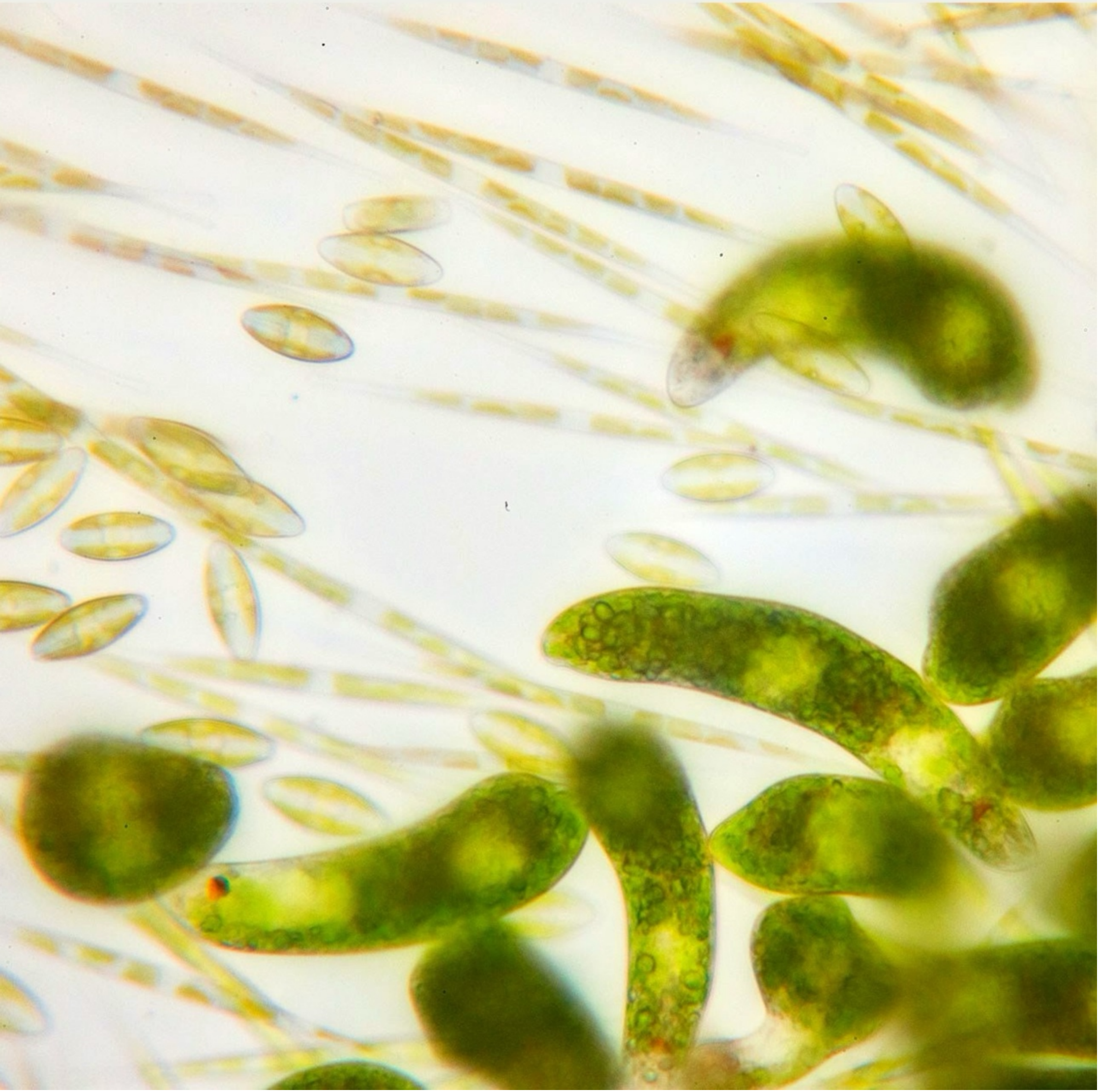
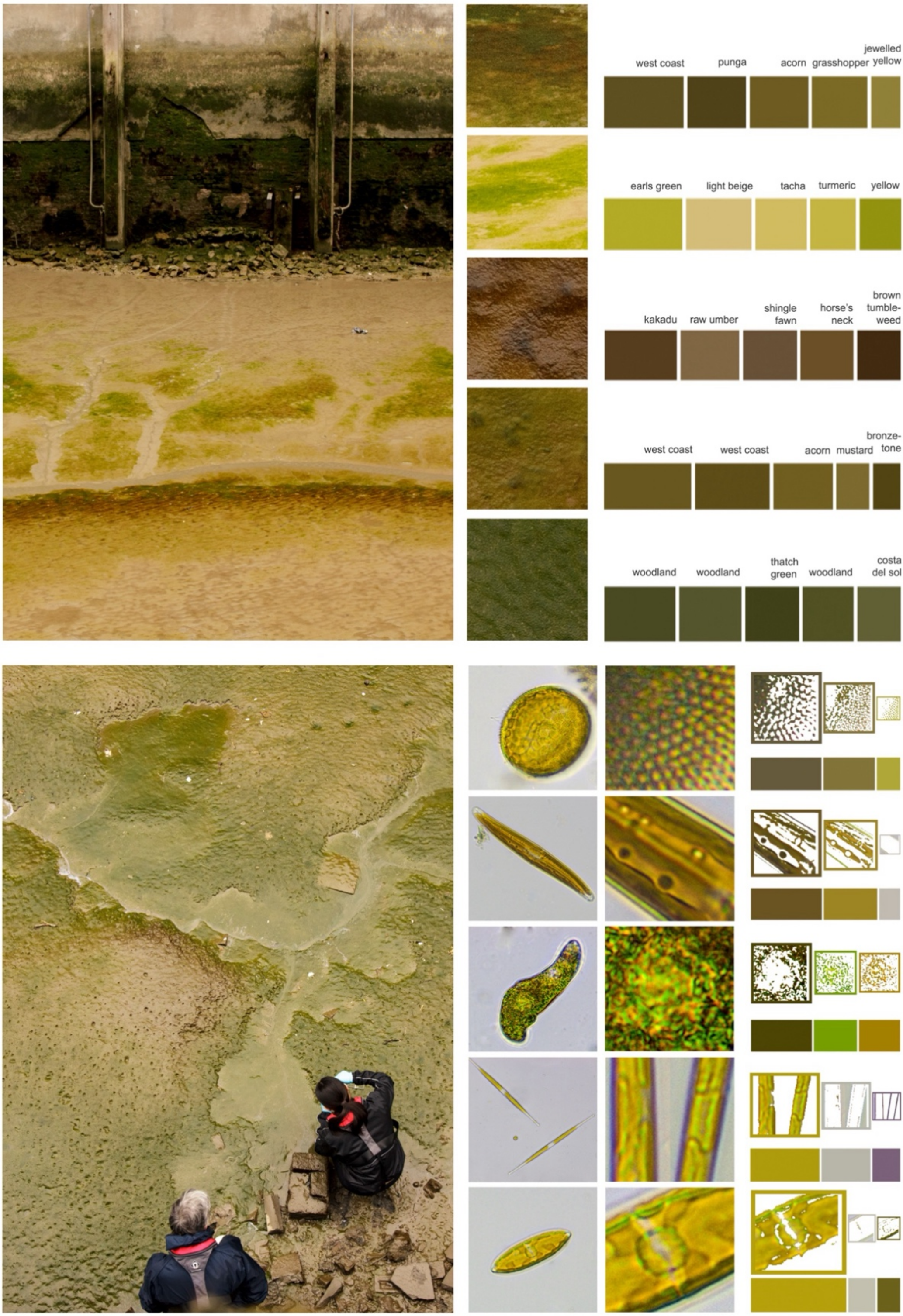
Jan 2025

SLIMEWATCH 2

mudflat micro-algae of Deptford





Slimewatch 1, St Saviour's dock 2019: poster 7

A community science project, documenting the Creek's carbon-negative commuters

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Find out more online at:

bit.ly/SW2Deptford
(inc Slimelapse movies)

Microscopesandmonsters
(Martyn Kelly's blog)

bit.ly/CDCProjects
(Creekside website)

Project initiated by Susi Arnott; led by Andy Lyon,
with the volunteers of Creekside Discovery Centre.
Supported by phycologist Martyn Kelly and funded by
the British Phycological Society; forthcoming publications
in BPS journals 'The Phycologist' and 'Applied Phycology', 2025

Text by Susi Arnott with Martyn Kelly and Andy Lyon.
Cover image Crispin Hughes; p3 painting Martyn Kelly;
microscopy various, with SEM by Dain Son and Andy Ball of the Natural History Museum.

SPACE AND SCALE

Deptford Creek's mud is one of its richest habitats – but to appreciate it, you have to think small. The visible food-web of worms, snails, shrimps, crabs, fish and birds depends on the work done by microscopic, single-celled algae.

These live in the water itself but also on the surfaces of rocks and pebbles, on the river walls and on the sides of boats. Some live down in the mud itself, only living and working on the surface during daylight low-tide.

The mud seems grey when the water first retreats, but micro-algae soon paint sheets or patches of greens and browns onto the surface - from below! These colourfields are made by millions of individual tiny organisms, moving towards the light to photosynthesise.

Like trees or grass or other plants, they re-configure carbon dioxide and water (CO_2 and H_2O) into glucose ($C_6H_{12}O_6$), and then use this to build more complex organic molecules. The cells themselves, and the sugars and other molecules they excrete – along with the oxygen they expel as a waste product- all nourish life in the Creek, and beyond.

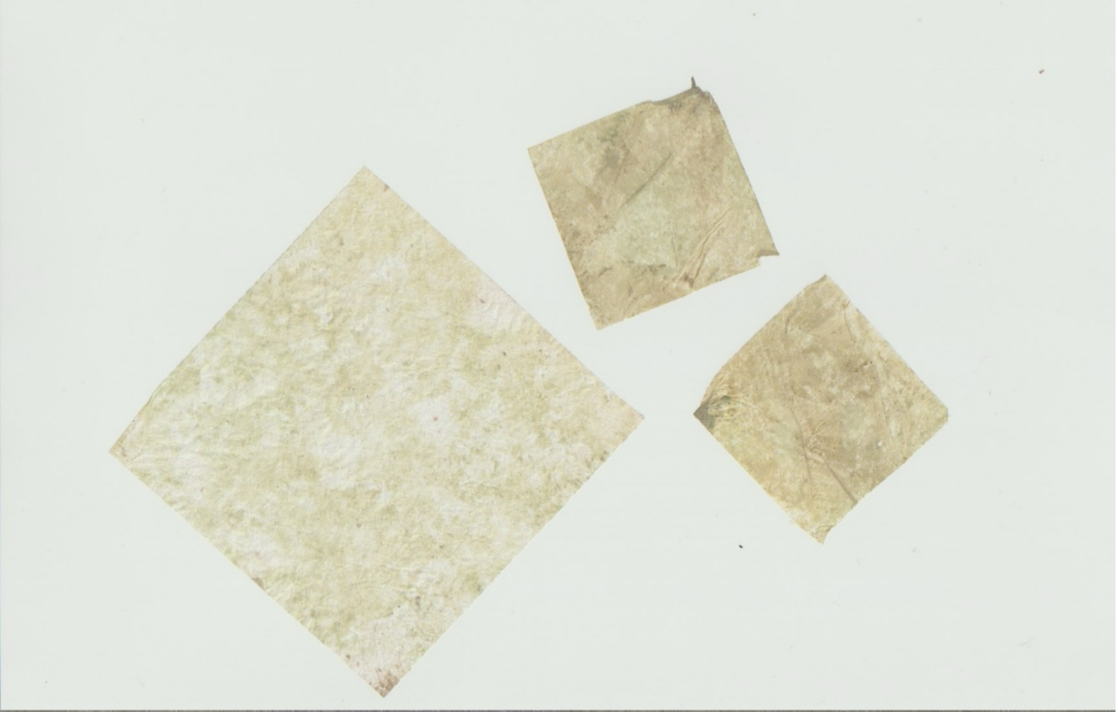
We're sampling these microalgae using small squares of lens tissue. Scraping up the surface mud to look at under the microscope is messy and difficult. But the microalgae can move of their own accord – they are 'motile' – so we take advantage of this, offering them a surface to move onto that we can take away and wash them from, to examine under a microscope.

Scientists have experimented with different materials, including little glass cover-slips, but lens tissue is safer: transparent enough that light still attracts them upwards, absorbent enough to hold the water they need to function, and strong enough to peel away from the mud again without tearing.

The tissues themselves, holding hundreds and thousands of organisms, can be interesting colours – but under the microscope, we can look at their individual passengers.

COLOURS AND SPECIES

Different microalgae make and use different pigments. The Slimewatch 1 exhibition played with what we see in individuals and populations (see inside front cover). It's rare to only get one type, and mud surface colour patches vary according to 'relative abundance' of each – like mixing paint at the DIY shop. Bright green is usually from euglenids – see p6; the brown, orange, yellow or 'olive' colours usually belong to diatoms – see p8.



TIDES

Gravity pulls the ocean towards both the moon and the sun. The moon's much smaller, but also much closer – making the pull much stronger. Tides are biggest when they're both pulling the same way at the same time, which happens roughly every 14 'solar days'.

Photosynthesis depends on sunlight, and most living things, even nocturnal animals, have a timetable based on the solar day- our 24-hour clock. But 'lunar time', from one 'moonrise' to the next is nearly 25 hours. So tide times 'slide forward' just under an hour a day- coming back to roughly the same time roughly every fortnight, as well.
Sometimes the tide's low in the middle of the day, then a week later it's high, with low water only morning and evening. This changes things not just for human Creeksiders, but for all the wildlife- including microalgae.

TIME

The Slimewatch project began with time-lapse filming of tides in the Thames. Research on plankton raised the subject of 'commuter diatoms' and their appearance on mudbanks. Did any populations exist here in London?
A biologist suggested looking in St.Saviour's Dock, near Tower Bridge.
(See inside front cover.)
It's hard to actually see the tide rise and fall, in 'real time'. But if we just look every once in a while, the changing water level is obvious.
It's the same with the emerging and disappearing colour patches on the mud: our eyes can't 'notice it' moment by moment, without help. Timelapse filming lets our brains see the changes happening.
Gaining physical access to the mudbanks of St Saviour's was awkward. But samples taken by Prof Jane Lewis (University of Westminster) showed commuter diatoms and euglenid 'vertical migrants' living there. And time-lapse filming from one of the converted warehouse flats showed huge populations of both, emerging and retreating with the tide.

Now Slimewatch 2 is documenting populations over seasons and years.
As the days get longer and then shorter again, yet another rhythm intersects with the others. As climate patterns break down, the seasons are already less predictable – though Creeksiders have been recording air temperature and a weather description along with their monthly samples.
These pictures from the footbridge show stages in different timelapse films.






April 10th 2022 (tide-fall)
greens, mainly euglenids



August 18th 2022 (tide-rise)
browns, mainly diatoms



EUGLENIDS

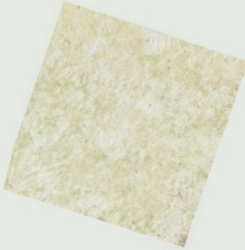
These wriggly shape-shifters are puzzling. They're green, like most plants, and make their own food by photosynthesis – but they can move around, like animals. Do they have to be one or the other?
Not at the microscopic level.

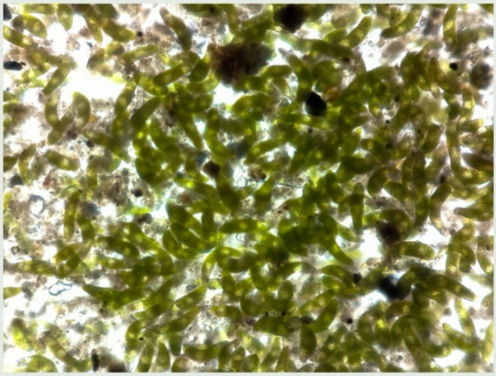
Billions of years ago, photosynthesis evolved in 'cyanobacteria' (aka 'blue-green algae'). Bacteria are simple cells. Their contents aren't organised into 'organelles' specialising in different jobs; they don't even have a nucleus holding their genetic material- everything's in the one 'bag'.

Then hundreds of millions of years ago, a cyanobacterium was engulfed/eaten by some sort of scavenger single-celled organism (again, not really an 'animal'). Somehow the cyanobacterium wasn't digested, but survived and carried on photosynthesising, now feeding this bigger cell as well as itself.
It could even reproduce, making several small 'bags' of photosynthetic machinery inside the one bigger cell – these became 'chloroplasts' inside a whole new type of single-celled organism. This was a major step forward in the evolution of more complex plants, but this single-celled lifestyle remained successful too.

Euglena and their relatives are found in all sorts of wet habitats – from oceans to tiny puddles. In intertidal muds, their ability to move is especially useful. They seek light to photosynthesise, and once they've found a good location it can be worth trying to stay there – commuting up out of the mud and then back down into it, as the tide falls and then rises again.
They have two ways to move: one is by wriggling their bodies, with strips of protein wound around their bodies that contract and relax (known as the 'pellicle'). And most species also have one or two little flagellae – 'whips' – though these are more useful for swimming than 'creeping' – if they're washed away by the tide, or want to re-locate within a puddle or pond. Some are grazed by fish and even ducks or swans, but life goes on. There's no evidence that euglenids ever have sex! They reproduce simply, by cell division.

They can sense light with a little red 'eyespot'. You might see these under the microscope; another colour brought into the mix when we see them in their millions, with 'the naked eye'. But the main pigments are chlorophylls, bringing vivid green to our eyes most brightly in the warmer months, and longer days.





20 micrometres
(=1/50th of a mm)

DIATOMS

The other main group of micro-algae we find on the Creek's mudflats are very special; each individual diatom lives inside a rigid, glass-like 'frustule' made of silica. These can be fairly simple, or fiendishly shaped with grooves, spikes, pores and slits – but they're all symmetrical, one way or another.

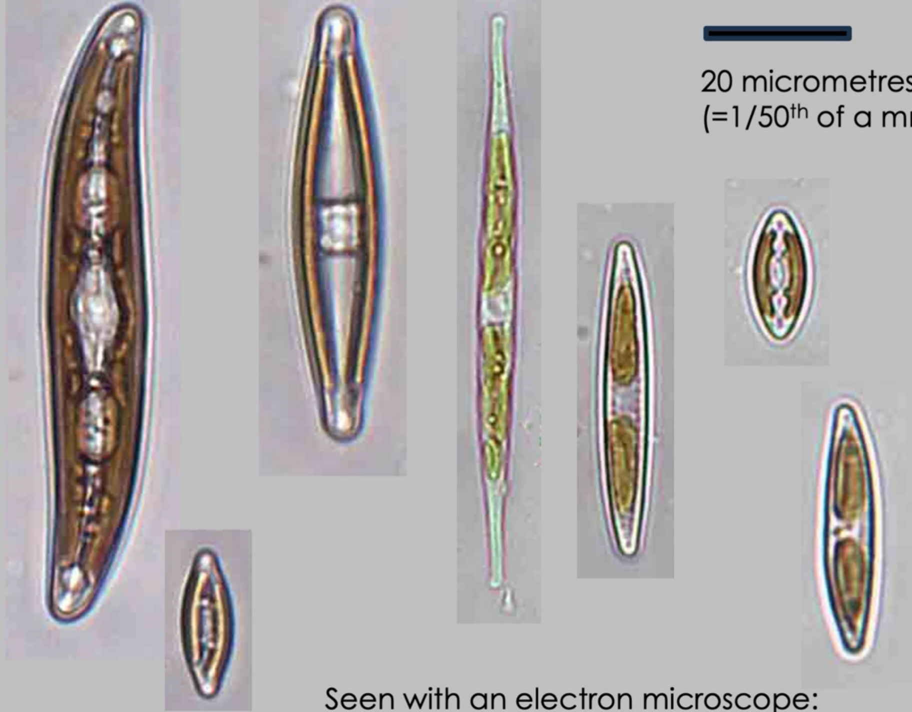
'Diatom' means 'cut in two'; frustules come in two halves, or 'valves', identical except for size. A bigger 'valve' holds a smaller one, like the lid of a Petri dish or a date box snugly holds a smaller partner. And, like these examples, they can be round, and radially symmetrical – the 'centric' diatoms. Or they can be 'pennate', more or less 'stretched out'. (Some even have a twist, like 'Gyrosigma' shown opposite.) And they can only grow by expanding the equally stiff silica 'girdle bands' between the valves. Roughly once a day, they reproduce by splitting apart, with each half becoming the bigger valve for a new individual. (So the average size gets smaller and smaller, over time; sexual reproduction to make a full-sized new 'parent' happens much less often.)

Like euglenids, they're single-celled – but sometimes grow into stacks, or chains. Many of them can move, too, by excreting long-chain molecules out of slits – 'raphes'- along their valves. The gliding motion we see on a flat glass microscope slide suggests what they might do in 3-D mud.
But instead of being bright green, their chloroplasts are yellowish, brown or olive-green. They have chlorophyll, but also 'accessory pigments' that absorb and transfer light energy in different ways – sometimes to protect them from too much light, sometimes to take advantage of lower light/wavelengths 'left over' by other organisms.

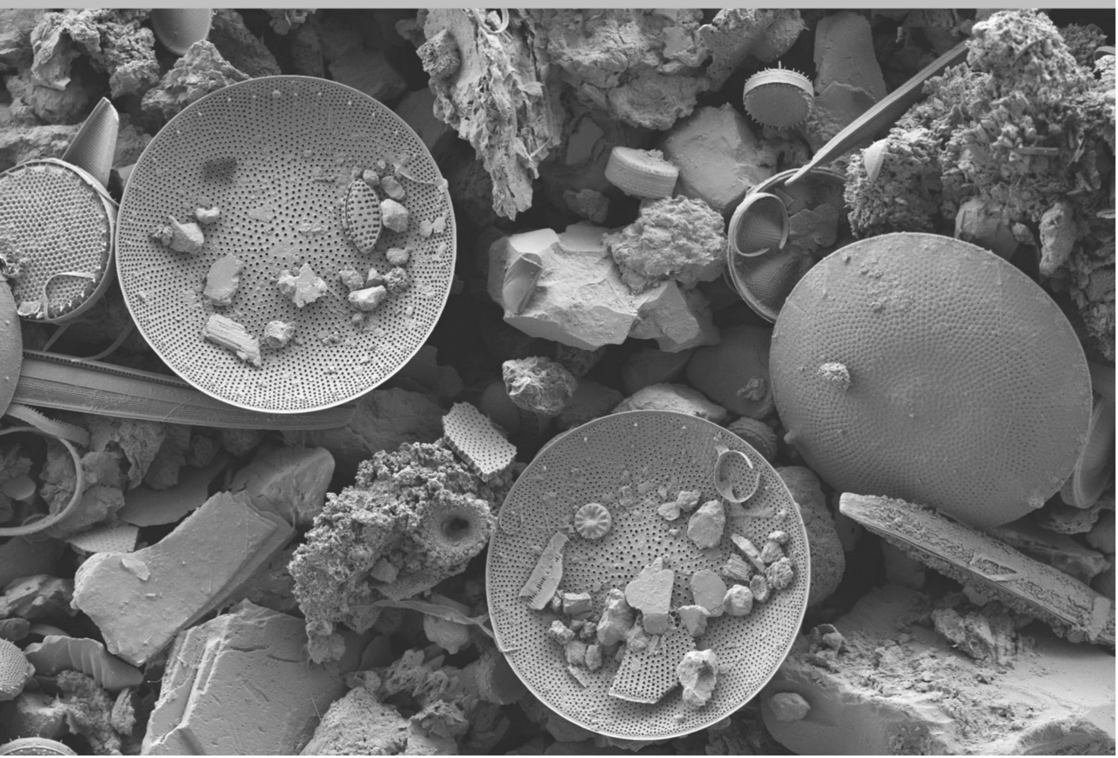
Diatoms are 'younger' than euglenids, or even plants; the first fossil evidence is from around 200 million years ago. They're often in the fossil record, as frustules can be left intact (or at least remain in large pieces) when the soft, organic biomass has been digested – by grazers, or decomposition.
And scientists clean away their insides, and the slimey outside coating too, to see the frustule more clearly. The bottom picture shows a Slimewatch1 sample cleaned with hydrogen peroxide, then scanned under an electron microscope at London's Natural History Museum.

If you're at a Slimewatch event in Creekside, ask to see the 'gigapan' record, to zoom in and out of the whole sample for yourself.

Seen with a light microscope:



Seen with an electron microscope:



COLOURS AND SPECIES ACROSS THE SEASONS

Creeksiders sample and photograph at a daytime low-tide every month, using this simple but careful 'protocol' so that comparing results is meaningful. First, take an overview photo from the bridge, and choose three areas to sample. Then on the foreshore, for each coloured patch of wet mud:
- place a 2cm x 2cm square of lens-cleaning tissue onto the surface
- mark position with a flag; with colour palette in shot, take a photo
- pipette 3ml creekwater into a small, pre-labelled specimen bottle
- after 40 minutes, retrieve the lens tissue and place it into the bottle
- shake well to loosen microalgae into this small volume of water

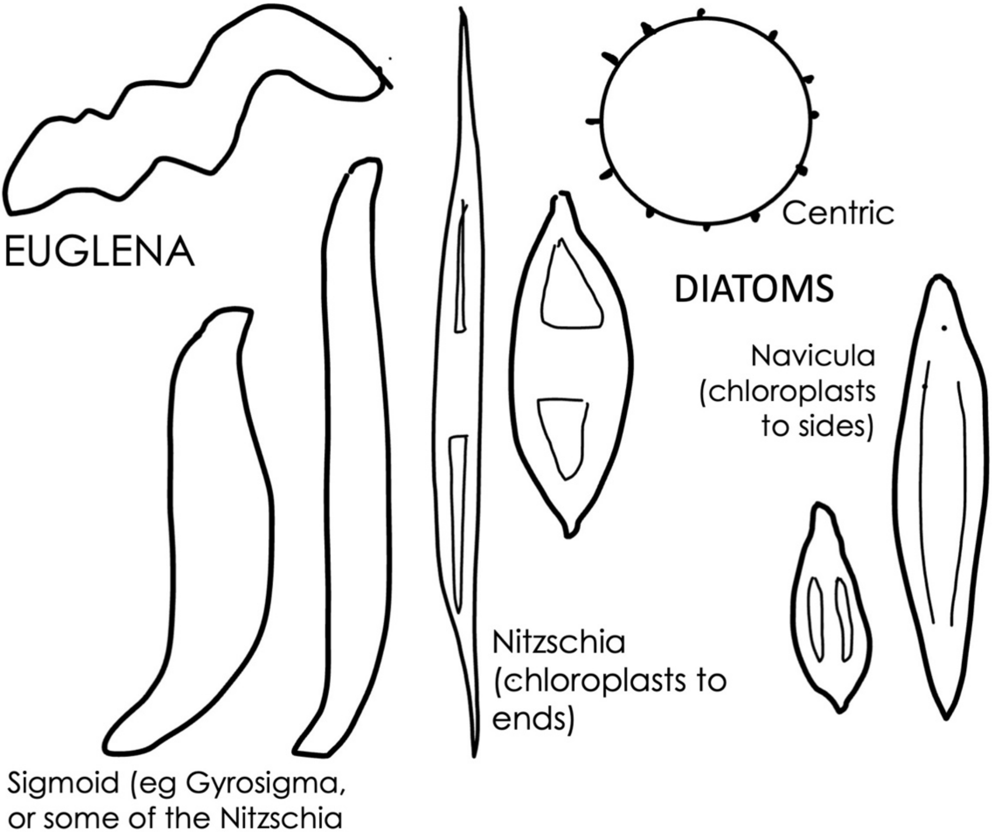
Back in the Centre, the samples are examined under an iolight microscope. The different types of microalgae are counted; they're identified using simple categories, not species (see opposite) using the squares marked on the microscope platform 'graticule'.
The results – and photographs – are stored in the online database 'Epicollect'. Records include the air temperature, and a general comment on the weather.

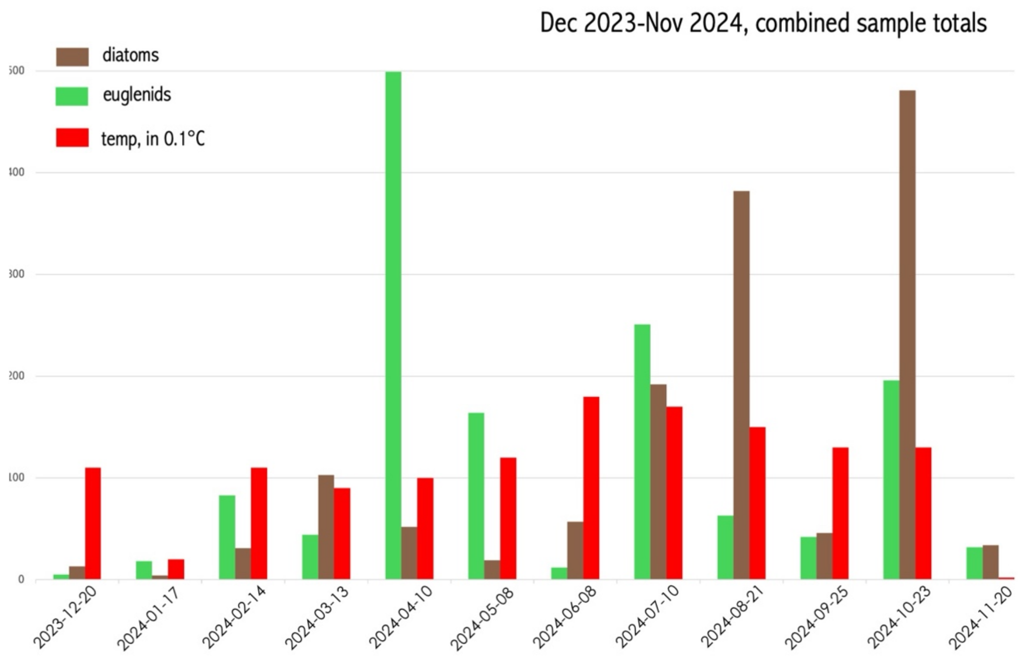
The photographs are 'white balanced' using the colour palette, and sub-samples fed into https://mk.bcgsc.ca/color-summarizer/ . Experimental analysis and comparisons are made for aesthetic as well as scientific purposes.

WHAT'S NEXT?

The Creek habitat is changing: climate breakdown continues to accelerate, with more rainfall and less predictable seasons. And sedimentation has been affected by the work of Thames Tideway, excavating for London's new 'super sewer'. Meanwhile Creeksiders continue to monitor and advocate for wildlife in many shapes and forms; the Slimewatch plan is to keep honing skills and developing the database. Volunteers have suggested more specific ideas; visitors can add their own! For example:

- *Staged, timed tissue sampling during the course of a single low tide (echoing Slimewatch1, but with easier access)*
- *isolating mud samples to observe over time, out of the Creek itself; do euglenids or diatoms 'know the time of the tide' without physical cues?*
- *Relating findings to the wider ecosystem. eg Creeksiders have been documenting birdlife and invertebrates for over a decade*
- *extending work downstream with Trinity Laban (Deptford Creek)*
- *sharing/replicating with other tidal Thames locations, eg Cody Dock*
- *supporting visitors in making the invisible visible in artworks*


EUGLENA
DIATOMS
Centric
Navicula (chloroplasts to sides)
Nitzschia (chloroplasts to ends)
Sigmoid (eg Gyrosigma, or some of the Nitzschia


Dec 2023-Nov 2024, combined sample totals
diatoms
euglenids
temp, in 0.1°C
0
2023-12-20
2024-01-17
2024-02-14
2024-03-13
2024-04-10
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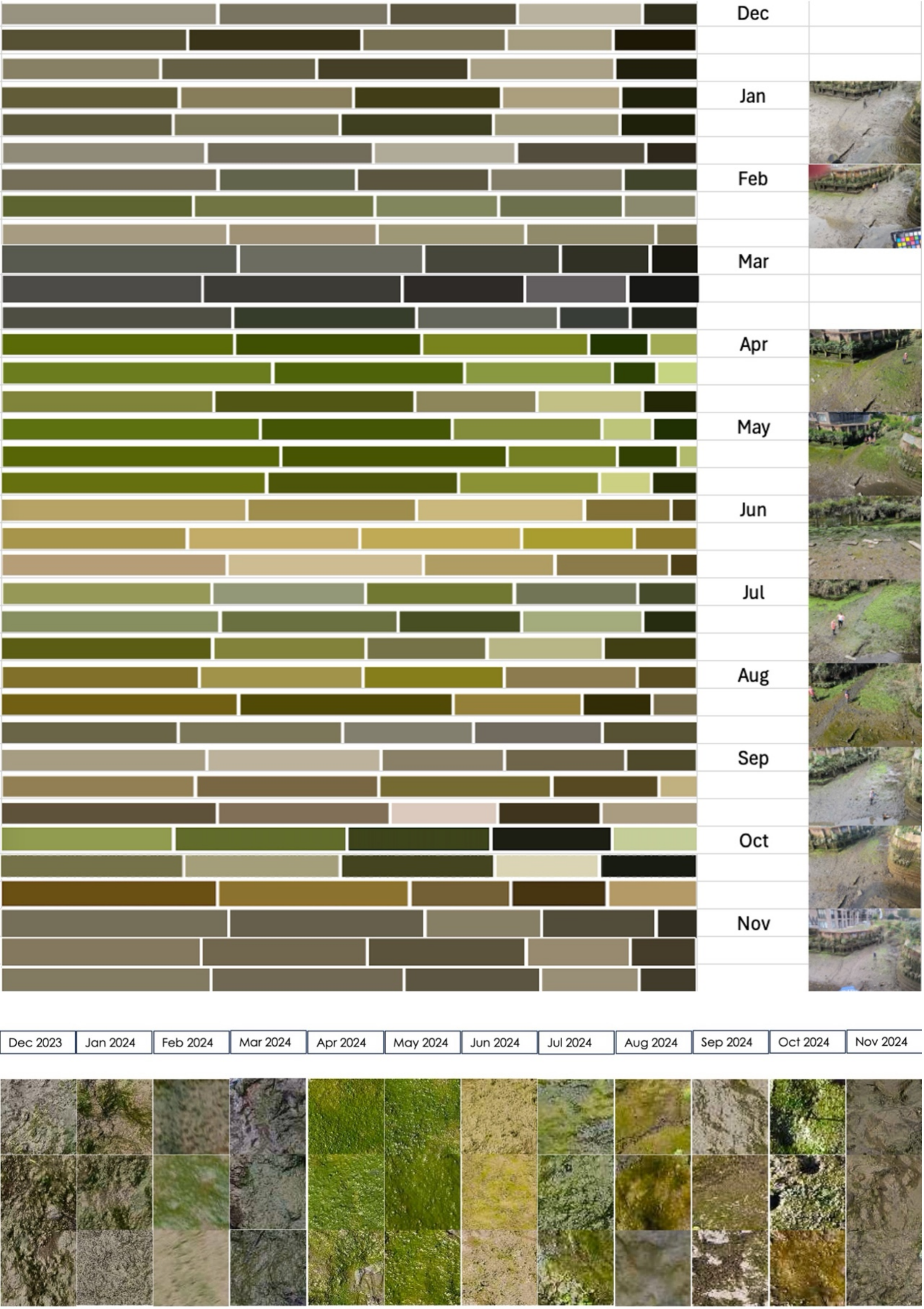
2024-11-20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Jul 2024
Aug 2024
Sep 2024
Oct 2024
Nov 2024

notes/drawings:


walking pictures ltd.
British
Phycological
Society
Understanding and using algae
CREEKSIDE
DISCOVERY CENTRE