# Comparing benthic seaweed communities within Sussex in 2019 and 2020 through towed video transects

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## Introduction

Seaweed habitats are a keystone to coastal biodiversity in the UK. They assemble as a complex natural habitat of primary producers that supports a colourful array of life from epiphytes [Duggins, 1980; Dunton & Schell, 1987] to epilithic and pelagic organisms [Steneck & Watling, 1982; Estes & Steinberg, 1988; Bustamante, Branch & Aekhout, 1995]. In the Intertidal zone, they form a protective barrier against low tide desiccation [Jenkins, Hawkins & Norton, 1999; Steneck et al., 2002] and in the sublittoral zone they shield the coast from the hydraulic power of the marine system, dampening the energy of currents and waves to create a buffer zone [Yesson et al, 2015; Boller & Carrington 2006].

This dampening effect is primarily attributed to a particular community of seaweeds, kelp forest, which in the UK are formed by large brown seaweeds, *Phaeophyceae*, of the genera *Laminaria* and *Saccharina*. This buffer zone created by kelp forest is a particularly vital habitat as it is a major feeding and breeding ground for a diverse range of organisms – including species of economic value [Bernstein & Jung, 1979; Paul & Steneck, 1993; Levin, 1994; Duarte, 1995; Steneck, et al 2002]. Together kelp forests and seaweed communities in general generate billions of pounds every year via ecosystem regulation and supporting services [Beaumont et al, 2008; Smale et al, 2013]. The importance and economic value of kelp habitat makes reports of kelp declines alarming. Reports started with anecdotal evidence and evolved into an overarching trend of retracting range within the UK [Wernberg et al, 2011; Moy & Christie, 2012; Koch et al, 2013; Smale et al, 2013; Yesson et al 2015].

One documented example of a dramatic decline in kelp forest lies along the coast of Sussex, a county on the English south coast shown in Figure 1. It has had an estimated 95% decline in kelp forest in 20 years which was originally recorded from Beachy Head in the East, to Selsey Bill in the West as shown in Figure 1. This was made up of 3 species: *Laminaria digitata*, *Laminaria hyperborea* and *Saccharina latissimi*.

In an attempt to restore nearshore marine habitat, including historic kelp beds , the Sussex Inshore Fisheries and Conservation Authority (IFCA) has proposed a trawling exclusion area along the coast of Sussex. [ https://www.sussex-ifca.gov.uk/kelp ]. In order to measure the impact of these ecosystem-based management measures and any potential rewilding projects, a detailed map of existing benthic communities is required.  This study documents benthic communities in the region based on comparisons of towed camera surveys performed in July 2019 and August 2020.

## Methodology

### Surveys

Twenty-four towed camera transects were conducted by Sussex IFCA on 10th August 2020 as a repeat of the previous surveys performed on 16th & 17th July 2019. These spanned c. 40km of the near shore from the east side of Selsey Bill, through to Shoreham, covering areas where historic kelp beds used to be. Video data were collected from a benthic sled which was towed from the rear of the Sussex IFCA patrol vessel "Watchful". The sled was equipped with a Seacam (480p) wide angle colour camera attached to a RovTech RSL portable camera system by a 300 ft umbilical Bowtech system, a Rovtech Seabeam Ultra LED light,and two Trident SCUBA lasers. Each transect was approximately 12 minutes long towing at ~0.8 knots, covering ~300 metres of seabed.

### Analysis

Still images were extracted from the survey videos at approximate 30 second intervals, chosen when the image was stable and the seabed was clearly visible (following Long et al. 2020). Observable organisms were annotated using the Biigle annotation platform [Langenkämper, et al. 2017]. Organisms were labelled based on the categories shown in Figure 2. The categories of seaweed forms were based on Bunker et al. (2017) while animal identifications were based on taxonomic Order [Worms Editorial Board 2020]. Sediment size was estimated by visual inspection based on the Wentworth scale [Wentworth, 1922]. Percentage algae cover was also estimated for each image by visual inspection rounded to the nearest 20%.

Red Algae

1. Fine, whorled or closely spirally arranged branches around a macroscopic axis
    a. *Asparagopsis armata*
2. Thicker flat reds without veins
    a. *Grateloupia turuturu*
3. Fringed reds
    a. Beautiful Eyelash Seaweed, *Calliblepharis ciliata*
4. Fine cylindrical axes and branches, not in whorls
    a. *Chondria* sp.
5. Slippery, gelatinous or lubricous reds
6. Feathery reds
7. Very fine reds
8. Fan-shaped reds
9. Cylindrical and branched in various ways.
10. Elongated, worm-like and cylindrical reds

Brown Algae

11. Thin branched browns
    a. *Desmarestia* sp.
    b. Dead man's rope, *Chorda filum*
12. Flat or membranous browns.
    a. *Dictyota* sp.
13. Bushy wracks
    a. Sea Oak, *Halidrys siliquosa*
    b. *Sargassum muticum*
14. Kelps

Animals (Order Level)

15. Actiniaria
    a. Dahlia anemone, *Uticina felina*
    b. Snakelocks Anemone, *Anemonia viridis*
16. Alcyonacea
    a. Dead Man's Fingers, *Alcyonium digitatum*
17. Cheilostomata
    a. *Flustra foliacea*
18. Canalipalpata
    a. Keel worm, *Pomatoceros triqueter*
19. Poecilosclerida
    a. Shredded Carrot Sponge, *Amphilectus fucorum*

Figure 1: Label tree used for assigning organism annotations. Algae categories from Bunker et al, 2017, animals based on taxonomic order (Worms Editorial Board, 2020).

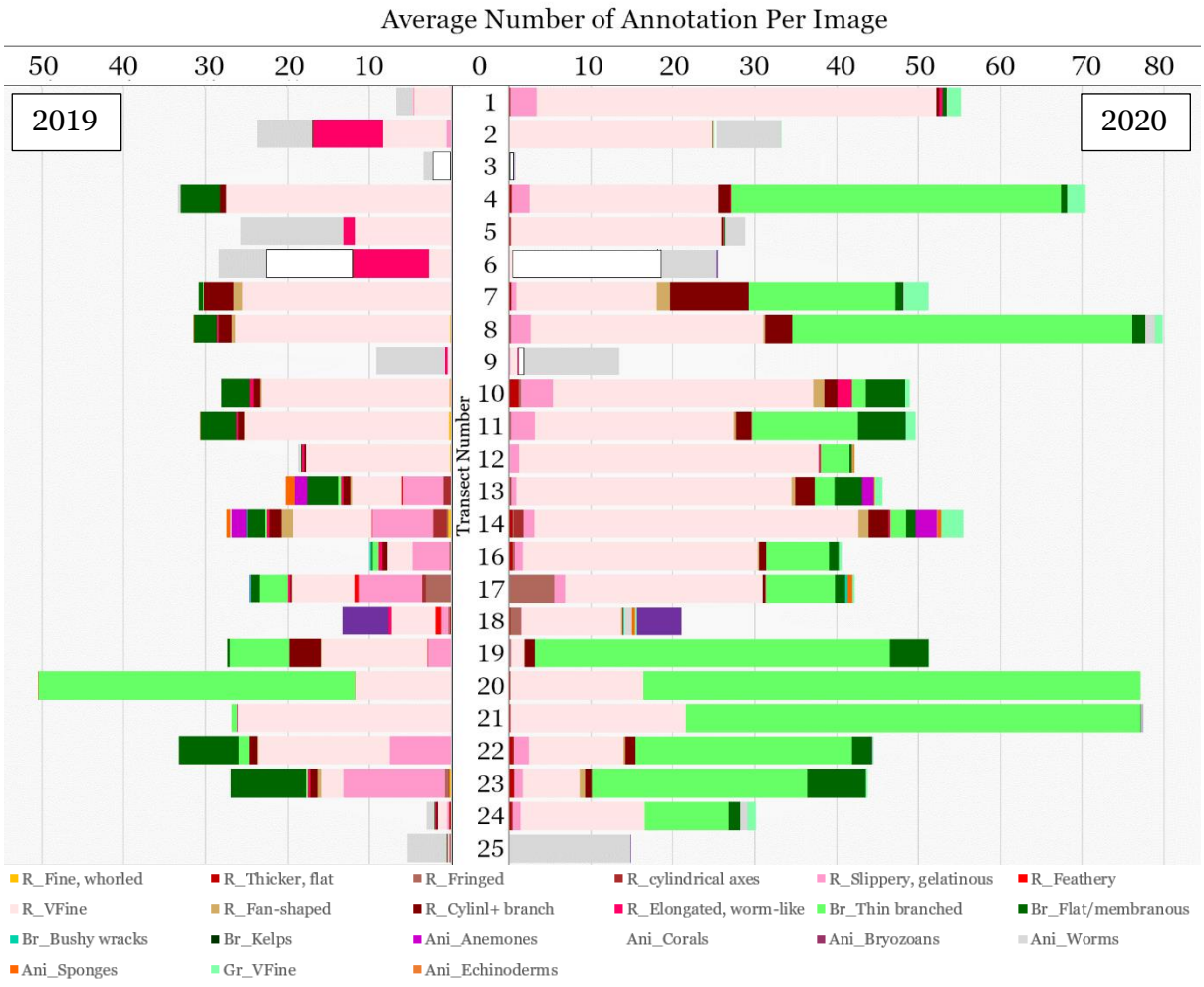



Figure 2: Distributions of Algae and Sessile/ Slow moving Animals 2019-2020. Horizontal axis is total number of annotations per transect number, vertical axis, divided by total number of images in that transect

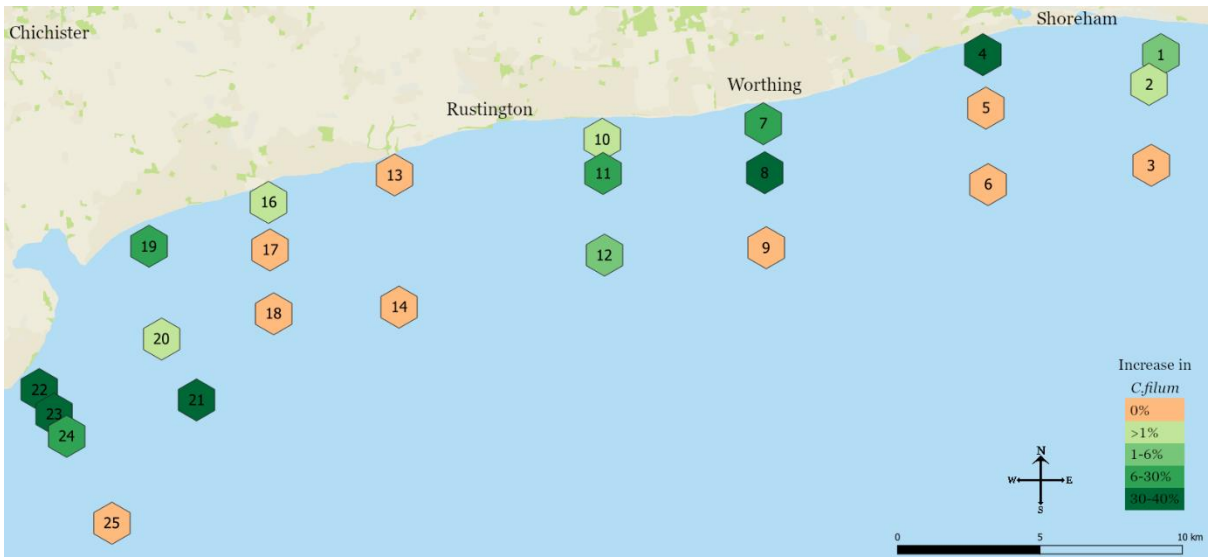



Figure 3: increase in percent of annotations that are *C. filum* from 2019 to 2020 at each transect.

## Results

In observing the videos from every transect in 2020 not a single frond of the 3 main kelp species, oarweed, forest kelp or sugar kelp, was seen in any of the sampled still images – compared with only 2 incidences of kelp seen at the same stations from the 2019 surveys. No kelp is seen in any of the images in either 2019 or 2020. However, a key change between the two years, shown in Figure 2, is a doubling in the total number of annotations per image in each transect.

Initial inspection, outlined in Table 1, indicated that this could be because algae at most of the transects was thicker and denser than seen in 2019. A large part of the overall abundance increase is driven by a sharp increase in *Chorda filum* within the category "Br_thin branched", which has proportionally increased by up to 40% in some transects (notably transect 21-23) as shown in Figure 3. Another explanation for the increase in annotations in 2020 is that the Field of View (FOV) could be different between 2019 and 2020. The FOV is affected by the angle the camera is mounted to the sled, with a more horizontal view increasing the amount of seabed visible therefore the quantity of algae. Unfortunately, camera angle was not recorded in 2019, but has been added to the Standard Operating Procedure for future surveys.

The spread of *C. filum* appears to mostly follow the coast to the east of its original recorded transects 19, 20 & 21. *C. filum* has notably flourished less in transects 13-18, despite these transects being of a similar depth to the western transects 22-24, where it is now abundant. It is possible transects with thicker and more diverse algae communities are harder to colonise compared to the less diverse transects 1-12, However *C. filum* remains absent from the animal dominated transects that had no algae, such as 25, 9 and 3.

Populations of *C. filum* are known to have a large degree of year on year variation in the area (Ray Ward pers. comm.), though this boom could also be linked to less physical damage due to reduced trawling effort in the 2020 COVID-19 outbreak. A study in the population of *C. filum* in the Gulf of Finland by South & Burrows (1967) indicates the long thallus of the secondary sporphyte stage vanishes by March, after beginning its decline in length in October. As the 2019 survey was done earlier in the year (July rather than August) it is possible that the population of *C. filum* had not reached its maximum, however, such a change in density and distribution in just one month is unlikely.

Algae classed as very-fine reds have also had a notable increase in abundance in 2020, in transects 1,2,5,12-17 & 24 as shown in Figure 2. This, along with the overall increase in annotation number, may be an artifact of the survey design, due to camera angle affecting the FOV. Conversely, algae classed as elongated & worm like reds have seen a notable decline, as have the slippery & gelatinous reds, although this could also be due to misidentification, as these can be difficult to distinguish from very-fine reds.

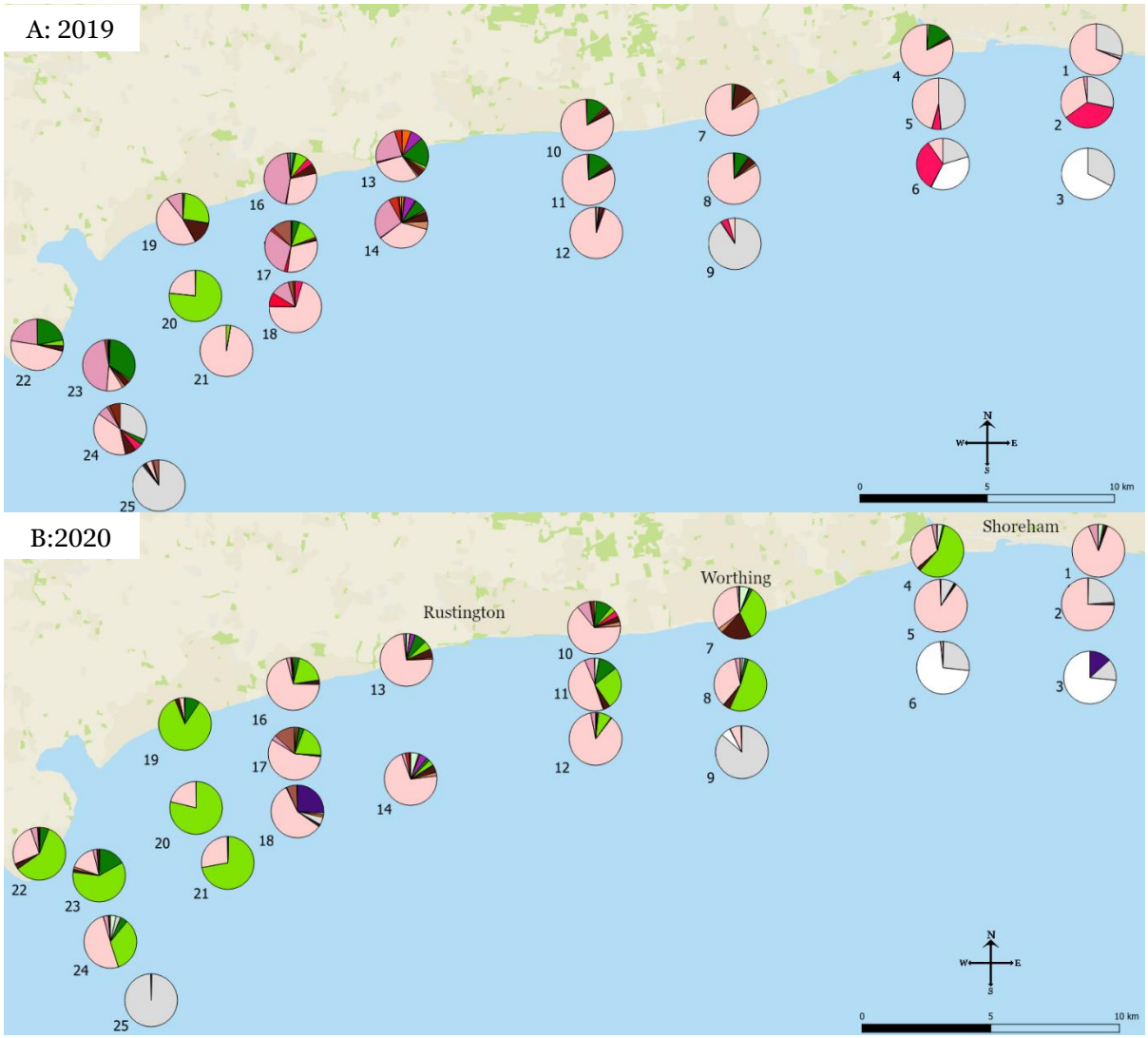
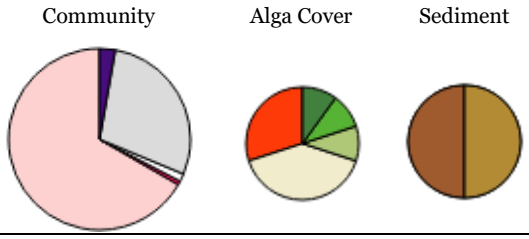



Figure 4: Proportional community compositions of Algae and Benthic Animals 2019-2020. Legend is for Figure 4 and Table 1 below.
A) shows community composition from transects 1-28 collected in 2019
B) transects 1-14 & 16-25 collected in 2020.

Table 1: Qualitative comparison of each transect, based on direct observation of transect GoPro/camera footage. Pie charts are proportional community composition and proportion of image labels for algal density and sediment, Legend in Figure 4.

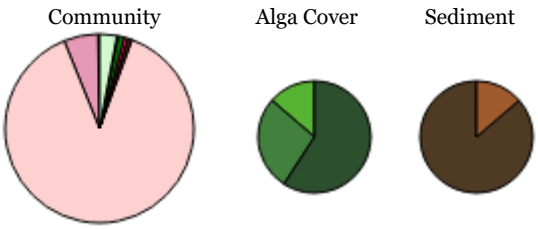
**Transect 1 2019**

Sediment mix of Cobbles to pebbles, overlayed with silt with occasional boulders. Larger Cobbles/boulders covered by Keel worm, *Pomatoceros triqueter*, along with occasional *asterias Sp*. star fish. Algae consists of intermittent clumps of very-fine reds, and occasionally Slippery/ gelatinous/ lubricous reds



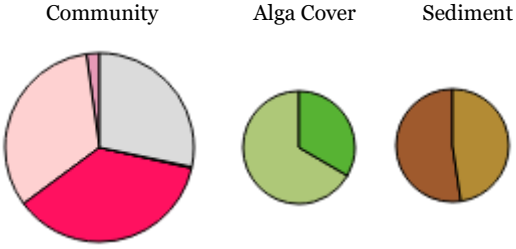

**Transect 1 2020**

Sediment mix of Cobbles to pebbles, overlayed with silt – occasional boulder.
Keelworm and starfish still present. Algae is similar form but denser in cover. Same occasional Slippery/gelatinous/lubricous reds along with an occasional *chorda* frond.



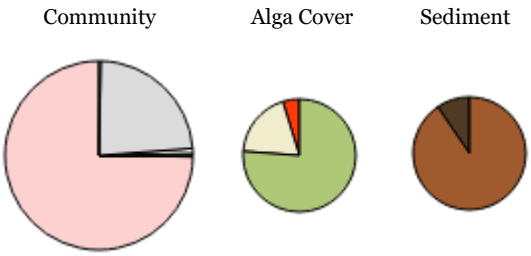

**Transect 2 2019**

Sediment cobbles and pebbles, occasional boulder, sometimes covered with silt/sand. Most cobbles encrusted in keelworms, *P*.triqueter. Occasional sea urchins, *Strongylocentrotus droebachiensis*, holding dead shells with star fish *asterias Sp*. and sea squirt *Styela clava*. Algae consists of a Very-fine reds, and Elongated/worm-like cylindrical reds



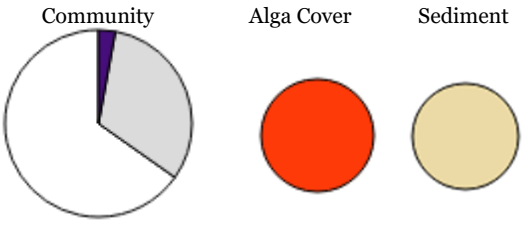

**Transect 2 2020**

Sediment cobbles and pebbles, occasional boulder. Sometimes covered with silt/sand. Keelworms, sea urchin, starfish and sea squirt still present. Algae mostly Very-fine reds, Elongated, worm-like reds notably absent.



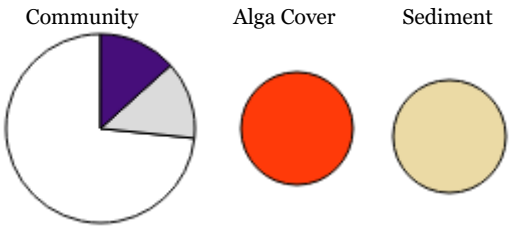
**Transect 3 2019**

Sediment mostly sand beds, with occasional cluster of large cobbles/ small boulders. On these are Keelworm, *P.triqueter*, and Dead Man's Finger's Coral, *Alcyonium digitatum*, sea urchin S.droebachiensis, sea squirt *S.clava*, and star fish *asterias Sp*. No Algae Present.



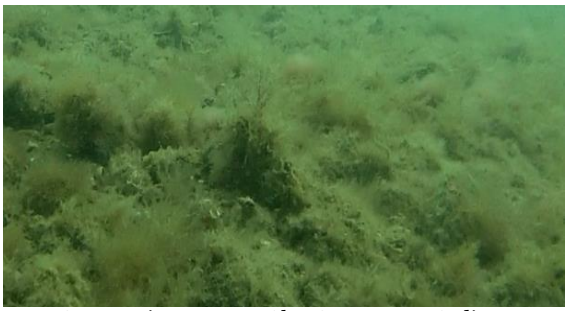

**Transect 3 2020**

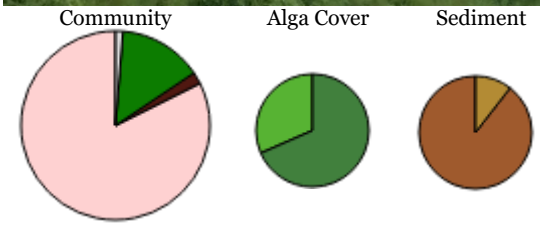
Sediment sand beds with occasional Cobbles and pebbles. Keelworm, Dead Man's finger and sea urchin still present. No sea squirts sighted. Still no Algae.




**Transect 4 2019**

Sediment mix of pebbles to large cobbles. Alga an extensive but short carpet of very-fine reds and flat delicate forms like *Dictyota Sp*. Occasional sea squirt *S.clava* present.






**Transect 4 2020**

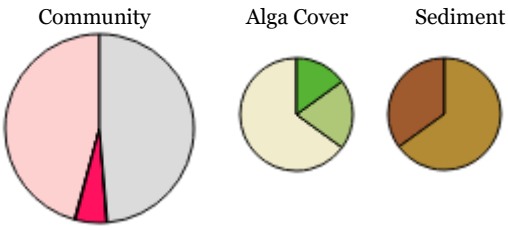
Sediment mix of pebbles to large cobbles. Alga is a fairly dense Chorda forest with an understory of very-fine reds, Slippery/gelatinous/lubricous reds, flat delicate forms like *Dictyota Sp*. and Cylindrical branched alga. Occasional sea squirt.


**Transect 5 2019**

Sediment mix of silt, pebbles, and cobbles. Keelworm, *P.triqueter*, sea urchin *S.droebachiensis*, sea squirt *S.clava*, and star fish *asterias Sp*. Algae is sparse mix of very-fine reds and Elongated/worm-like cylindrical reds.

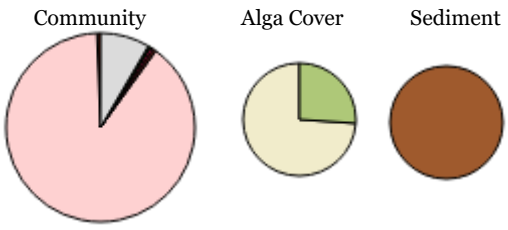
**Transect 5 2020**

Sediment mix of silt, pebbles, and cobbles. Keelworm, sea urchin, sea squirt and star fish still present. Algae similar cover of very-fine reds and Elongated/worm-like cylindrical reds with occasional chorda fronds.



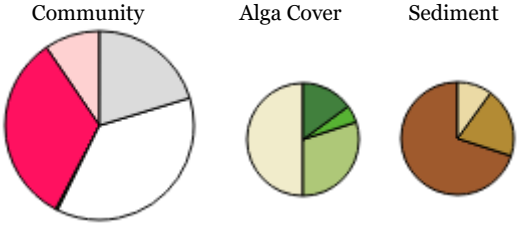

**Transect 6 2019**

Sediment mix of silt, pebbles, and cobbles. Keelworm, *P.triqueter*, sea urchin *S.droebachiensis* covered by shells, Dead Man's Finger's Coral, *A.digitatum*, sea squirt *S.clava*, with star fish *asterias Sp*. Algae is mix of occasional very-fine reds and numerous Elongated, worm-like & cylindrical reds.



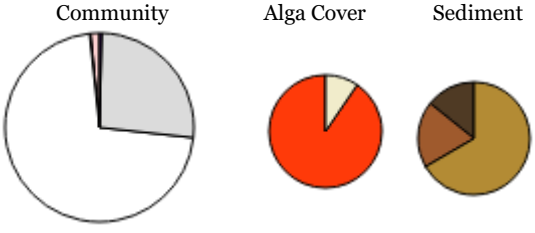

**Transect 6 2020**

Sediment mix of silt, pebbles, and cobbles. Keelworm, sea urchin, dead man's fingers, starfish, and sea squirts still present. Algae almost entirely absent. Sea cucumber also seen.



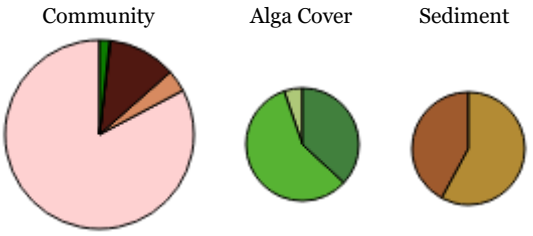

**Transect 7 2019**

Sediment mix of pebble and cobbles, occasional boulder. Algae a thin but widespread layer of very-fine reds, with Cylindrical branched reds, Fan-shaped reds, Slippery/gelatinous/lubricous reds, with some Snakelocks anemone *Uticina felina* and sea squirt *S.clava*.



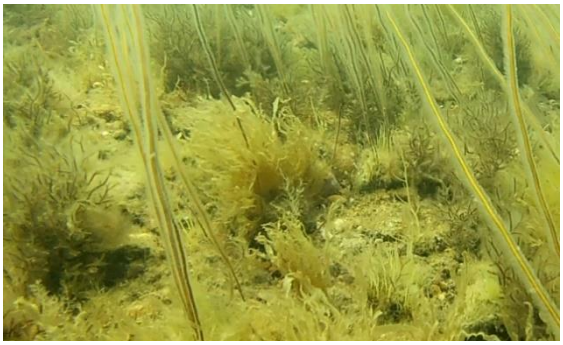

**Transect 7 2020**

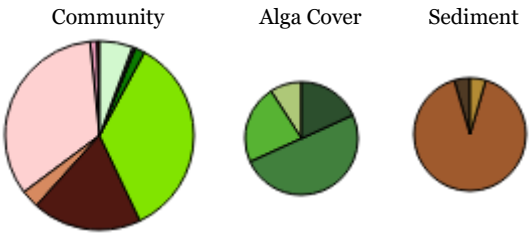
Sediment mix of pebble and cobbles. Thin layer of very-fine reds overlayed with numerous chorda, Cylindrical branched alga and Thicker flat reds without veins. Occasional Slippery/gelatinous/lubricous and Fan-shaped reds




**Transect 8 2019**

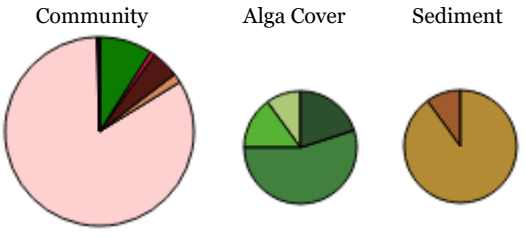
Sediment mix of pebble and cobbles. Alga a thin but widespread layer of very-fine reds, occasional Slippery/gelatinous/lubricous reds, and Cylindrical branched Reds. A few of Fan-shaped reds and sea squirt *S.clava*.





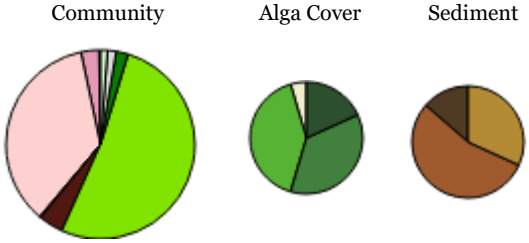

**Transect 8 2020**

Sediment mix of pebble & cobbles. Alga thicker widespread layer of chorda with an understory of Cylindrical branched & Slippery/ gelatinous/ lubricous red algae w/ occasional flat delicate browns. some Fan-shaped reds. *S. clava* present




**Transect 9 2019**

Sediment mix of pebbles and Cobbles covered in Keelworms *P.triqueter*, with occasional sea urchin *S.droebachiensis* covered by shells, Dead Man's Finger's Coral, *A.digitatum*, sea squirt *S.clava*, and star fish *asterias sp*. Alga mostly absent with occasional Elongated, worm-like reds.




**Transect 9 2020**

Sediment mix of pebbles and Cobbles. Keelworm, starfish, sea urchin, dead man's fingers, and sea squirt still present. Alga still mostly absent with occasional Elongated, worm-like reds.

Community Alga Cover Sediment

Community Alga Cover Sediment

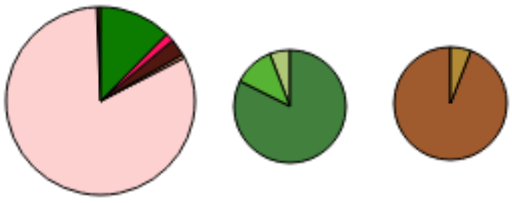
**Transect 10 2019**

Sediment mix of pebble and cobbles, occasional boulder. Alga a thin but widespread layer of very-fine reds, with some Fan-shaped and Slippery/gelatinous/lubricous reds and some flat/delicate browns. Occasional *Amphilectus fucorum* sponge and sea squirt *S.clava*.

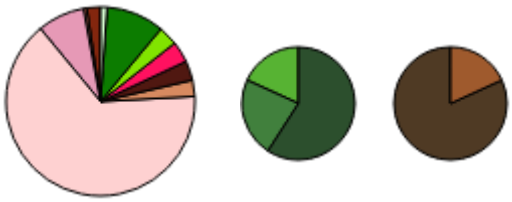
**Transect 10 2020**

Sediment mix of pebble and cobbles. Algae a thick widespread layer of flat delicate browns, Thicker flat reds without veins, Slippery/gelatinous/lubricous Reds and Very-Fine Reds. Occasional Fan shaped reds and chorda fronds

Community Alga Cover Sediment



Community Alga Cover Sediment

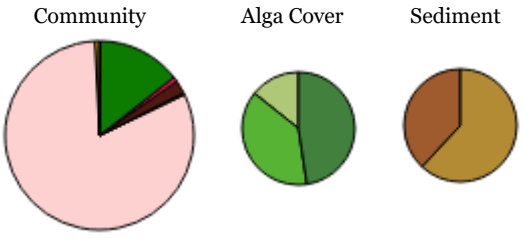


**Transect 11 2019**

Sediment mix of pebble and cobbles, occasional boulder. Alga a mix of very-fine reds, Slippery/gelatinous/lubricous reds and flat/delicate browns. Occsaional Fan-Shaped reds, *A. fucorum* sponge and sea squirt *S.clava*.

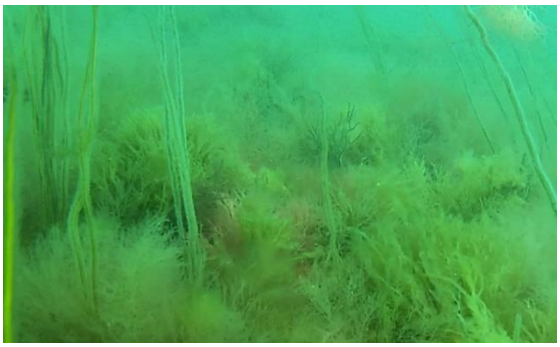
**Transect 11 2020**

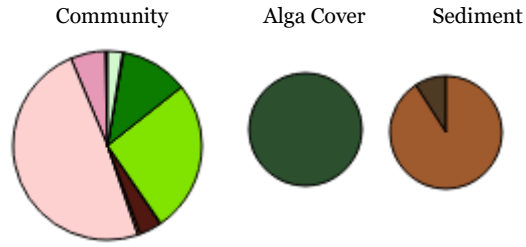
Sediment mix of pebble and cobbles. Algae a thin chorda forest, with a thick understory of flat delicate browns, Thicker flat reds without veins, Slippery/gelatinous/ lubricous Reds and Very-Fine Reds. Occasional Cylindrical branched Reds and Fan shaped reds.




**Transect 12 2019**

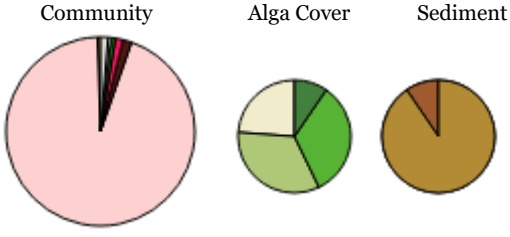
Sediment a consistent layer of pebbles and sand, with occasional boulder. Alga sparse carpet of Very-fine reds, with boulders encrusted with *A.fucorum and Halichondria panicea sponges;* sea squirts, *S.clava*, Large orange balls of Bryozoans; Beautiful Eyelash Seaweed, *Calliblepharis ciliata;* Dead Man's Finger's Coral, *A.digitatum;* and Very-Fine reds.





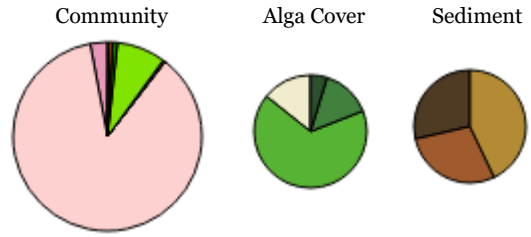

**Transect 12 2020**

Sediment a mix of pebbles and cobbles. Alga a sparse to medium density of Slippery/gelatinous/lubricous reds dotted with chorda. Occasional Dead Man's Finger's Corals, Bryozoans, sponges, Beautiful Eyelash Seaweeds or sea squirts attached to boulders.




**Transect 13 2019**

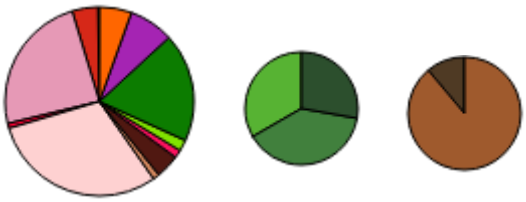
Sediment cobble occasionally going into boulders. Alga a relatively dense carpet of Very-Fine reds combined with Slippery/gelatinous/ lubricous Reds and flat delicate browns. Occasional Cylindrical/branched reds, Fan shaped reds and Thin branched browns (possibly a Desmerestia Sp.). Numerous Snakelocks Anemones, *U.felina*, and a few *A.fucorum and H.panicea sponges*.



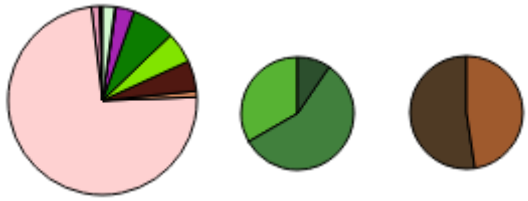

**Transect 13 2020**

Sediment cobbles and numerous boulders. Alga a relatively dense carpet of Slippery/gelatinous/ lubricous Reds, Cylindrical/branched reds, flat delicate browns and Thin branched browns. Anemone s also numerous and sponges present.

Community Alga Cover Sediment



Community Alga Cover Sediment



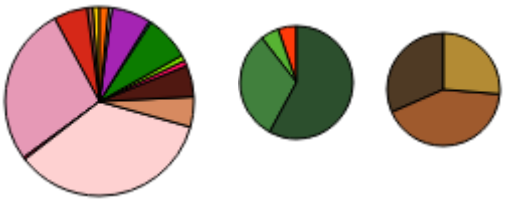
**Transect 14 2019**

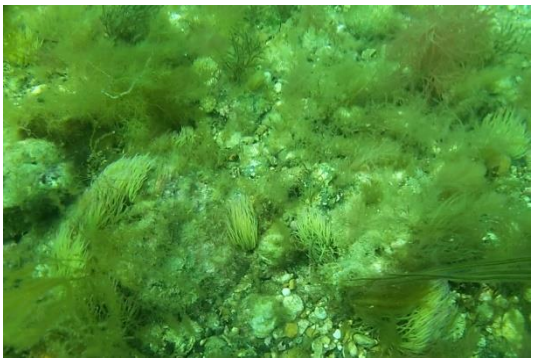
Sediment pebble and cobble mix. Alga a relatively dense carpet of Very-Fine reds combined with Slippery/gelatinous/ lubricous Reds. Occasional Cylindrical/branched reds, Fan shaped reds and Thin branched browns. Numerous Snakelocks Anemones, *U.felina*, and a few *A.fucorum* and *H.panicea* sponges.

**Transect 14 2019**

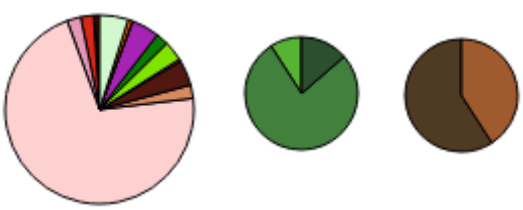
Sediment mix of pebble and cobble. Alga notably thinner, with similar mix of Very-Fine reds and with Slippery/gelatinous/ lubricous Reds. Cylindrical/branched reds, Fan shaped reds and Thin branched browns still present, with occasional chorda frond. Remarkably high density of Snakelocks Anemone.

Community Alga Cover Sediment





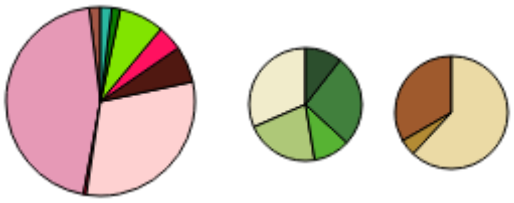
Community Alga Cover Sediment



**Transect 16 2019**

Sediment mostly sand and silt, with occasional patches of pebbles and cobbles. The silt is mostly bare, but the patches of stones have a dense carpet of Very-Fine reds and Slippery/gelatinous/ lubricous Reds. Occasional Thin branched browns and a couple of Sea Oak (*Halidrys siliquosa*) and Chorda fronds.

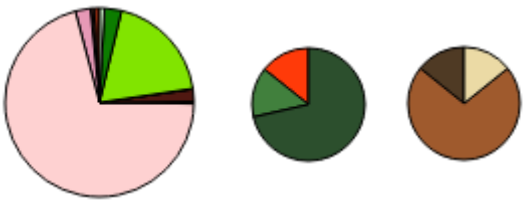
Community Alga Cover Sediment



**Transect 16 2020**

Sediment still sand and silt, with a little more area of pebbles/cobbles. Silt is still mostly bare, but carpets of alga have more Cylindrical/branched reds and flat delicate browns. No sea oak, a few Snakelocks Anemones, *U.felina*. New form of alga which is Finger.

Community Alga Cover Sediment



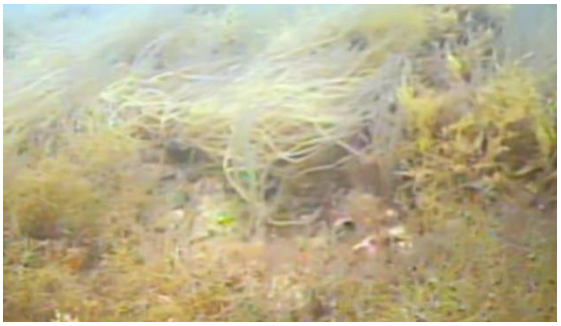
**Transect 17 2019**

Sediment a mix of pebbles and cobbles, covered by thin layer of silt. Alga a thick carpet of Very-Fine reds and Slippery/gelatinous/ lubricous Reds with numerous Thin branched browns and Beautiful Eyelash Seaweed, *C.ciliata*.

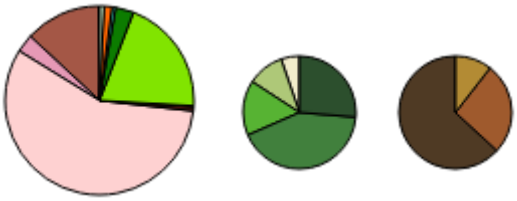
Community Alga Cover Sediment

**Transect 17 2020**

Sediment same mix of pebbles and cobbles with thin layer of silt. Alga same carpet of Very-fine & Slippery Reds, with numerous thin branched browns and *C.Ciliata*

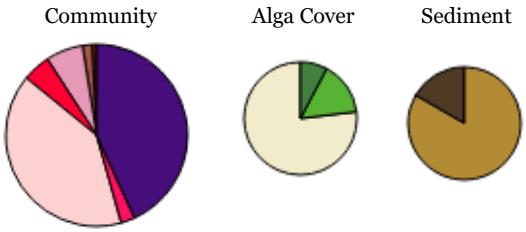


Community Alga Cover Sediment



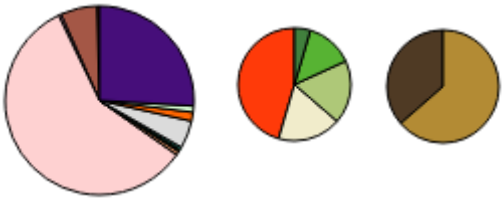
**Transect 18 2019**

Sediment a thick layer of Dead Shells and silt with periodic boulders. Shells/silt devoid of alga but with occasional clusters of brittle stars. Boulders covered with Very-Fine reds, Beautiful Eyelash Seaweed, *C.ciliata*; with large orange Bryzoans and some *A.fucorum* and *H.panicea* sponges.



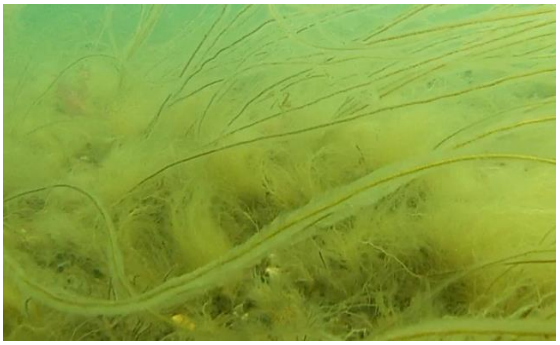

**Transect 18 2020**

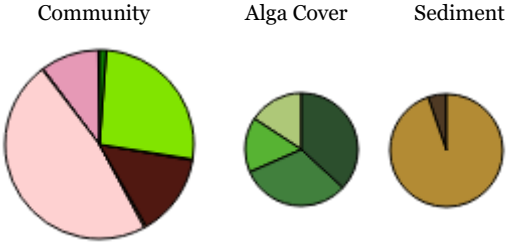
Sediment same dead shells/ silt mix with periodic boulders. Brittle stars still present, boulders covered with same Very-Fine reds, Beautiful Eyelash Seaweed, sponges and bryzoans – but with a few sea squirt *S.clava*




**Transect 19 2019**

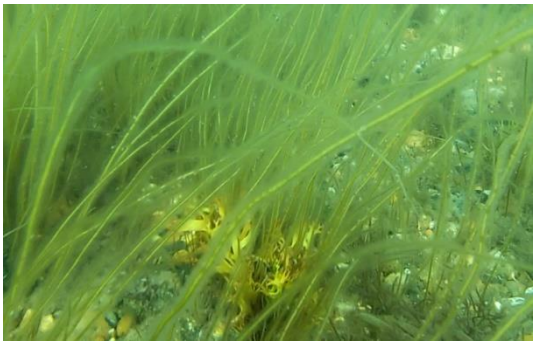
Sediment mostly pebbles. Alga a carpet of Very-Fine reds and Slippery/gelatinous/ lubricous Reds with thin forest of chorda and occasional Cylindrical/branched reds and Fan shaped reds.

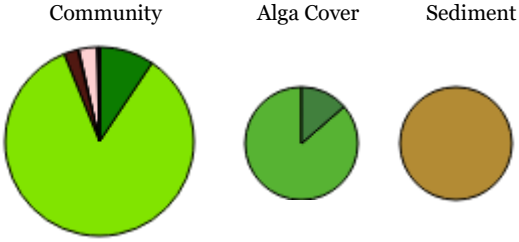





**Transect 19 2020**

Sediment pebbles. Alga a thick forest of chorda with an understory of Cylindrical/branched reds. Still occasional Fan shaped reds.






**Transect 20 2019**

Sediment flat pebble bed. Alga a carpet of Very-Fine reds with a medium chorda forest. Occasional sea squirt *S.clava* and Sea Oak (*H.siliquosa*).

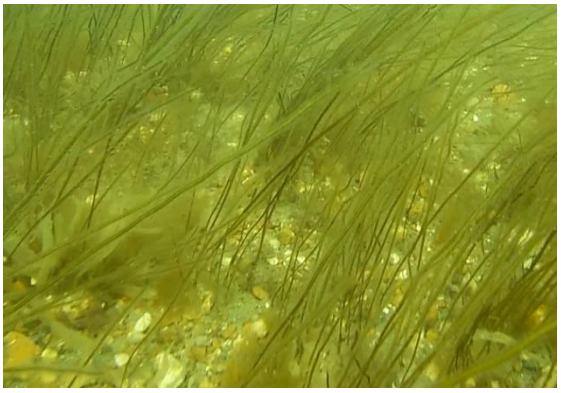
**Transect 20 2020**

Sediment a mix of sand and pebbles. Alga same forms but more Chorda and fewer Very-Fine Reds.

Community Alga Cover Sediment

**Transect 21 2019**

Sediment flat pebble bed. Alga thin sparse carpet of Very-Fine reds.

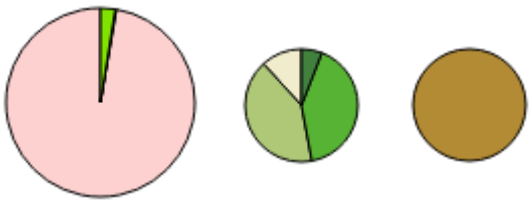


Community Alga Cover Sediment

**Transect 21 2020**

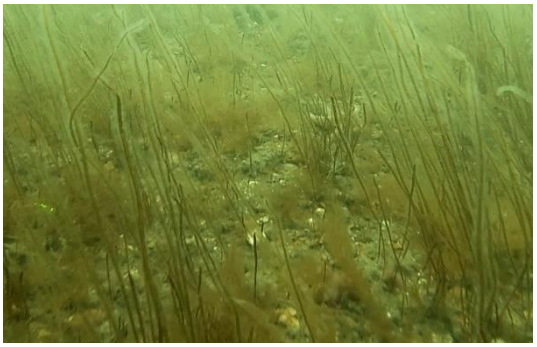
Sediment flat pebble bed. Alga thin carpet of very-fine reds with medium but short chorda forest, occasional Thicker flat reds without veins and *Asterias sp*. starfish

Community Alga Cover Sediment



**Transect 22 2019**

Sediment a flat pebble bed. Alga a carpet of Very-Fine reds and Slippery/gelatinous/ lubricous Reds with occasional chorda, Thin branched browns, and fan shaped reds.

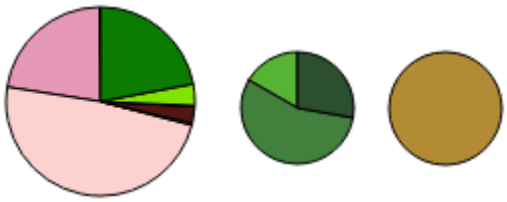


Community Alga Cover Sediment

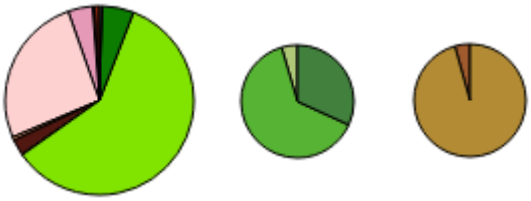
**Transect 22 2020**

Sediment pebble bed. Alga carpet still very-fine reds and Slippery/gelatinous/ lubricous Reds but with more fan shaped and Cylindrical/ branched reds. Chorda forest much thicker. Finger like algae also.

Community Alga Cover Sediment

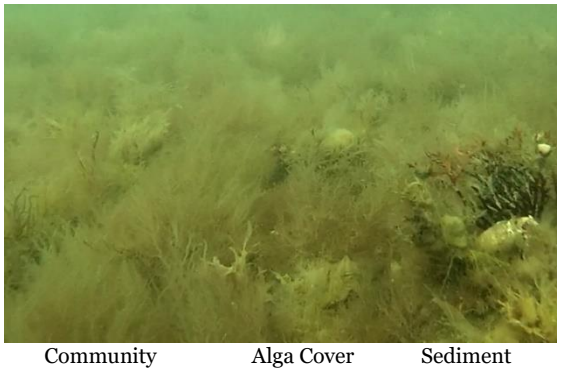


Community Alga Cover Sediment

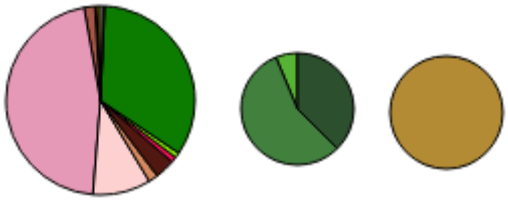


**Transect 23 2019**

Sediment pebbles with occasional cobble. Alga a carpet of Slippery/gelatinous/ lubricous Reds and flat/delicate browns. Occasional fan shaped red, Beautiful eyelash seaweed, *C.ciliata*, and *asterias sp*. starfish.

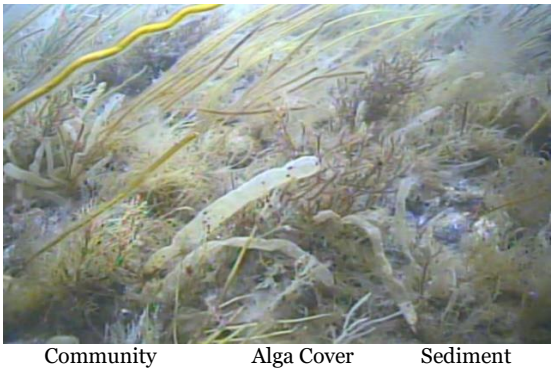


Community Alga Cover Sediment

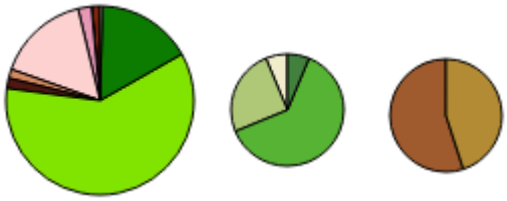


**Transect 23 2020**

Sediment pebbles. Alga a mixed carpet of Slippery/gelatinous/ lubricous Reds; Cylindrical/branched reds; thin branched browns; flat delicate browns and Finger like algae – all covered by chorda forest.



Community Alga Cover Sediment



**Transect 24 2019**

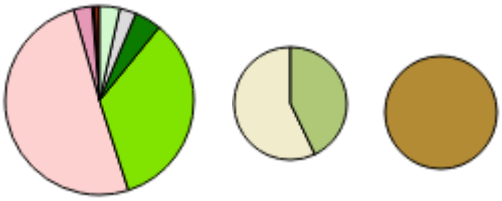
Sediment mix of cobbles and pebbles, occasional boulder. Alga a very thin and sparse carpet of Very-Fine reds with a few Snakelocks anemone, *U.felina*, and Beautiful eyelash seaweed, *C.ciliata*.

Community Alga Cover Sediment

**Transect 24 2020**

Sediment pebbles and cobbles. Alga a sparse carpet of Very-Fine Reds and Slippery/gelatinous/ lubricous Reds with very thin chorda forest.

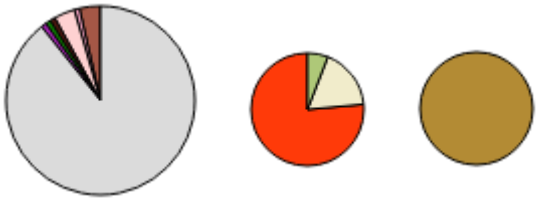
Community Alga Cover Sediment



**Transect 25 2019**

Sediment Pebbles, with an occasional boulder. Pebbles covered in keelworms. Boulders covered by Very-Fine reds and beautiful eyelash seaweed with occasional sponge (*A.fucorum* or *H.panicea*); Dead Man's Finger's Coral, *A.digitatum*; and a few possible kelp fronds.

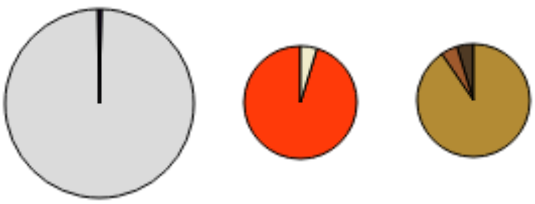
Community Alga Cover Sediment



**Transect 25 2020**

Sediment pebbles with occasional boulder. Keelworm still present, only Very-Fine reds and beautiful eyelash seaweed seen on boulders, with some sponges.

Community Alga Cover Sediment



## Multidimensional Scaling Analysis

Annotations were amalgamated to create a dataset of survey transect x taxa for subsequent analysis. An ordination analysis was performed to summarise similarity in community composition. Data was transformed using both a Wisconsin and square root transformation in order to reduce the influence of highly abundant organisms [Legendre and Gallagher, 2001]. A multidimensional scaling (MDS) analysis was performed on the community composition data using the metaMDS function from using the R package “Vegan” [https://CRAN.R-project.org/package=vegan].

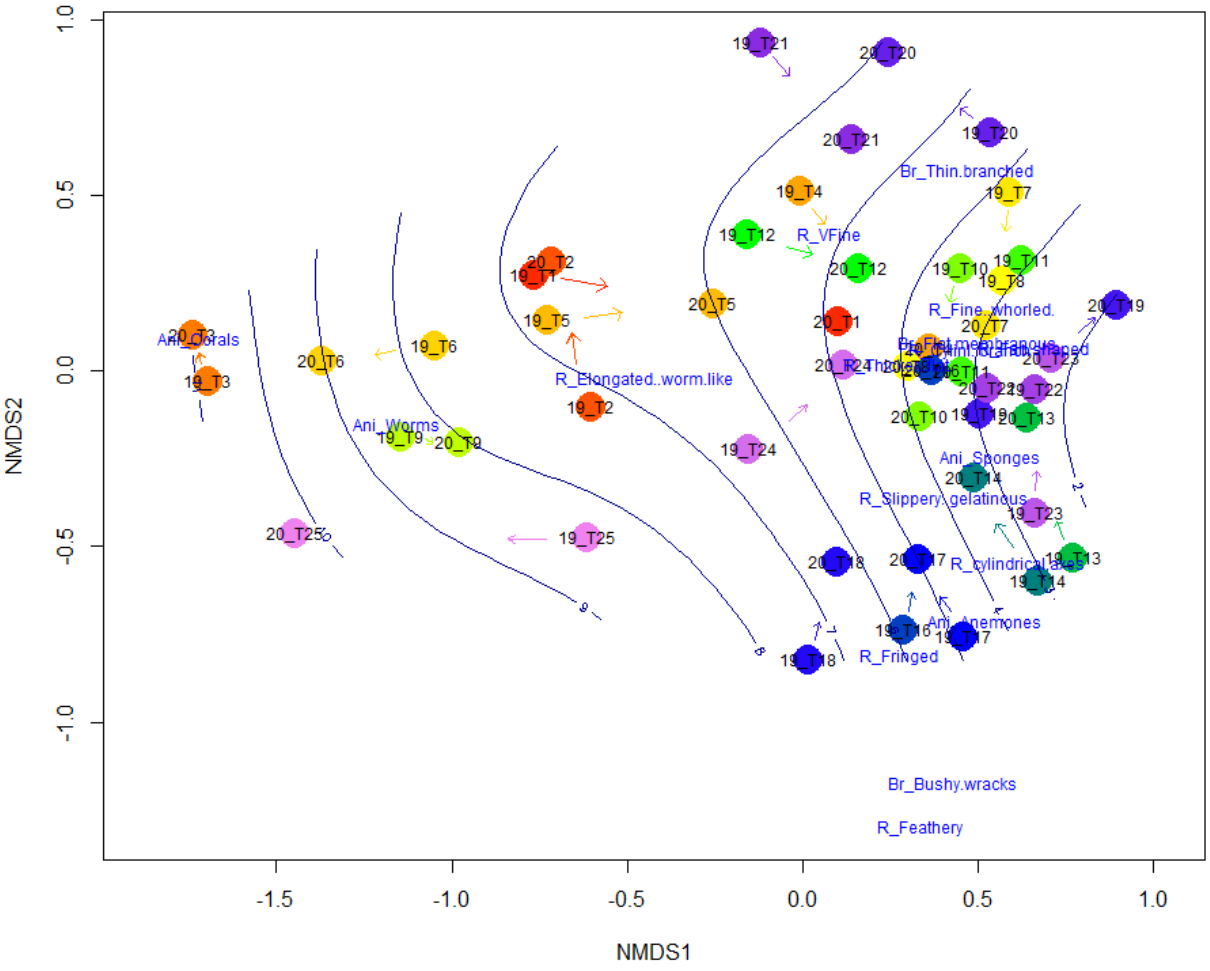



Figure 5: MDS plot comparing 2019 and 2020 annotation data.
Black text is TransectYear_TransectNumber, blue text are annotations, contour lines show a simplified fit of station depth onto the ordination. Colours of dots are matching transect numbers from consecutive years. Coloured arrows indicate direction of change from 2019 to 2020. Adjacent stations show similar community composition.

## Results

The general close proximity of 2019 and 2020 data points in Figure 5 indicates a general similarity in transect community composition. The relatively random direction of arrows also does not indicate an overall regime shift in algal community, or systematic sampling bias between 2019 2020. The results appear to show more of an annual variability.

The deep-water animal dominated transects show the least variation in composition. Much of the change in the shallower habitats are likely due to a high abundance of *Chorda filum* which shifted many of these transects closer to the thin branched browns (Br_thin.branched), in particular 4,7,8,12,16 & 19.

Transect 10 has also shown a shift towards Fringed Reds (R_fringed) whilst transect 14 more towards cylindrical branched reds (R_Cylinl.branch).

## Conclusions

Overall, there was no kelp sited in any station in 2020 – which combined with the near total lack of kelp in 2019 indicates the kelp forest which was once extensive across Sussex coast is essentially gone from its original range.

The 2020 survey did show an increased density in alga at a number of transects, in particular the Brown alga *Chorda filum* showed a massive increase in range and density. It is not clear if this change is due to natural variability, decreased fishing effort because of COVID-19 or another factor.

Yearly repetition of this standardised video sled survey at each transect are vital in understanding the dynamic composition and ranges of benthic communities and provide a strong baseline for monitoring the effectiveness of a management change, when the Nearshore Trawling Byelaw comes into place.

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