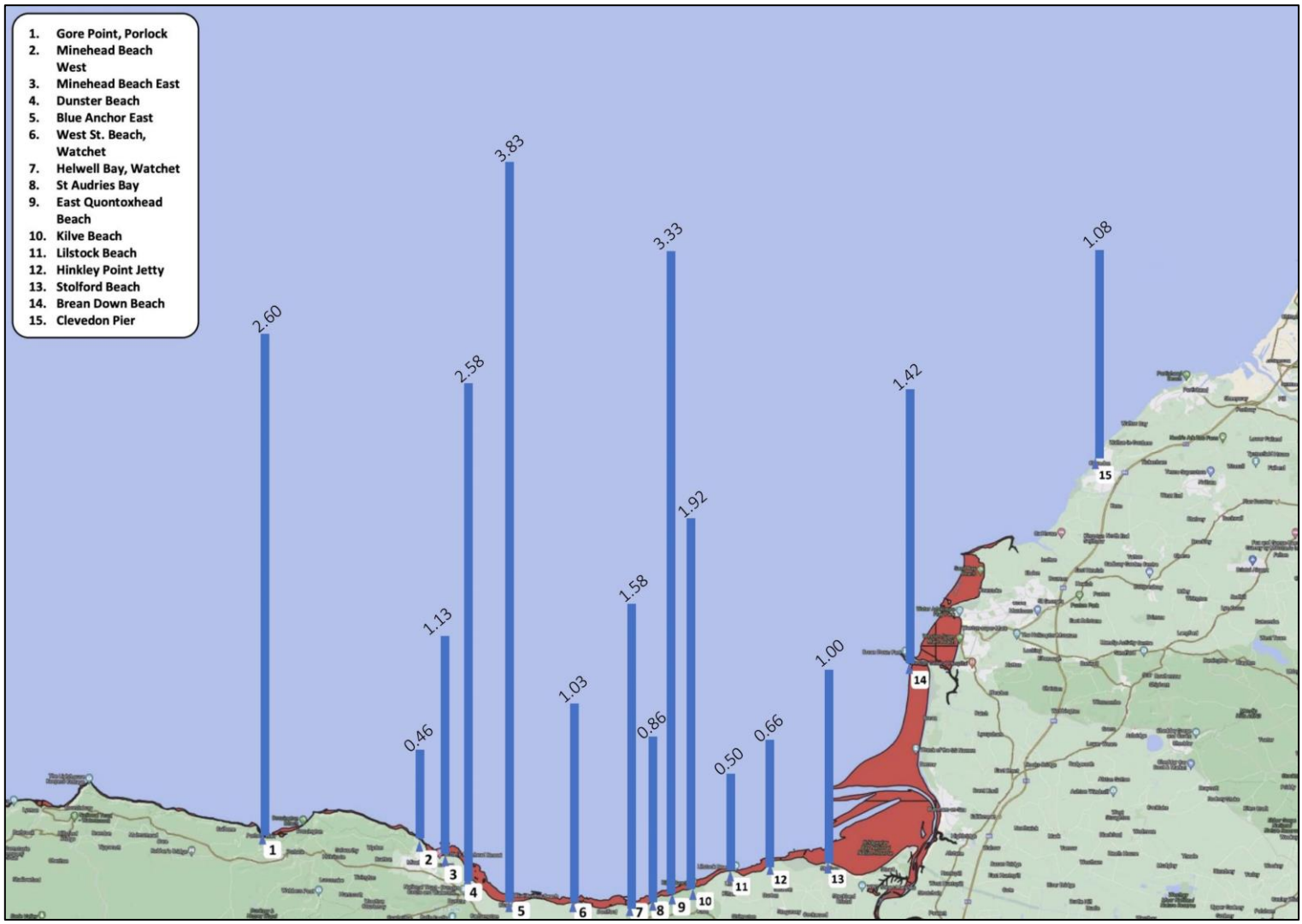
P. vulgata.
Photographer: Peter Barfield.

Limited to the rocks upon which they live and feed, distribution and abundance of limpets across the Somerset coast is likely to be largely substrate dependent. However, there does seem to be lower levels recorded to the east of Helwell Bay, Watchet. This could be due to other factors that limit the abundance of *Patella spp.* such as denser growth of brown seaweeds or siltier conditions across the rock surfaces on which they graze. Further studies would be useful both to determine if different species of the *Patella* genus are present and how the ratios of these may differ along the coast and also to measure the relative sizes (ages) and shapes of individuals at different locations in relation to factors such as seaweed cover and wave exposure, geology and topography

Littorina obtusata/Littorina fabalis

Count Data

L. obtusata, known as the flat periwinkle (flat winkle), lives all around the British Isles on any shores where the brown seaweeds on which they feed are found [19]. A second species of flat winkle *L. fabalis*[20] is also present on most UK shores. These tend to be smaller with thinner shells and live slightly lower down the shore, but are likely to overlap with *L. obtusata*. Because they can be difficult to separate in the field, in these surveys any flat winkles are recorded as *L. obtusata/fabalis*. The identifying feature of both these species is the eponymous flattened spire that gives the shells a smooth rounded shape. Both species can show a wide variety of colour morphs from dark brown through olive to yellow and orange[19]. Coloration is genetically determined and allows individuals to be camouflaged against different seaweeds at different levels on the shore[21]. Both species are not overly sensitive to lower salinity levels and are tolerant to varying levels of wave exposure.



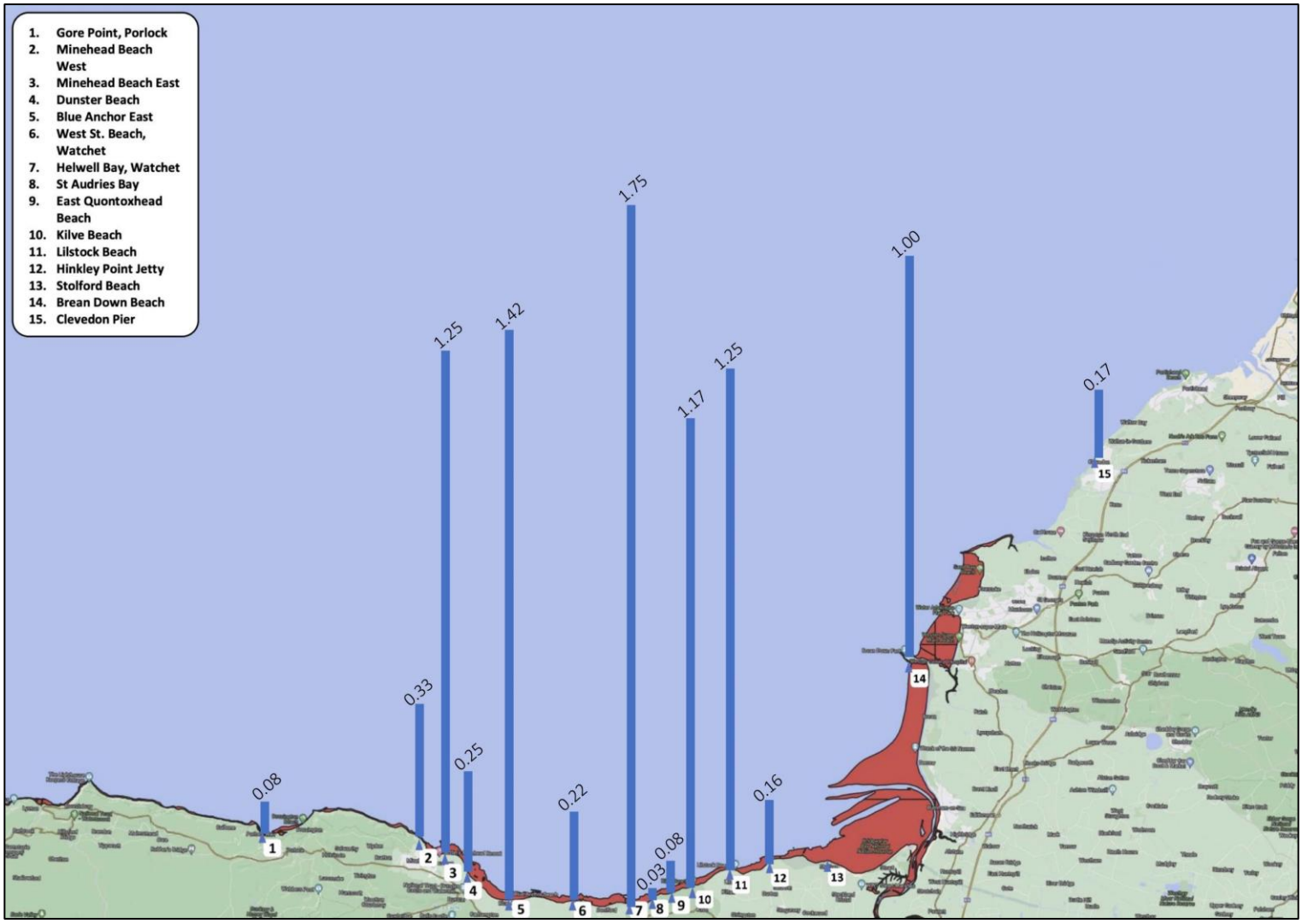
L. obtusata.
Photographer: Peter Barfield.
Copyright: Peter Barfield.

As at least some brown seaweeds were found at every location, there is no shortage of suitable habitat for this snail in Somerset. *L. obtusata/fabalis* were identified at all the locations surveyed making them most well distributed of the periwinkles found. As expected, they were largely found in quadrats with an abundance of brown seaweed. Small holes found on flatter parts of these seaweeds were likely evidence of grazing and were considered synonymous with the presence of these species during the survey. Gelatinous egg masses were also regularly seen. Flat winkle abundance may have been under-estimated due to their camouflage. Although not recorded it was generally noted that the colour of flat periwinkles surveyed were largely olive green-brown without much variation which is similar to the colour of the egg wrack, bladder wrack and saw wrack on which they live.

Littorina littorea

Count Data

L. littorea, also known as the common or edible periwinkle (winkle), is the largest periwinkle species found in the British Isles. This species can be found on rocky shores across the UK at any tidal position from upper shore into the sublittoral zone and can tolerate a wide variety of exposures [22]. It is also known to tolerate a range of salinities. This species is identifiable by its ridged shell, dark colouration and its relatively evenly curved aperture. It can be easily confused, especially when young, with the generally smaller rough winkles such as *L. saxatilis agg*.. However, when young it has a very distinctive white inner lip to its shell aperture with a contrasting brown banded outer lip. This species has a broad diet feeding on microalgal film, detritus and even dead animal material.



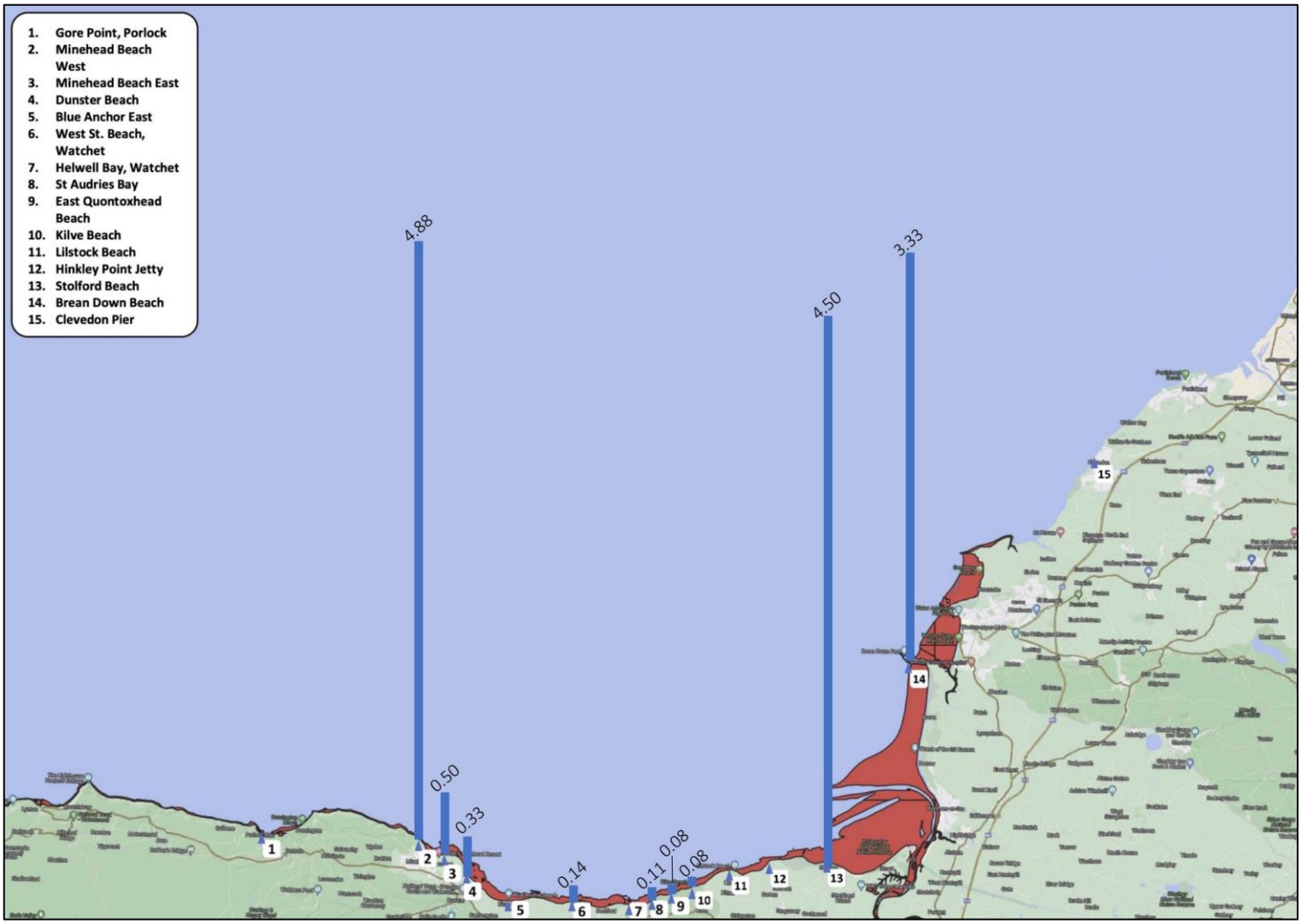
L. littorea.
Photographer: Judith Oakley.
Copyright: Judith Oakley.

L. littorea doesn't seem to observe any trend from East to West. Generally, compared to the flat periwinkle, this species seems to be both less well distributed and less abundant within the locations it is found. It could be that *L. littorea* were hard to observe within quadrats as they are often found on vertical rock surfaces where it is hard to position quadrats. It also has been observed that when *L. littorea* are found individuals often cluster rather than being more evenly distributed across a sample area. This could lead to lower mean abundance due to the relatively small area sampled (usually 12 quadrats) missing these clusters. Mis-identification of juvenile *L. littorea* with *L. saxatilis agg*. may also affect the reliability of these data.

Littorina saxatilis agg.

Count Data

L. saxatilis agg., known as the rough periwinkle (rough winkle), is found all around the UK[23] living on rocks from the upper to lower shore as well as on salt marshes, compact mudbanks and in brackish waters. There are now known to be several species of rough periwinkle, often co-existing in slightly different microhabitats, differing in size, shell texture and shape as well in their reproductive strategies. For the purpose of this survey they are recorded as *L. saxatilis agg*. (*agg*. = aggregation of several species). *L. saxatilis* is likely to be the commonest species found. They graze on microalgal film and can survive higher up the shore than other periwinkles due to physiological and behavioural adaptations to desiccation and temperature stress, often found clustered in cracks and crevices, even being able to live inside dead barnacle shells. Rough winkles can be confused with juvenile *L. littorea*. They are identifiable by the more even coloration of their aperture lip which joins the main shell at more of a right angle than in *L. littorea*.



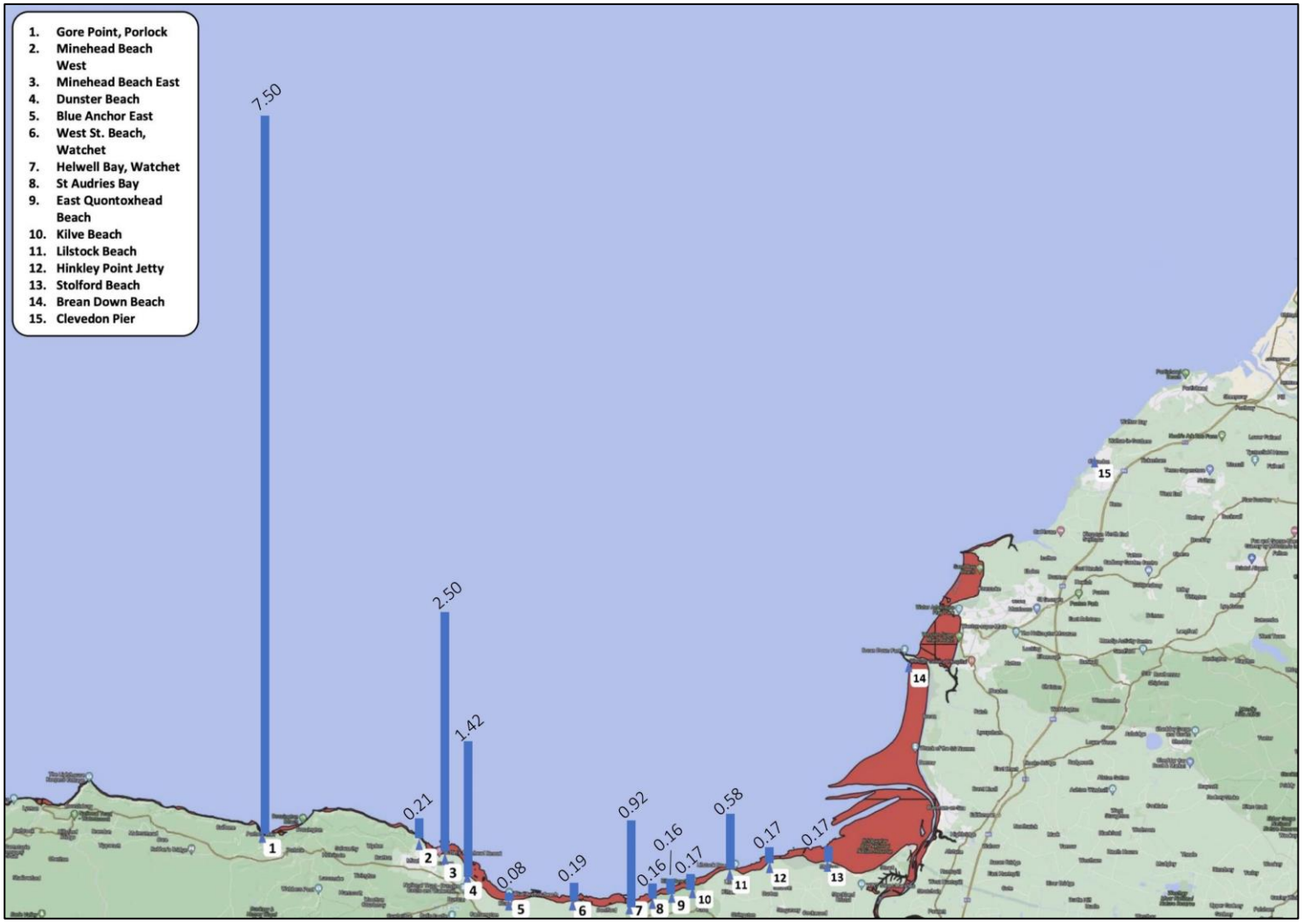
L. saxatilis amongst Semibalanus balanoides.
Photographer: Sue Scott.
Copyright: Sue Scott.

Distribution and abundance of *L. saxatilis agg*. appear to more limited than the other two periwinkle species noted in this report. The data shows that they are found at fewer locations and generally with a low abundance. However, at Brean Down Beach, Stolford Beach, and Minehead Beach West the abundance of *L. saxatilis agg*. is higher and is similar to (if not more abundant than) the abundance of the other periwinkle species. This is likely due to specific environmental factors at these locations which would require investigation upon returning to understand why this species favours these shores in Somerset. *L. saxatilis agg*. is perhaps also found more on shores with larger areas of exposed rock. Mis-identification of *L. saxatilis agg*. with juvenile *L. littorea* may also affect the reliability of these data.

Steromphala umbilicalis

Count Data

S. umbilicalis, known as the flat or purple topshell, is found at all levels on the intertidal zone in south and western coasts of the UK although is most abundant in the middle eulittoral or lower. The species is generally not found on eastern coasts bordering the North Sea and the eastern English Channel[24]. The species name derives from a navel-like hole found at the centre of the underside of the snail. It is a grazer of microalgal film and is well adapted to the environmental conditions found in rock pools, but is less tolerant to surviving on open rock, especially higher up the shore.



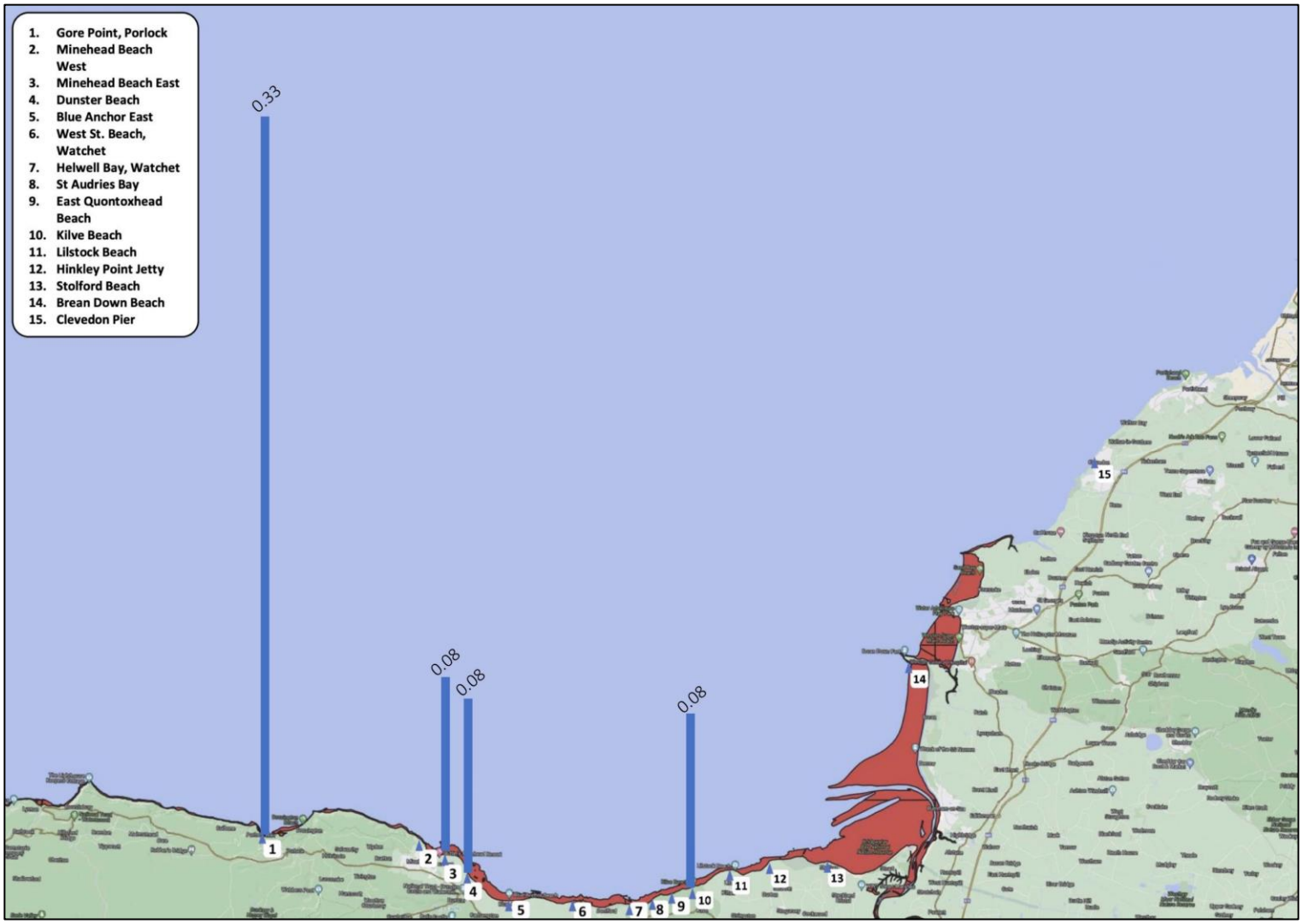
S. umbilicalis.
Photographer: Judith Oakley.
Copyright: Judith Oakley.

The distribution of *S. umbilicalis* shows a clear trend of increasing abundance from East to West. None were found at the two most easterly locations (Brean Down Beach and Clevedon Pier). This could be in response to the increasing clarity of water from east to west. As microalgal grazers their feeding may also be impacted by the siltier conditions found to the East. Less tolerance to lower salinity further up the Bristol Channel may also affect their survival. Difference in microhabitat, local topography and amount of rock pools and standing water may also determine abundance between particular locations. It is interesting for instance that abundance is lower at Minehead Beach West than at the adjacent locations of Minehead Beach East and Dunster Beach to either side.

Phorcus lineatus

Count Data

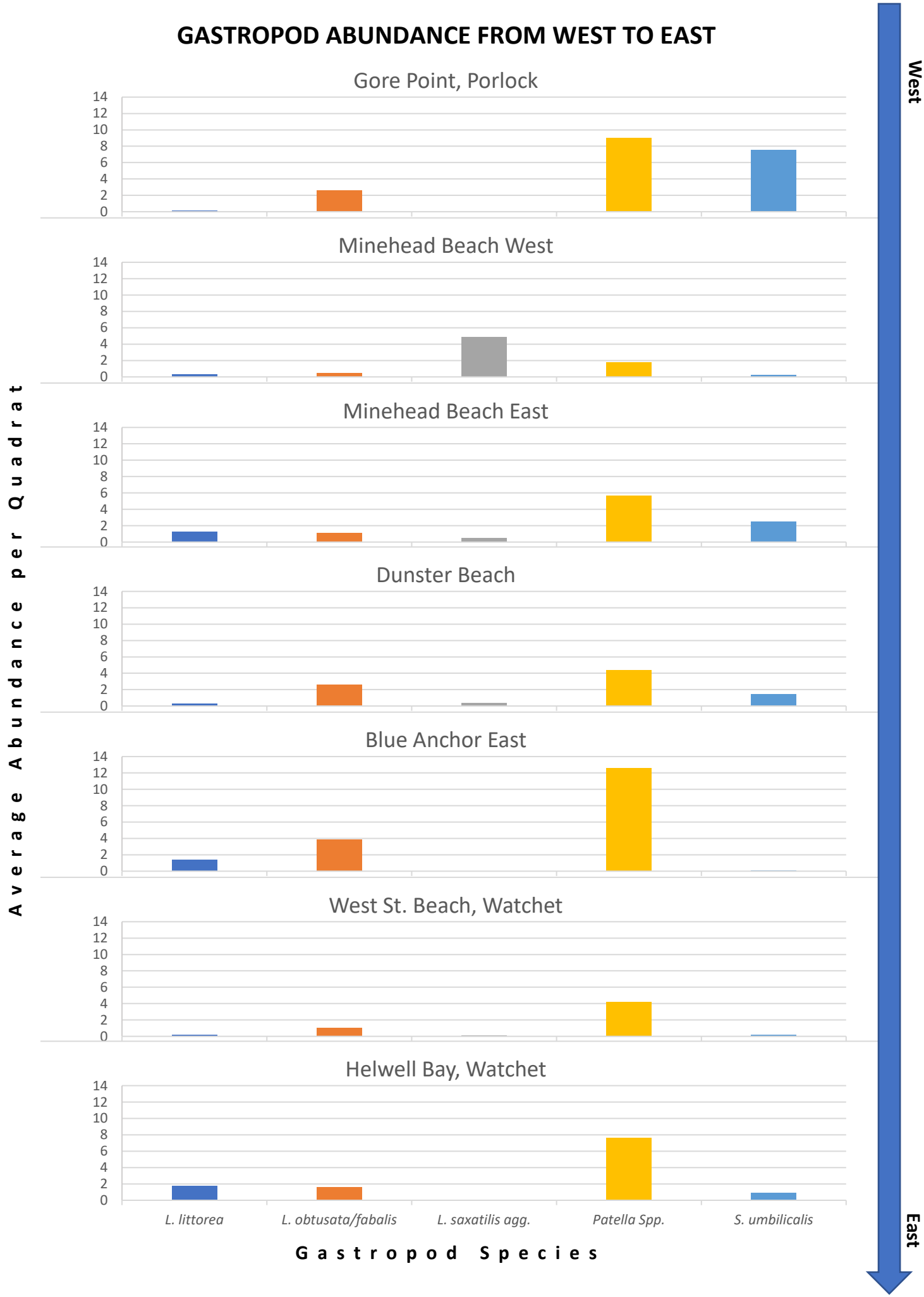
P. lineatus, known as the common toothed or thick topshell, is more limited in its geographical UK distribution than other gastropods noted in this report. It is commonly found on rocky shores on the western and southern coasts of the British Isles with a rough northern limit at North Wales and eastern limit at Lulworth, Dorset. Globally, the species can be found in the North East Atlantic on coasts of Morocco to the northmost tip of the Cotentin peninsula, France, where the species favours warmer waters [25]. It may be a useful species as climate change indicator[26]. *P. lineatus* is a grazer of microalgal film. It is well adapted to higher temperatures and desiccation stress, so can survive higher up the shore and on open rock, although juveniles tend to be found lower down the shore, in rock pools and under seaweed. At the edge of their northern range they can be severely impacted by cold winters.

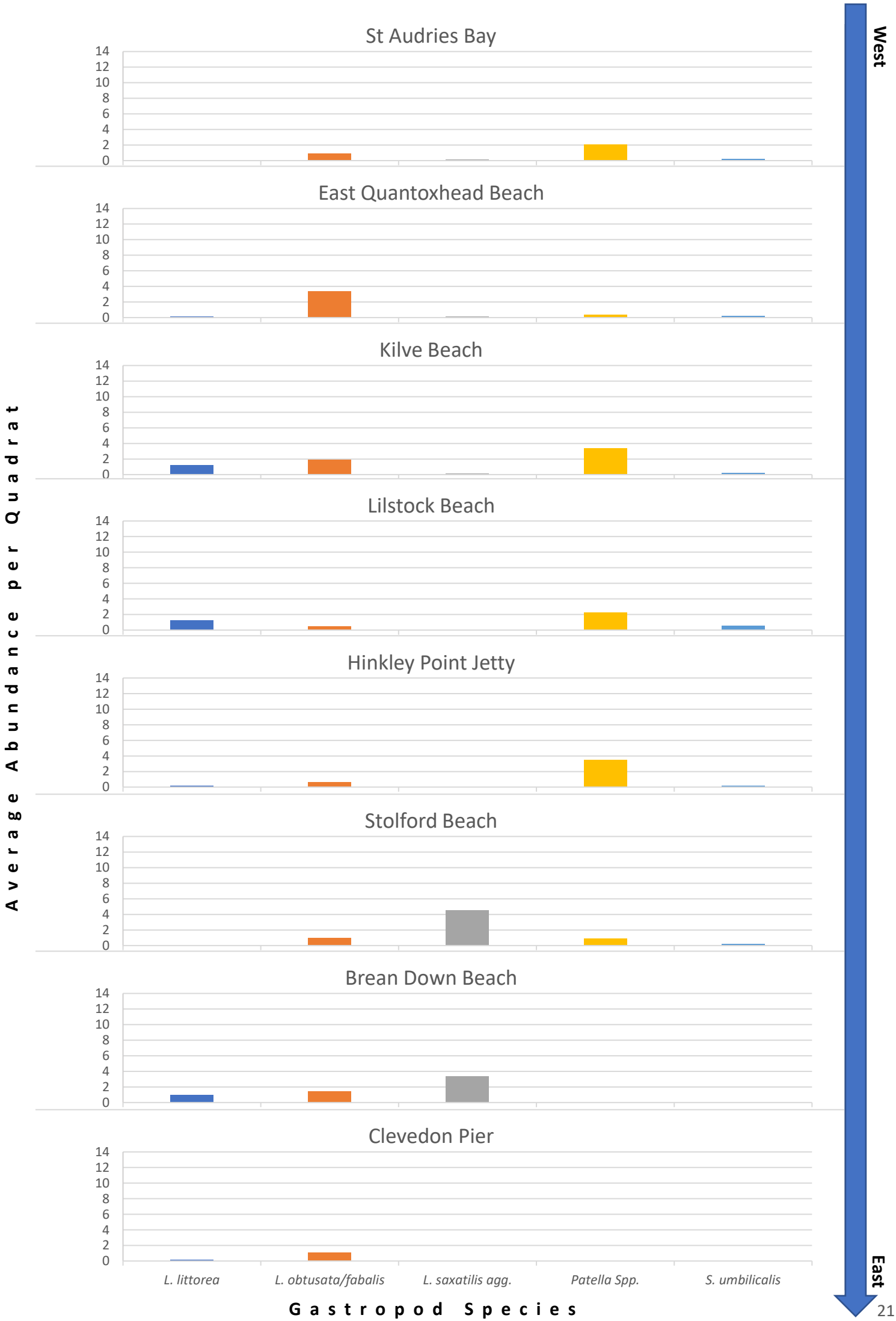


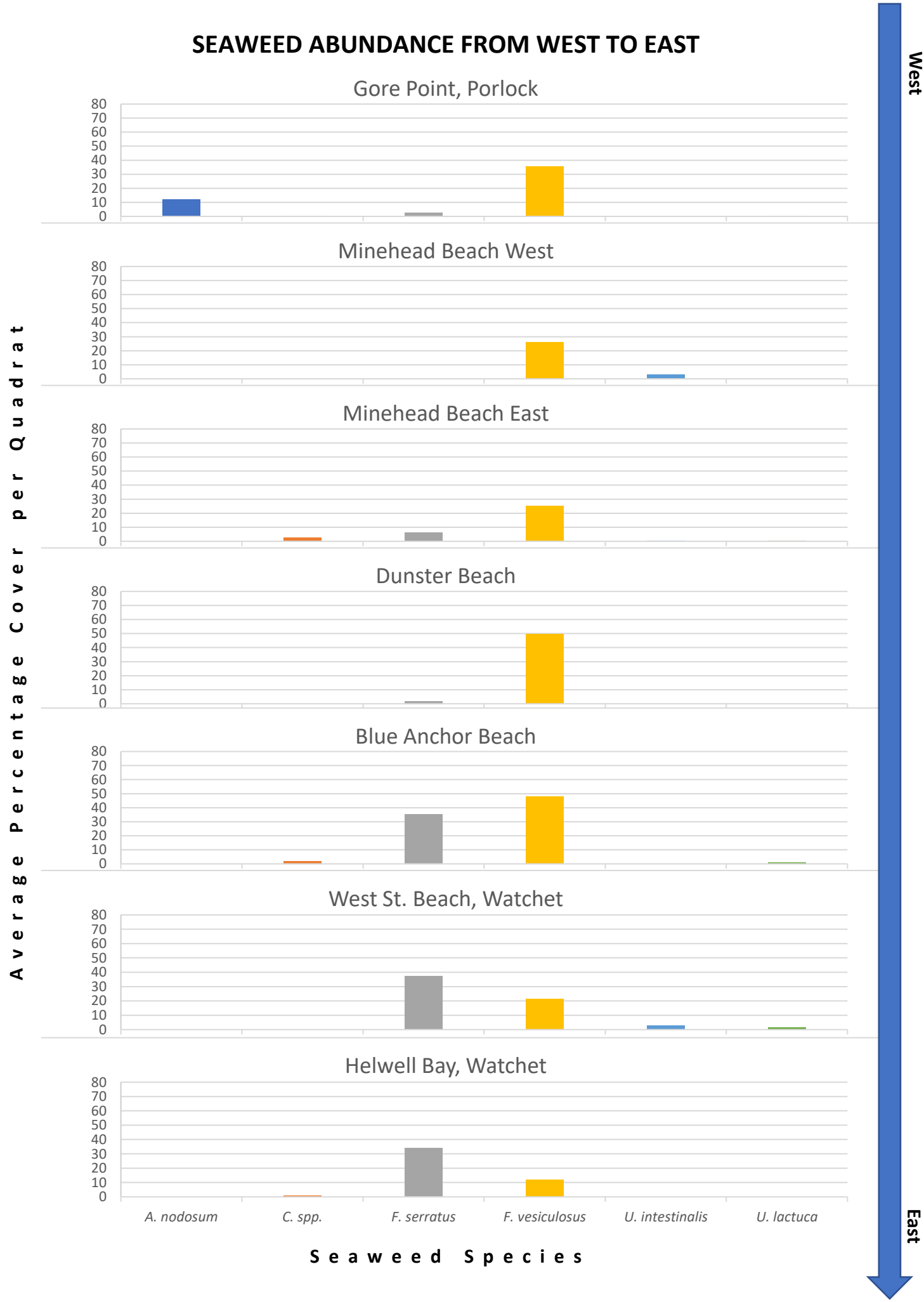
P. lineatus.
Photographer: Peter Barfield.
Copyright: Peter Barfield.

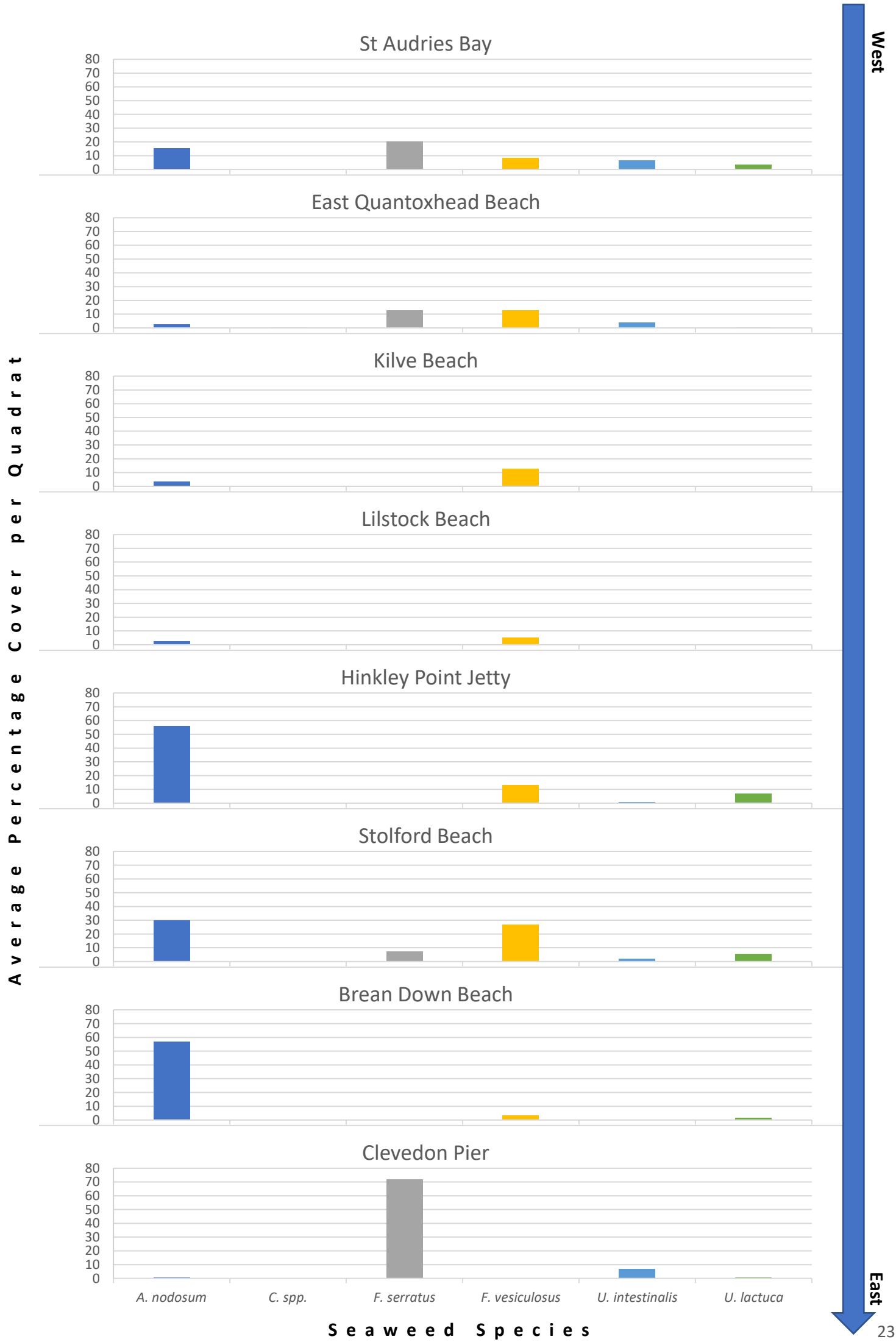
P. lineatus was only identified at four middle eulittoral locations. While data is limited, there is a possible increase in abundance from east to west similar to that found in *S. umbilicalis*. Data collected for this species could be used as a baseline to monitor possible changes in distribution abundance linked to increased sea temperature in coming decades. It is likely however that decreased abundance further up the Bristol Channel is linked to other factors such as siltier rock surfaces on which it grazes or on decreasing salinity. As this species can be aged (by counting growth 'checks' that it lays down each winter) there is scope for further studies measuring size, age and growth at different locations.

Graphs Showing Diversity of Species by Shore Location.


GASTROPOD ABUNDANCE FROM WEST TO EAST
Gore Point, Porlock
Minehead Beach West
Minehead Beach East
Dunster Beach
Blue Anchor East
West St. Beach, Watchet
Helwell Bay, Watchet
0
2
4
6
8
10
12
14
Average Abundance per Quadrat
L. littorea
L. obtusata/fabalis
L. saxatilis agg.
Patella Spp.
S. umbilicalis
Gastropod Species
West
East


St Audries Bay
East Quantoxhead Beach
Kilve Beach
Lilstock Beach
Hinkley Point Jetty
Stolford Beach
Brean Down Beach
Clevedon Pier
0
2
4
6
8
10
12
14
West
East
Average Abundance per Quadrat
L. littorea
L. obtusata/fabalis
L. saxatilis agg.
Patella Spp.
S. umbilicalis
Gastropod Species


SEAWEED ABUNDANCE FROM WEST TO EAST
Gore Point, Porlock
Minehead Beach West
Minehead Beach East
Dunster Beach
Blue Anchor Beach
West St. Beach, Watchet
Helwell Bay, Watchet
0
10
20
30
40
50
60
70
80
A. nodosum
C. spp.
F. serratus
F. vesiculosus
U. intestinalis
U. lactuca
Seaweed Species
Average Percentage Cover per Quadrat
West
East


St Audries Bay
East Quantoxhead Beach
Kilve Beach
Lilstock Beach
Hinkley Point Jetty
Stolford Beach
Brean Down Beach
Clevedon Pier
0
10
20
30
40
50
60
70
80
A. nodosum
C. spp.
F. serratus
F. vesiculosus
U. intestinalis
U. lactuca
Seaweed Species
Average Percentage Cover per Quadrat
West
East

The gastropod graphs above may indicate a decrease in diversity of sample species from West to East and highlight at which locations certain species are more dominant. The apparent decrease in diversity is likely due to changes in factors such as nutrient load, turbidity and salinity away from the Severn Estuary which is concordant with known trends in nature where high nutrient availability causes reduced biodiversity [27]. It should be noted that the scope of diversity here is limited only to gastropod species that were included in this report and is not a true representation of biodiversity on each shore. To gain a more accurate understanding, future study should conduct a Shannon's/Simpson's Biodiversity Index based on **all** species recorded through Shoresearch quadrat surveys.

The seaweed graphs above show no trend in diversity of seaweeds from West to East. This may indicate a greater tolerance in these species to the known shift in conditions from West to East in the Bristol Channel and that distribution of these species is more dependent other abiotic factors such as substrate type/availability and level of shelter. As with the gastropods, it should be noted that the graphs above do not provide a true scope of algae biodiversity as the species included are only those mentioned previously in the report. Again, to gain a true scope of biodiversity of algal species on the Somerset coast a Shanon's/Simpson's Biodiversity Index should be conducted on **all** species of this taxa recorded via the Shoresearch quadrat methodology.

As volunteers' skills develop in IDing intertidal species to a greater extent, it is likely the case that data will be recorded more uniformly to the species level rather than to the varying taxonomic ranks that are included in this report and in the unfiltered dataset. As such, future Somerset Shoresearch reports may be able to analyse data which more accurately measure biodiversity along the Somerset coast based on data gathered by more experienced volunteers from 2023, onwards. Equally, future reports are likely to present more precise data as returning volunteers' skills are bought up to a more uniform level. Within the scope of time that this report focuses on, training videos on identification of different algal groups were delivered to volunteers by experts. As such, being the first report that Somerset Shoresearch has produced and dealing with a dataset that is gathered by a team with ever-growing compentencies, it is likely that the dataset is skewed by an expected increase in detection of certain species over time. This is an issue that should naturally become less significant as the project develops and sustains a core team of highly competent volunteers.

Summary

Somerset Wildlife Trust Shoresearch survey data has identified a great deal of variation in abundance and distribution of intertidal taxa along the Somerset coast with the majority of taxa most likely varying in response to specific environmental characteristics of each location. The data begins to give better understanding of favourable habitats for specific taxa and provides the foundation for understanding which habitats support greater diversity as seen in the graphs from page 19-23. It may also be the case that trends from East to West along the Bristol Channel such as that seen in the case of *S. umbilicalis* may emerge as further data collection continues as well as showing any temporal changes at each location from year to year.

The data gathered for this report were produced by a team of citizen scientists. It has been widely documented within the scientific community that citizen science data carries its problems [28]. Nevertheless, the consistency of data collection through Shoresearch provides opportunity for volunteers to rapidly improve field-identification skills and build a firm understanding of the methodology. As a result, data collected may be more accurate as returning volunteers' skills improve. While variables such as time of day, number of repeats, and surveyor proficiency were not standardised, the large dataset produced by the team was overseen by a professional in the field who is able to confirm identification of species as well as uphold good scientific practice. As such, the data produced by Shoresearch is inherently valuable. Any variables that may produce a bias in the results such as weather and time of day were recorded and are logged within the dataset.

By gathering and documenting the data outlined in this report, and by continuing to do so in the future, Somerset Shoresearch volunteers are providing the framework from which locations of important species richness and diversity, and population trends and distribution can be identified and monitored. The regularity of data collection provides opportunity to identify changes in abundance, distribution and diversity and allows the Wildlife Trust to recognise any negative or concerning trends before taxa are severely impacted. Future reports should compare findings of taxa distribution year to year in order to monitor change on the Somerset coast however, they could also separately be combined and compared with other current, previous and future data to explore trends and patterns in more detail. There is much scope for further separate research to be carried out on specific taxa, recording population density, mean specimen size or cover and in some cases age and growth rate at different locations.

Data gathered to inform this report can be found in the appendix. The data used to produce this report and all its graphics are taken from a much more extensive dataset readily available from the Somerset Wildlife Trust and downloadable from the national Shoresearch data portal.

Acknowledgements

This report would not be possible without the consistent help of Shoresearch Leader & Somerset's Wilder Coast Project Manager, Dr Mark Ward. Mark has provided advice and feedback on the writing of the report throughout every stage of its creation: from initial idea to finished product, and continuous editing help.

Thanks also goes to Rob Sidaway for his diligent proof-reading and suggested edits.

Final thanks should also go to all Somerset Shoresearch volunteers who without their time, this report would not be possible. Hopefully this report acts as something to give back to the hours of data collection on many a rocky shore over the past two years.

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Appendix

Table 1 – Average number of species per 0.5x0.5m quadrat.

Location	*L. littorea*	*L. obtusata/fabalis*	*L. saxatilis agg.*	*Patella spp.*	*S. umbilicalis*
Gore Point, Porlock	0.08	2.60	0.00	9.00	7.50
Minehead Beach West	0.33	0.46	4.88	1.75	0.21
Minehead Beach East	1.25	1.13	0.50	5.71	2.50
Dunster Beach	0.25	2.58	0.33	4.33	1.42
Blue Anchor East	1.42	3.83	0.00	12.58	0.08
West St. Beach, Watchet	0.22	1.03	0.14	4.17	0.19
Helwell Bay, Watchet	1.75	1.58	0.00	7.58	0.92
St Audries Bay	0.03	0.86	0.11	2.02	0.16
East Quantoxhead Beach	0.08	3.33	0.08	0.33	0.16
Kilve Beach	1.17	1.92	0.08	3.33	0.17
Lilstock Beach	1.25	0.50	0.00	2.25	0.58
Hinkley Point Jetty	0.16	0.66	0.00	3.50	0.17
Stolford Beach	0.00	1.00	4.50	0.92	0.17
Brean Down Beach	1.00	1.42	3.33	0.04	0.00
Clevedon Pier	0.17	1.08	0.00	0.00	0.00

Table 2 – Average percentage cover of species per 0.5x0.5m quadrat.

Location	*A. nodosum*	*A. modestus*	*C. spp.*	*F. serratus*	*F. vesiculosus*	*U. intestinalis*	*U. lactuca*
Gore Point, Porlock	12.00	0.08	0.16	2.41	35.58	0.00	0.08
Minehead Beach West	0.00	0.00	0.00	0.00	26.04	2.95	0.00
Minehead Beach East	0.00	4.50	2.75	6.04	25.25	0.13	0.21
Dunster Beach	0.00	0.25	0.00	1.67	49.75	0.00	0.00
Blue Anchor East	0.00	3.09	2.00	35.36	48.22	0.00	1.00
West St. Beach, Watchet	0.22	0.50	0.14	37.36	21.36	2.97	1.67
Helwell Bay, Watchet	0.00	0.00	1.08	33.92	12.17	0.00	0.17
St Audries Bay	15.17	2.58	0.00	20.33	8.19	6.50	3.36
East Quantoxhead Beach	2.50	0.33	0.08	12.67	12.75	3.83	0.33
Kilve Beach	3.33	11.75	0.25	0.00	12.75	0.00	0.25
Lilstock Beach	2.25	1.92	0.00	0.00	5.00	0.00	0.00
Hinkley Point Jetty	56.00	0.33	0.00	0.00	13.00	0.50	6.67
Stolford Beach	29.67	13.35	0.00	7.50	26.58	2.00	5.38
Brean Down Beach	56.79	6.08	0.00	0.00	3.17	0.16	1.42
Clevedon Pier	0.50	0.00	0.00	71.91	0.17	6.83	0.58