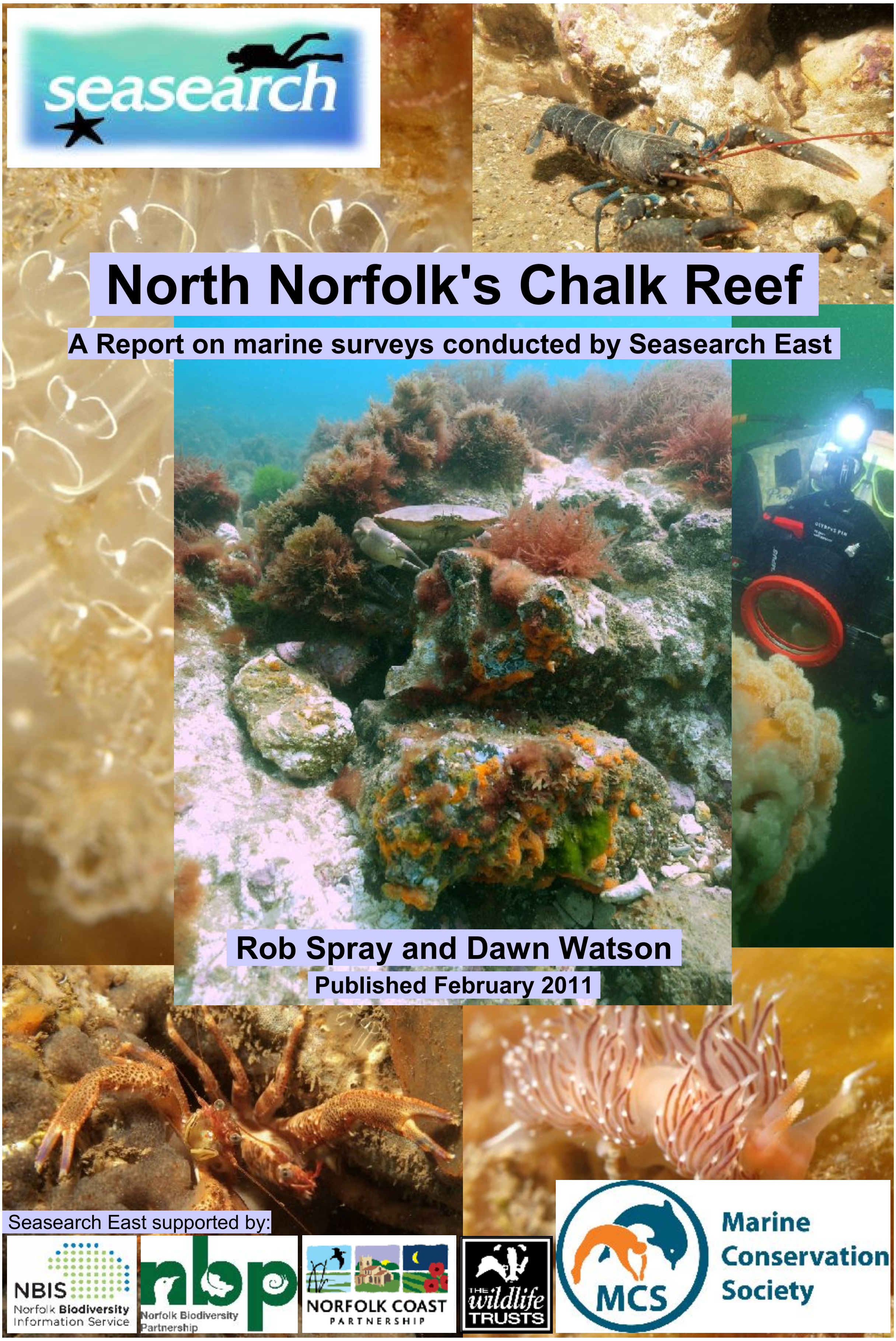

North Norfolk's Chalk Reef

A Report on marine surveys conducted by Seasearch East

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1 Norfolk's sub-tidal chalk

The East Anglian coast is notably short of significant rocky shores and hard seabed features. This lends the sea an often turbid appearance as most of the seabed is mobile and easily disturbed. That certainly does not mean that these areas are free of life but can make observing it difficult. Hard seabed features allow plants and sessile animals to colonise, forming the foundation of a biodiverse localised ecosystem. North Norfolk is unique in the region in having areas of rocky seabed where chalk is exposed sub-tidally - and inter-tidally, most notably at West Runton.

Sub-tidal chalk is a Biodiversity Action Plan (BAP) habitat and with the encouragement of Norfolk Biodiversity Partnership (NBP) and Norfolk Biodiversity Information Service (NBIS) we have been attempting to survey the extent and biodiversity of the inshore area mostly commonly known as the Sheringham Chalk Gullies (sometimes alternatively attributed to Weybourne).

The reef is a mosaic of different seabed relief and rock combinations. To describe the more significant features of this area merely as gullies is dismissive. There are gullies in the chalk but these are features of a reef complex where some of the most striking sights are dramatic arches more than 2m high at the seaward ends of the tide cut gullies.

The Wildlife Trusts contributed support which allowed a greater number of survey dives to be completed and we are also extremely grateful to Fugro UK Ltd who supported the survey both through the provision of a sonar system and the benefit of their professional marine survey expertise.

The surveys were carried out as part of the Marine Conservation Society's Seasearch project, which asks amateur divers to record flora, fauna and habitat on their dives around the UK and Ireland.

2 Chalk History Primer

The chalk was laid down over 65 million years ago during the Cretaceous Period, formed by the compression of tropical ocean phytoplanktonic diatoms called coccoliths. This has been been overlaid by subsequent geological events, most notably clay from glacial deposition. The exposed extent is just the tip of the 'iceberg' with the chalk layer more than 400m thick in some places. This strata also emerges in other areas of the UK. The same sheet is exposed as the white cliffs of Dover, Flamborough Head and as the monumentally carved downs in the West. Off North Norfolk it emerges through the clay into a surrounding seabed of moving sand and gravel to form features which are little known and poorly recorded. Above sea level the soft, crumbling Norfolk coast is retreating over the chalk as it is eroded by wave action and tidal processes so chalk exposure is increasing.

The rocky nature of the seabed in this area has given rise to an established and well known crustacean fishery. The distribution of crab pots along the coast was always something of a clue that some of the biodiversity of this seabed has been common knowledge amongst the fishing community for a very long time. The stretch of coast between Blakeney and Trimingham has been protected from trawling by local by laws since 1962.

Divers in this area are far less numerous than in most other regions. The traditional focus of their attention has been the many, many wrecks of the North Sea. Some of the local diving clubs only dive the fringe of the main reef and never know they have missed some of the most significant chalk less than a mile away. The generally accepted, largely anecdotal, dived extent of the chalk was from a gradual start near Weybourne, running East past Sheringham and coming into shore at West Runton.

Clearly individual fishermen, divers and anglers knew about particular areas but very little had been formally recorded. The character of the underwater chalk and its different features were understood in general terms, not as a reef complex or an ecosystem.

3 Comparative Importance

Chalk is a relatively scarce environmental resource occupying only around 1% of the UK coast line, although these deposits represent 75% of the marine chalk found in Europe. We haven't, so far, found a definitive figure for marine chalk globally. The lack of information suggests that it is globally scarce and that the UK's deposits are just as significant in a worldwide context.

The East coast of England has several significant chalk reefs. The most notable, aside from those in Norfolk, are around Flamborough Head in Yorkshire and along the Thanet coast in Kent. Both differ from the North Norfolk coast in that their sub-tidal chalk is backed by dramatic cliffs of the same material – making them much easier to find! According to current surveys Flamborough has the largest area of chalk reef in Europe and the 16km stretch is third longest behind the Thanet Coast at 23km which due to the findings of our 2010 survey is now succeeded by the 30km length of the North Norfolk coast reef as the longest in the UK.

This ranking has been confirmed by comment from the Joint National Council for Conservation (JNCC) as far as Europe is concerned. There has been further speculation that the North Norfolk chalk may be the longest in the world. Whatever the world ranking the potential for the reef to be significant on a global scale has excited a great deal of press coverage which has given rise to a significant increase in public awareness.

All three sites are very important habitats for wildlife, both Flamborourgh and Thanet are already recognised and protected under UK and European law for their biological significance as Special Areas of Conservation (SAC). It is hoped that the North Norfolk chalk will be recognised as part of the current Marine Conservation Zone (MCZ) process and will join the other areas in achieving designation and protection. With support from the Marine Conservation Society's Your Seas, Your Voice campaign and listing by the Wildlife Trust amongst the significant habitats within the Net Gain region some degree of recognition is likely but the area designated and the strength of protection are very much still to be decided.

The MCZ process urges that reference areas are established to provide an indication of the level of human impact. The comparatively low level of commercial exploitation under a long term trawling prohibition (in some form since 1902) should mean that such an area would return quickly to reference condition potentially providing a significant summer tourist attraction if it is placed accessibly.

4 The 2010 Survey Project

The project was instigated in late 2009, unfortunately missing the diving season but benefiting from the work which had been done previously. In 2010 we were able to make excellent progress. Although the weather was inconsistent and often unsuitable the dives which were possible were very productive. This productivity was also a side effect of the much greater than expected extent of the chalk – in fact it was hard to miss it!

The survey was conducted under the auspices of the Seasearch project which has established a methodology for amateur divers to record flora, fauna and habitats. Professional dive surveying is immensely expensive but by training and encouraging recreational divers to record their observations data can be gathered much more cost effectively, with the significant added benefits of public awareness and local involvement.

This survey is the result of 111 (77 from 2010) diver records, made during boat and shore dives between Cley and Trimingham. None of our 2010 survey trips found only the plain sand or sediment we thought we would have encountered in abundance. We found chalk on every trip and where the chalk appears to run out to the East and West it gives way to ridges of exposed clay, another BAP habitat.

Norfolk attained UNESCO Biosphere status some time ago without significant contribution from this aspect of its environment. Awareness of the reef could play a part in cementing this status, if its retention was deemed valuable as it has been by other regions with strong profiles in eco trourism.

5 Dive Surveying in North Norfolk

Norfolk isn't considered an all year round dive destination. A combination of onshore winter winds and a spring bloom of plankton mean that for much of the period between October and May visibility is practically zero. As summer approaches the winds drop in strength and usually settle to a prevailing South Westerly. This allows the sea water to clear and it is possible to enjoy some excellent diving. These conditions allow trained, amateur divers to conduct detailed surveys safely and effectively.

5.1 Water Clarity

Divers describe water clarity in term of metres of visibility. Less than 1m of visibility makes for a difficult and unpleasant dive while 10m is excellent for the UK. The Norfolk visibility is generally better and more consistent offshore and the water clears earlier there too. Diving often starts in May offshore, these dives test the conditions and give advance warning of inshore visibility which generally starts to improve around a month later. By July the inshore visibility has often risen to between 5 and 10m - which is very pleasant.

5.2 Water Temperature

The shallow inshore waters of Norfolk are some of the warmest in the UK during the summer. They rise from close to freezing in winter to over 20°C in late July. In late summer Norfolk's inshore waters can be 5°C warmer than the Gulf Stream warmed SW coast of Britain.

5.3 Wind

It is wind strength and direction that play the greatest role in determining sea state and visibility during the summer. Force 4 winds are the accepted upper limit for safe diving, but even weaker onshore winds will quickly build up waves and destroy the visibility close to shore. Weak South Westerly winds are ideal as they flatten the sea, driving the waves away from the shore.

5.4 Tide

Traditionally dives are carried out at slack tide – the period when the sea is 'stationary' as it pauses to change direction between high or low tide. To cover as much ground as possible we have surveyed largely by drift diving, using the current between high and low tide to transport divers quickly over the sea floor. Tidal speeds can reach a brisking jogging pace but are more typically a gentle walking pace, 1-2kmh. This might sound very relaxing but a diver is a passenger in any significant current, it is not easy to stop for a better look or to make progress across the current.

6 The 2010 Survey

This first year of concerted surveys has effectively made a narrow, longitudinal scan of the seabed parallel with the coast. It is fair to describe this as a linear survey, measuring the length and recording the terrain of the reef. We have found chalk down to around 14m deep and out to 1250m from the tidal chart datum. It establishes the presence of chalk along the coast but doesn't yet allow us to make accurate estimates of the total area. We have simply not had time to explore the reef's outer limits yet.

6.1 Method

To confirm the presence of chalk, or other seabed types, there is no better way than first hand observation. It can be difficult to interpret remote surveys via sounding equipment and core samples are poor at assessing surface habitat layers. Diving is however time consuming and expensive so we have tried to identify likely exposures from anecdotal evidence, aerial photographs, surface observation and previous experience before taking to the water. Once on the water we use sonar to scan the bottom both to identify potential chalk and eliminate obviously mobile seabed areas.

Once underwater we follow standard recreational diving and Seasearch surveying procedures, to ensure the data is collected safely and as widely useful as possible.

6.2 Seasearch

Our diving is conducted as part of the Seasearch diving survey project. Seasearch is run by the Marine Conservation Society for a steering group including the major diving organisations, The Wildlife Trusts and government conservation bodies. The project trains recreational divers to observe and formally record the sites that they dive. These records are submitted to the National Biodiversity Network (NBN) and are made publicly available via the the NBN Gateway. In Norfolk we also supply NBIS with these records to allow more flexible and extensive local interpretation.

Divers are able to report first hand on the condition of the seabed

These results were also supplied to the ongoing Marine Conservation Zone project in the North Sea – Net Gain. The work has proved to be extremely timely as the seabed data available initially did not reflect the presence of the chalk at all. Later data has still confused the location of the chalk so our findings have enabled the Marine Conservation Society and Wildlife Trusts us to intervene with well documented proof to press for recognition of this important habitat.

Seasearch East volunteers launching at East Runton

6.3 Survey record history

Seasearch has been active in Norfolk since 2002, although data is limited in depth before 2005. Since then the volume of data has been steadily increasing and as the experience of the team has followed suit we have made efforts to broaden the coverage of the surveys year on year.

Data is transferred from Seasearch forms onto the National Biodiversity Network (NBN) database, from where it is accessible to all via the internet. The NBN terminology is slightly different from our normal Seasearch definitions.

6.3.1 Seasearch definitions:

'Forms' are single returns from a single recorder or recording pair – which would be considered a record in most survey programs. There are two levels of Seasearch record:

Observer – two simple sides of A4 where the habitat and species are summarised.

Surveyor – much more detailed assessment of multiple habitats and seabed composition with species assigned to the identified habitats.

After submission these initial paper based records are validated by the local Seasearch co-ordinator and further checked when a Seasearch data entry specialist enters them into the NBN via Marine Recorder. Species and habitat are entered for each location. The combination of seabed composition, flora, fauna and exposure to sea action is coded into a JNCC marine biotope code which is intended to precisely represent the potential community.

Please see section **10** for more information on JNCC Biotope codes.

6.3.2 NBN definitions:

A **sample** is usually a single site record from a single recorder (or recording pair)
A **record** is each item (species or habitat) which can be separated from a Seasearch form
A **species** should be simple, inconsistent identification can produce multiple 'species'.

6.3.3 Seasearch East records on the NBN

The following table shows the Seasearch data from Norfolk which is currently held on on the NBN gateway, and will be available there as soon as the 2010 data entry is complete.

Year	Samples	Records	Species	Notes
2002	3	39	25	Survey limited to North Norfolk during 2002-2006
2003	10	141	53	
2004	6	87	45	
2005	15	274	90	
2006	3	63	39	
2007	36	825	140	Survey broadened from 2007
2008	42	903	127	
2009	66	1432	152	
2010	102*	3000*	160*	Provisional estimate

Data for 2002-2009 from NBN Gateway

During 2010 we received 77 records contributing to the survey of the chalk from 16 volunteer divers. This survey also includes a further 34 records from dives in previous years.

The other 25 Seasearch dives in Norfolk during this period cover mostly dives around wreck sites further offshore and dives to map the outline of the blue mussel bed off Sea Palling. Far from being superfluous to the main chalk survey they have at least shown that the chalk is not the exposed seabed type in those areas, although it may underlie the surface substrate. A complete list of survey dives and species recorded are in sections **11** and **12** respectively.

6.4 Drift diving

Diving surveys are most often conducted on small sites during slack tide, but to cover significant areas during the limited time available on each dive a technique known as drift diving was employed. Divers use the running current to carry them over the seabed, marked by a buoy so that a boat can follow them.

Diver taking photographs while on a drift dive

Conveniently the ebb and flood tides produce currents which travel parallel to the coast, which allow divers to survey over distances impossible using just leg power – typically between 400 and 1000m per dive. Because of the constant movement it is more difficult to survey while drift diving. Digital photography helps hugely to note features and species quickly but quality is compromised and opportunities are limited during a drift dive.

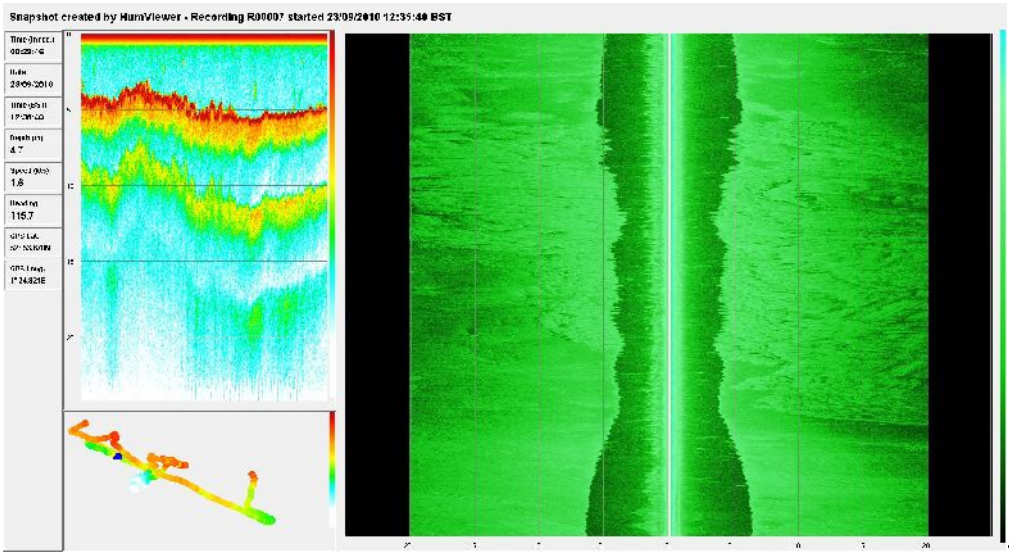
This has allowed us to cover approximately 23km (14 miles) of seabed so far and quickly dispelled the belief that there was only 8km (5 miles) of significant chalk reef. In a single, short season of concerted surveying we have established that the length of chalk is at least four times what was anticipated.

6.5 Sidescan sonar

The topography of the seabed is not mapped to nearly the same extent as the terrestrial environment. Famously we know more about the surface of the moon than the bottom of the sea. Even navigational chart mapping of the sea is approximate and only offers an indication of large features and hazards. In less than perfectly clear water a depth sounder is required to gauge depth and locate seabed features.

A depth sounder, or sonar, emits sound pulses and processes echoes back from the seabed to measure the water column. Recording a series of these readings can produce a profile of the seabed which can be used to guide diving. More recently sonar systems which use a wide spread of narrow pulses to scan the seabed in detail have become available. Known as sidescan sonar, and when combined with GPS equipment, these systems can produce detailed records of the seabed topography and enable precise location of particular features.

Seasearch East has used a small sidescan sonar to aid in the location of chalk exposures. The unit has an integrated GPS receiver for recording track, site and scan position. Interpreting sidescan sonar images is something of a black art which the team has been learning. The unit aims to provide a guide to substrate composition and density by colour coding a conventional sonar plot of the bottom but the trained human eye can be much more effective at interpreting information.



Sonar recording: Showing conventional sounding display (top left), track colour coded by depth (bottom left) and joined left and right side scans as the boat crosses a 1.5m ridge of chalk (right)

During the 2010 survey seabed profiling was limited. In such relatively shallow waters the width of the sidescan beam width is restricted. The width of each scan sample is approximately twice the depth of water beneath the boat, the survey has been conducted in water between 3m and 15m deep. Stripes of topography can be recorded wherever the boat travels but to approach full seabed coverage a contiguous well tessellated track over the entire area of interest is required. Samples are combined to form a mosaic of the seabed. Full mapping of the the approximate 30km by 1km outline of the whole reef would require precise navigation over roughly 3000km. Boat speed while plotting is limited to between 5-8km/h, so recording the full topography would take around 600 hours at sea. So the unit has been used primarily to guide diving!

In future surveys we aim to return to the most significant and interesting areas and make concerted mapping efforts. This would enable those to be studied in more detail, rendered for public awareness and used to highlight the geomorphology of the reef.

6.6 Plotting data using GIS

The use of GPS equipment allows the use of GIS (Geographic Information System) to plot the locations and paths of surveys. GIS is the merging of digital mapping with data collection and analysis. Our use has been very simple to represent the positions of static dives and the tracks of drift dive surveys as transects but its collection and retention allows further analysis in the future. When our sonar expertise, technique and coverage develop we hope to map the topography of seabed areas.

This information will also be available to others – notably to NBIS and via the NBN Gateway.

6.7 Photography

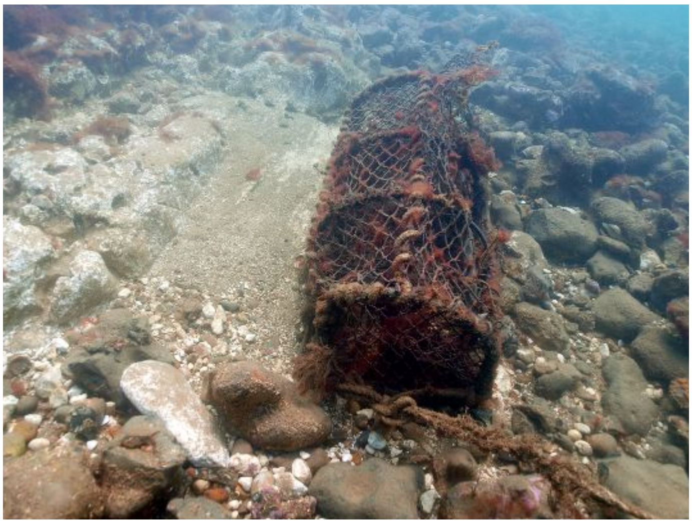
Digital photography has become an important part of underwater recording. Images of the marine environment allow volunteers to confirm key ID details, confer over species identification and share finds. Dive duration is limited by many factors so having a good visual record allows much more time to be spent assessing surveys and remote experts to be involved when more experience is required

Photographs can also provide a vital resource for raising awareness. If divers are lucky enough to find something unusual, eye catching or amazing the non diving public are very interested – as demonstrated by the response to the news of the reef reaching the local, national and international press in late 2010. Seasearch East is fortunate enough to have the support of Olympus for their photography.

6.8 Tidal flows

North Norfolk experiences strong and generally predictable tidal cycles. Inshore tides are on a 12 hour 25 minute cycle and tidal range from low to high tide is more than 5m. Offshore the many sandbanks produce variations as they move but the hard seabed of the reef makes it simple to predict slack tides for static diving on fixed sites. In general the survey used the tides as much as possible to cover more ground with speeds of 2.5-3km/h recorded on some dives.

Although barely a brisk walking pace a diver cannot usually chose to stop or resist these tidal flows. Water is around 800 times denser than air and a diver must go with the flow unless they can shelter from the current. This means that we cannot survey to the same detail when we are drift diving. The speed of the tide can lift the fine sand at some sites, most notably Trimingham, where visibility can reduce dramatically between low and high tide.



This lost (unbuoyed) lobster pot off Sheringham has worn away 200mm of chalk relief from the reef surface as it has been scrubbed back and forth by the tide. It is difficult to recover heavy items without preparation so divers have cut open the side so it can no longer 'ghost fish'.

7 Survey Coverage

The main advance made by this survey has been to join up the pockets of local knowledge and make it clear just what variation and potential habitats the chalk offers. Our year of surveys started neatly in the West and proceeded generally East. The start of the sequence at Cley was intended merely as a test launch but proved immediately productive and set the trend for the rest of the year.

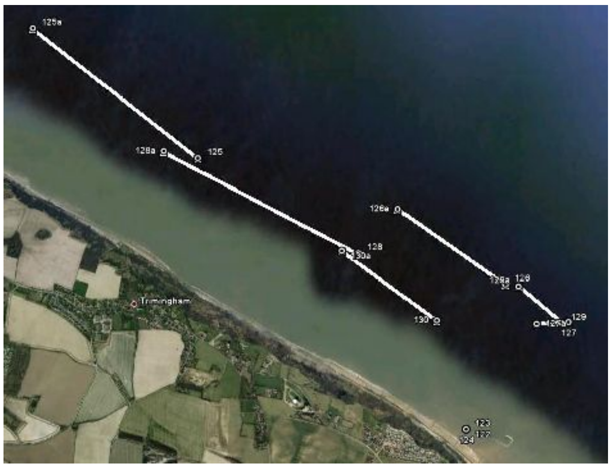
Data was collected on dives between Cley and Trimingham where clay to chalk transitions were recorded. This representation of dives and sea bed is schematic for clarity.

2010's Norfolk diving started off shore in April, from Sea Palling, during which one brave volunteer tested the waters and returned the year's first record. This continued in May with another 3 records from wreck sites up to 30km off shore – including the first observation of *Sagartiogeton laceratus* – an anemone - on the East coast. These dives were not aimed at mapping chalk but add to our knowledge of the region and give early indication of the progress of inshore conditions.

The inshore dive season started 'on schedule' with the visibility arriving in very late June. We were only able to fit in 2 days of shore diving but squeezed in 11 records. These included observation of juvenile Sea Snails – *Liparis spp.* - tiny fish with a sucker disc which allows them to cling to rocks.

By early July, as usual, the water was clear right to the edge. When the sea is this clear it is even possible to survey the reef off Sheringham, East Runton and Cromer by snorkelling. July was the most productive month for the survey, with the majority of planned dives going ahead and 57 records returned. A week of concentrated dives enabled us to characterise the most dramatic parts of the reef between Sheringham and West Runton. It was here we recorded Leopard Spotted Gobies - *Thorogobius ephippiatus* - and a Tompot Blenny - *Parablennius gattorugine* – small fish which favour rugged, overhanging reefs and, respectively, unrecorded and very rare in the East.

It would have been reasonable to expect August to continue in the same vein but unsettled weather and onshore winds limited us to only 6 records in the first half of the month. This is unusual as South Westerlies are predictably prevalent through most summers. Most of the diving in the region was adversely affected. The loss of this period of diving greatly reduced the scope for mapping the seaward extent of the chalk.



Drift paths and shore dives off Trimingham

Our diving ended in September, in a better year it would have run into October. We were thankful that the last dives were very productive and established good evidence of the Eastmost linear extent of the inshore chalk exposure. The recording of a clay layer reappearing over the chalk very neatly bookended the start of the season at Cley.

There are plots of the dives overall and in more local detail in Section **13**

7.1 Cley

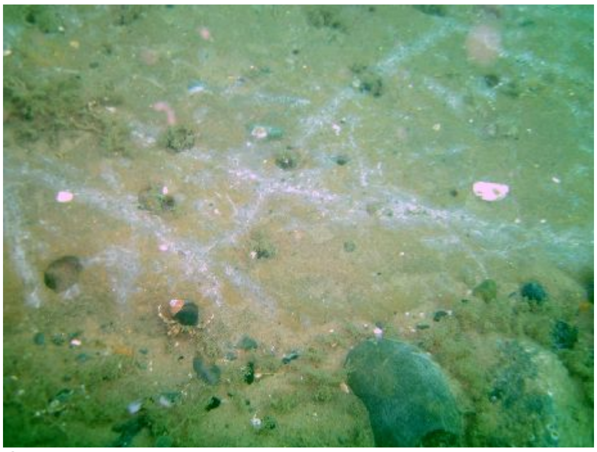
The gently sloping shingle shore at Cley makes for a comparatively easy beach launch, if you have enough volunteers for the recovery which is much harder!

No one expected any surprises here and the prime reason for the survey was to test the newly installed sidescan sonar. As we scanned the seabed we noticed a selection of interesting features which couldn't be ignored and led us to locate what appears to be the start of the chalk

The inshore initially reflects the shoreline (right) here and shingle extends for up to 50m from the shore before giving way to sand. There are numerous sections of wreckage here, primarily iron from the SS Vera but also quantities of rock ballast and remains of concrete wartime emplacements. The main body of wreckage provides a tide shadow which modifies the tidal sorting of sediment and creates an elongated plain of mixed sand and gravel to the East and West of the hull outline.

The sand plain extends out to around 300m from shore where we were very surprised to find a distinct ridge. This crosses a transition from clay to chalk (West to East) approximately aligned with the wreck of the Vera. The clay ridges (shown left) to the West are up to 1.5m high while the chalk to the East is a low, rough plain with scattered flints.

This fringe of the chalk reef is comparatively lightly populated. Mobile sediment makes it a hostile habitat, but some surprise species have been recorded here, such as this very tiny juvenile Striped Sea Snail (Shown on right, facing to top left with tapered tail curled around right side of the body).



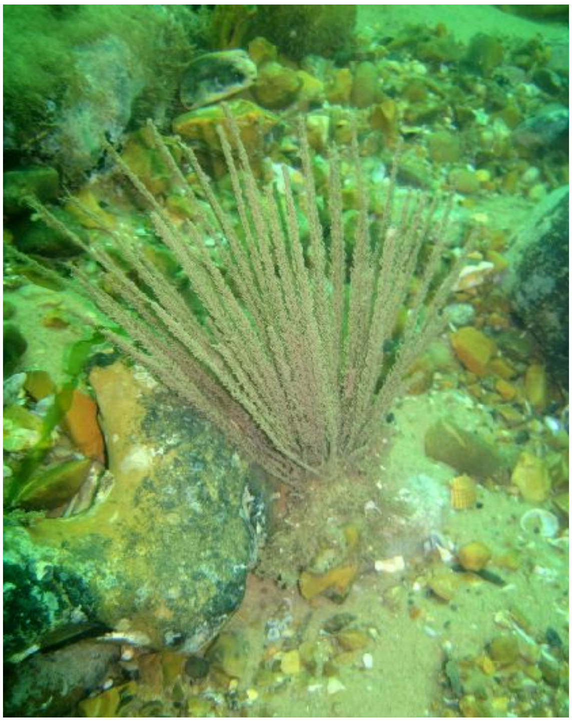
Chalk emerges to the East as the clay layer subsides

The hard clay is ideal habitat for burrowing Piddocks

Overhangs and alcoves in the clay ridges provide ample accommodation for large crustaceans

Edible crabs and common lobsters can dig in the clay to enlarge their burrows

The taller reef has a turf of Plumose anemones and breadcrumb sponges



The low reef is scattered with stones and cobbles – a sticky Antenna hydroid has been covered in sediment

7.2 Weybourne

Launching at Weybourne is hard work at the best of times. The tall, steep, shingle beach ensures any manual launch is arduous but the popularity of the Norfolk coast means you can often fall back on sun worshippers for the laborious recovery. We didn't drift dive from Weybourne in 2009 or 2010 but it was the site of some of our first speculative boat dives based on aerial photography in 2008. Our dives then found considerable (2m high) outcrops and mounds of chalk rather than the regular gully features off Sheringham. These were 300-400m off shore level with Sheringham Park.

Weybourne beach

Diving on the SS Rosalie – coated in Plumose anemones and red algae

Weybourne is best known amongst divers as the site of the wreck of the SS Rosalie. This large (120m long, 50m wide) wreck forms an extensive artificial reef which is an important and regularly monitored biodiversity hotspot. The excellent conditions here have allowed the recording of some very clear video of the life on the wreck. The wreck has stood very securely for nearly 100 years so although it doesn't rest obviously on the reef the seabed is extremely stable. The stability of the wreck on top of the underlying chalk may have allowed sediment to collect further around it.

This beach was also the traditional, anecdotal start of the chalk for many divers. Our first dive club used to dive level with the brave row of houses clinging to the top of the cliff at the end of the lane past Weybourne windmill.

Breadcrumb sponge thrives in strong currents

The tunnels in the chalk are ideal homes for lobsters

This was a pleasant but low lying area of chalk which waxed and waned with the retreat and advance of the lightweight, tide shifted sediment.

The shame was that we'd never tried moving on a little further as the dip in the cliffs behind Sheringham Park marks the start of an area of much more dramatic reef. At this point there are 2m deep gullies and pinnacles of chalk.

The stretch of reef East from here to Sheringham is one of the most dramatic sections of the chalk. We will return to this area to conduct more detailed species recording in future surveys.

7.3 Sheringham

The regular structure of the groyne stabilised beach at Sheringham belies the almost undisturbed natural chalk that is at its very most dramatic just 400m off shore. Here the chalk is easily accessible from the shore by divers or snorkellers less than 25m from the water's edge at low tide.

Sheringham, below The Esplanade

Sheringham's central slipway and sea defences

Boat launching at Sheringham is complex. There are two slips used by local fishing boats, one wooden which would be simple to access and one concrete which is in constant use by fishing boats. The concrete public slip is viable only around high tide, with tight, awkward access. We launched elsewhere and based divers on the shore using the boat as a local shuttle.

Sheringham's chalk has three predominant characters. There is a continuum between the low inshore reef which becomes more rugged and uneven with distance from the shore and the gullies which start running perpendicular to the shore after 200-300m. The gullies deepen over the course of a further 200m to a step where an upper strata of chalk gives way to another approximately 2m lower. Whether this difference is the result of the erosion of the upper strata as the walls of the gullies are cut back or as the result of movement at a fault we do not know.

It seems unlikely that a fault would have aligned so conveniently with the arches at this precise point in time so common sense would suggest that the lower plateau is a distinct, harder raft of chalk. This lower plain is extremely rugged with a dense cover of chalk and flint boulders – likely to have been released by erosion from the softer strata above.

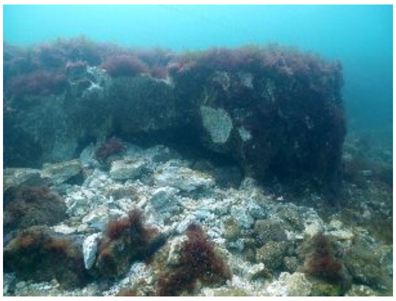
Close to shore the chalk is low and gradually becomes more rugged and variable...

...gullies deepen (to around 2m) until a step occurs 400m from shore...

...beyond this step a dense layer of sponge encrusted cobbles and boulders cover the bedrock

7.3.1 Arch formation

The chalk strata here appears to be stepped some 4-500m offshore. From the shore to this point there is a rugged plain with a variety of habitats punctuated by outcrops, ridges and gullies. The initial plain terminates as a 2m step down to another more exposed plain. It is the erosion of the inner plain which has given rise to a row of arches and tunnels. Coarse sediment and large mobile flint appear to have sawn into the chalk with the wave action perpendicular to the shore. This produces gullies which cut down into the chalk up to 2m deep at the step. What starts as a narrow gully is a 2m wide channel with walls up to 2m high by the step. Thus it is the 2m high outcrops or fingers of the upper chalk which are most apparent at the step. Chalk is soft and prone to inclusions and so these are eroded at their ends by materials carried parallel to the coast by the tidal flow. This combination of abrasion and impact tends to undercut the chalk fastest where faults occur and accelerates once mobile material is driven into them by the current. Given time a tunnel is formed under the outcrop, these continue to grow until the outcrop collapses, orphaning the outer side of the arch or tunnel as an isolated pinnacle.



i.Rolling debris and wave action undercut the walls of the gullies

ii.Localised faults wear through more rapidly forming a tunnel

iii.Eventually the arch is isolated when tunnels collapse.

The upper chalk has a verdant growth of red and green seaweeds, this is significantly reduced on the lower strata. The fauna also appears denser on the upper chalk. The lower chalk hosts a low, robust, encrusting animal turf.

There are at least two areas of very rugged chalk very close to shore. An area known as Robin's Friend below the Sheringham Seawatch station at the start of the golf course and another some 200m out from the Lifeboat Station demonstrate the kind of relief which suggests robust but diverse fauna. Neither was surveyed, both would be targets of further observation.

As the reef proceeds East from the centre of Sheringham the height of the rugged upper strata declines from 2m to around 1m by the time it reaches Beeston.

This stretch of reef is amongst the most heavily potted, most are set just outside the upper layer. Potters tend avoid the most rugged areas to minimise loss of gear, especially in rough weather when fishermen will tend to set strings of pots (right) further out - on the smoother, lower plain.

The inner reef is low lying, large boulders and scattered cobbles over the bedrock which provide a multitude of hiding places

The gullies start as quite subtle features worn between raised areas, lending cover to larger animals and photographers

Squat lobsters (Galathea squamifera) are almost innumerable amongst the cobbles

Shore crabs (Carcinus maenas) are also very numerous and very active – this is a mating pair

There are relatively few mid water fish, most are bottom dwelling – such as this Long Spined Sea Scorpion (*Taurulus bubalis*)

Of course there are Common lobsters (*Homarus gammarus*), they will have a territory ranging around their home burrow or overhang.


The gullies fill with abrasive material...


...which cuts through the strata exposing high walls.


Some animals such as the Sea Toad (*Hyas* araneus, a spider crab) are extremely well camouflaged


The largest chalk features are large enough to attract fish which are more often seen shoaling around wrecks


The most dramatic, delicate arch – on borrowed time


The outer, lower reef is a more hostile, abrasive habitat

7.4 Beeston Regis

Launching at Beeston Regis isn't practical, with no beach access for boats. The prominent Beeston Bump marks the end of the Sheringham seafront and a transition to a more natural cliff terrain backed shore decorated by frequent static caravan parks.

Underwater this landmark marks the Western extent of an area of intermediately rugged character which runs until West Runton. Here the gullies are quite regular and around 1m deep. Areas of relatively level chalk begin to appear, littered with large sponge encrusted boulders. These encrusted plains extend past Cromer.

The Butterfish (*Phollus gunnelus*) is a small (150mm) eel-like blenny

The reef here is only slightly less rugged than off Sheringham – often reaching 1m high

Sessile animals such as Lightbulb Sea Squirts (*Clavellina lepadiformis*) coat many vertical surfaces where light levels are lower and algae struggles

There are several groups (phyla) of animals which are predominantly stationary (sessile) – this is a *Bugula spp.* sea mat or bryozoan

7.5 West Runton

The slipway here is viable for small boats but proximity to the much simpler launch at East Runton makes it a less attractive choice.

The rockpools to the West of the slipway are very similar to the rock strewn chalk plains which run past Cromer

The exposed chalk at the shore line is representative of the relief of the encrusted plain to the West and its polished sand margins to the East. Also typical are the many large flints. These are mostly paramoudra, also known as pot stones, annular silica deposits of ancient organic material. They are thought to be the result of lithification of ancient sponge material around burrows in the chalk, formed by Bathicnus paramoudrae - a little understood organism, known only from these formations.

The intermediate gullies appear to end here and encrusted plains become the prevailing underwater terrain. This bedrock plain is largely free of light abrasive sediment allowing all but the lowest surfaces to host encrusting fauna. Where the chalk is shallower mobile sediment tends to be present and polishes the bedrock clean.

This flint pot stone is filled with chalky deposits which are often eroded away

Chalk exposed on the beach to the East is similar to the shallower, polished fringe of the chalk plain

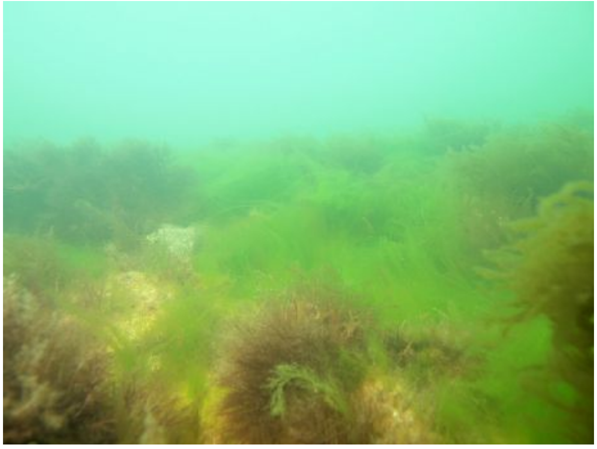
This pot stone is hollow, but encrusted with Shredded Carrot sponge – *Amphilectus fucorum*

The gullies give way to a rock covered plain here, the rocks are mostly flint Paramoudra, pot stones

7.6 East Runton

The steep, but simple, slipway and hard packed sand both lend themselves to small boat launching here. A band of flint cobbles at the top of the beach is the only complication – which can be overcome with either personal effort or, more ideally, by helpful bystanders. There is a wall-like feature close to shore, 300m West of the slip. This can be a navigation hazard, as it is concealed by the sea at high tide. The best return approach is perpendicular to the shore at the slipway.

The chalk starts in low ridges, emerging from the sand gradually less than 200m from the shore, increasing with greater distance from the shore. The low inshore chalk is 0.3-0.5m high and although scoured clean at the margins supports extremely vigourous red and green algal growth as the water is so shallow (2-3m). Further out the rough, plain topology which started at West Runton continues.



The chalk starts shallow and delicate green algae is the dominant reef cover initially

There are low gullies with scoured, polished sides here between flat chalk plateaus

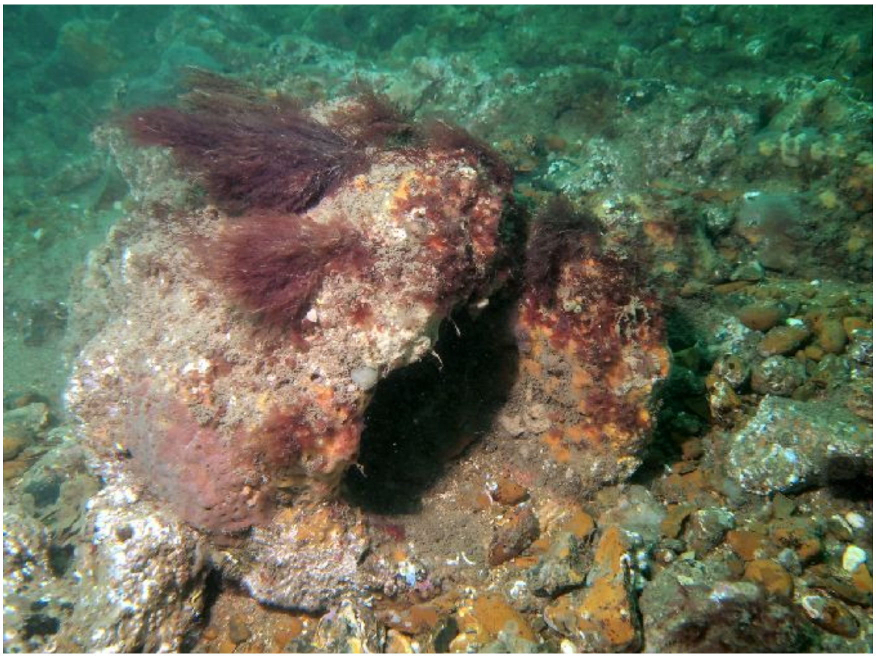
The reef here appears quite sheltered. The algae (seaweed) is home to many cryptic species such as this long legged (Macropodia spp.) spider crab

Further out and deeper there are larger outcrops of chalk which show the switch from algal to animal turf with the change in incident light levels.

7.7 Cromer

The launch points here are busy and the tractor traffic often disturbs the packed beach sand making it impassable by normal vehicles and very difficult to traverse manually.

The terrain is comparatively uniform as it passes Cromer. The chalk bedrock remains quite constant with the superficial coverage of heavy sediments, cobbles and boulders varying in density but retaining a robust, encrusting sponge and hydroid fauna.



Paramoudra flints, or pot stones, are common on the flint plain that passes Cromer

The density of cobbles and boulders varies but the underlying chalk is constant

7.8 Trimingham

Our final dives of the 2010 season were made from the slipway which lies at the boundary between Trimingham to the North and Mundesley to the South. Several local divers mentioned the underwater chalk here but it is also evident from the surface with brilliant white exposures through the fine sand beach to the South East of the slip. The slip and beach here are ideal for small boat launching but there is a confined access channel through the wooden sea defences where the dry sand is churned making it difficult to cross.

Exposed, clean chalk on Trimingham beach

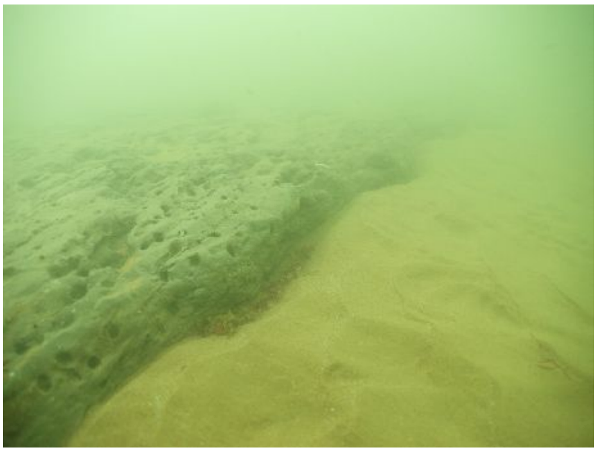
Approach to Trimingham slipway - note cordon through sea defence

The beach sand continues out from the shore, where irregular chalk exposures occur more frequently with distance from the shore. These exposures are cleaned by the extremely mobile sand which is fine enough to form a suspension under even modest tidal flows. Only the most robust epi-fauna is evident but these become quite dense on the highest rock (~1m high). There are gullies here but they are very narrow, <0.5m wide. The chalk becomes more significant to the North West with reducing sand and greater biodiversity. This region appears, inshore at least, to be the South Eastern extent of the chalk and there are considerable hard clay plains and fractured ridges.

Chalk gullies, outcrops and reef residents – 150-200m straight out from Trimingham slipway

The fine sand is very mobile; forming dynamic ridges which travel East and West with the tide

The underlying clay, rich in chalk, flint and other rock fragments is revealed when the sand is moved away



The raised clay is riddled with Piddock burrows

The clay layer is hard and fractures into blocks

The chalk is scoured by the sand close to the seabed and the encrusting turf on top is made up of the most robust sponges and red algae

As well as abrasion the covering turf must survive regular covering by the fine sand

8 Future Survey Areas

The surveys conducted so far pose as many questions as they answer. Far from comprehensive, they just scratch the surface of an unexpectedly large ecosystem. The results seem to have encouraged all those involved and many more who have heard about the chalk reef for the first time. There are many avenues for more investigation across numerous disciplines – for example we have become aware of the geological importance of what we had considered primarily an exercise in marine biology.

8.1 Continuing the Linear Survey

Our linear surveys have covered approximately 75% of the seabed between Cley and Trimingham. This first series of dives has allowed us to define the primary stretch of sub-tidal chalk. The media coverage of the story has prompted offers of information from other divers which will guide subsequent surveys. There is no doubt that further chalk exposures exist further out and to the East and West. There has been particular mention of chalk off Hunstanton and Happisburgh. Whether these are part of the main reef or separate fragments, isolated from it remains to be seen.

The initial linear survey has roughly quantified the scale of the task ahead but not provided an accurate bound to just how much chalk might be found. Although we have found distinct chalk/clay transitions it is not unreasonable to predict that both habitats may be irregular and more boundaries may occur. As well as extending the surveying to the East beyond Trimingham, where our surveys suggest the chalk may end it is clear that we must go West beyond Cley where we have observed the same transition into exposed clay.

8.1.1 Western Extent

The seabed from Blakeney Point to Cley anecdotally contains hard ground fished for crabs and lobster and may well include further chalk as well as what we expect to be a significant expanse of clay.

8.1.2 Eastern Extent

Beyond Trimingham we expect the clay to continue for a considerable distance, we believe it underlies the mussel bed we have recorded off Sea Palling.

8.2 Key areas not yet surveyed

8.2.1 Salthouse to Weybourne

Our limited dives off Salthouse in 2008 did not find chalk, but they were conducted from aerial photography without the benefit of sonar. In retrospect they were also conducted too close to shore. We will return here to more accurately characterise the seabed formations further from shore.

8.2.2 Other Habitats

As well as continuing the survey of the chalk we hope to connect our knowledge of the seabed around North Norfolk's chalk to other areas. We have had interest from two dive clubs from the region who would like to take part in the survey, this may help the coverage to extend further from shore and increase the density of records within the core of the reef.

8.2.3 Sea Palling

We have only recently found and started exploring the vast Blue mussel bed off Sea Palling. A Blue mussel bed is a BAP habitat in itself and appears to have established on top of another exposed clay. This bed is at least 5km long and has been put forward to the MCZ process as a potential reference site – this has good potential for acceptance as the proximity of the 'no trawl' zone which ends at Happisburgh has dissuaded fishing exploitation of this area and as such it is in excellent condition.

8.2.4 Happisburgh

The soft crag of the cliffs and exposed clay on the beach here have given up numerous startling archaeological finds in recent years. There is evidence of further features offshore, including ancient river beds and chalk, which we will aim to investigate.

8.2.5 Hunstanton

The cliffs at Hunstanton clearly demonstrate the proximity of chalk deposits to North West Norfolk and the Wash. We have had information that chalk has been observed offshore, this is most likely to be a separated fragment but only a visit will find out.

9 Conclusion

9.1 Primary summary

There can be no doubt that the chalk reef which shyly shows itself occasionally along the North Norfolk shoreline is a much larger, more dramatic ecosystem and geological feature than the survey team expected to find. Seeing the heart of the reef on the best dive day of 2010 was almost literally mind blowing. It made everyone, and the survey was very much a team effort, realise we were surveying something really, very special.

We were initially elated simply to have found four times more chalk reef than we expected but it wasn't until the press asked where it figured on a UK scale that we found it might be the biggest in Europe, or even the world. That was a somewhat startling moment, the realisation that a group of local divers could find a feature that figures as significant on a world scale less than half a mile from a tourist beach!

The reef is a biodiversity hotspot, supporting a range of flora and fauna species which we are only just beginning to realise is more extensive than we have seen before. We recorded not just the same species as on surrounding wrecks but rock reef specific animals, such as the Leopard Spotted Goby, *Thorogobius ephippiatus,* which are not known from this area at all. The different sections of the reef offer a very varied selection of niches for marine species – which often favours very particular habitat.

Other public domain recording in the seas around in East Anglia is very limited and this has led to an unwarranted misrepresentation in reference material as an area of endemic low biodiversity. This is inconsistent with our observations and patently at odds with the long history of fisheries in the Southern North Sea. Commercial fish do not exist in a vacuum and require a healthy ecosystem to flourish. The upper tiers of the food chain are demonstrably under pressure and the lower tiers must be protected to ensure that the whole food net can regain a sustainable condition. Successfully exploiting particular species does not indicate that the whole system is in healthy, overall condition.

9.2 Concurrent activities

As participants in the Net Gain Marine Conservation Zone project we've highlighted this area for the MCZ (Marine Conservation Zone) process all along and proposed draft areas which cover the reef. This designation would imply consideration of the habitat within it but does not introduce any measures by default. We worked, with help from volunteers and the Wildlife Trusts to get our new survey data accepted so that it appears with same standing and prominence as existing data sets. When it comes to discussions we will have accurate evidence ready in place of the extremely inaccurate SeaMap data set which was initially the only source of seabed information.

We are pressing for the reef to be recognised as an excellent example of its habitat type and this offers the opportunity for a smaller highly protected reference zone to be established. This would allow the condition of the reef as a whole to be assessed in comparison with a control area at the heart of the reef. This is an idea which strikes some interests as threatening but many of the fishermen involved already demonstrate a keen interest in the health of their area and understand that the extra recognition could have other benefits for the area.

In fact the local potting community has a history of protecting this area with a 'no trawl' area since the turn of the 20th century. The reef appears to be in generally good condition already and recognition will most likely add to the public appeal and awareness of the North Norfolk Coast. Designation would restrain new activities within the zone through requiring consultation for development and thus protect local interests in the health of the reef.

North Norfolk's chalk reef is a spectacular habitat teeming with wildlife

The reef is a dramatic but fragile ancient geological feature

10 JNCC Biotope code descriptions

Habitats recorded underwater are processed by Seasearch data entry specialists from descriptions into the corresponding JNCC developed biotope codes, These codes represent the combination of flora, fauna and substrate as a single string of characters. This data is entered into the NBN Gateway via a database application called Marine Recorder. It remains public domain and may be browsed and queried by anyone with internet access. Greater information depth and more complex queries are possible by registering as an NBN user – which is also open to all.

National Biodiversity Network (NBN) website - www.nbn.org.uk

We have found that the existing biotope codes are no more than adequate at coding the habitats of the Southern North Sea. The codes appear to offer much greater precision for the hard rocky habitats of the South West – perhaps because of the presence of the most significant marine organisations in that region.

We also supply the raw Seasearch data to NBIS, the Norfolk record centre, to allow more flexible local exploitation of the information.

10.1 Biotope Coded Habitats (Recorded in the 2010 Surveys)

The biotope codes are period delimited combinations of abbreviations for the key characterising species or features of that biotope.

IR.MIR
Moderate energy infralittoral rock

IR.MIR.KR.XFoR
Moderately exposed rock and boulders in areas of turbid water with dense red seaweeds and without kelp. Common in the Eastern channel.

IR.HIR.KFaR.FoR
Foliose red seaweeds on exposed infralittoral rock

IR.HIR.KFaR.FoR.Dic
Moderately exposed bedrock and boulders with dense foliose red seaweeds mixed with brown seaweeds, Dictyota dichotoma and/or Dictyopteris membranacea.

IR.FIR.IFou
Wrecks/concrete/pilings/cable debris or other artificial substrata with dense seaweed covering on both vertical and upper faces.

CR.FCR.FouFa
Wrecks/concrete pilings/cable/fishing debris or other artificial substrata in the circalittoral zone

CR.FCR.FouFa.AdigMetsen
Steel wrecks typically covered in dead mens fingers (Alcyonium digitatum) plumose anemones (Metridium senile) and white striped anemones (Actinothoe sphyrodeta). These last are replaced by elegant anemones (Sagartia elegans) on the East coast.

CR.MCR.SfR
Moderately wave exposed soft rock (chalk/limestone/clay) subject to moderately strong tidal streams. Circalittoral zone may be very shallow due to turbidity. Bored by piddocks, other bivalves and worms.

CR.MCR.SfR.Pid
Soft chalk or clay with abundant piddocks (usually Pholas dactylus), and limited fauna, especially on upward facing surfaces.

CR.MCR.EcCr.UrtScr
Dahlia anemones and sand tolerant fauna such as tapered chimney sponge (Polymastia penicillus) on tideswept bedrock and cobbles adjacent to gravel and sand

Cr.HCR.XFa
Mixed faunal turf communities on circalittoral bedrock and boulders in very wave exposed situations.

CR.HCR.XFa.FluCoAs
Hornwrack and colonial ascidians on bedrock and boulders often subject to scour.May also include dead mens fingers, dahlia anemones and a variety of hydroids.

CR.HCR.XFa.FluCoAs.X
Hornwrack and hydroid turf on boulders, cobbles and pebbles often subject to scour.

CR.HCR.XFa.ByErSp
Bedrock and boulders with moderately strong tidal streams. Bryozoans include crisiids, Alcyonidium, Flustra, Pentapora and Bugula spp. Hydroids include Nemertesia and Halecium spp. Characteristic erect sponges are Raspailia ramosa, Steligera stuposa and Steligera rigida.

CR.HCR.XFa.ByErSp.sag
As above, with a dense sponge, hydroid and bryozoan turf and frequent dead mens fingers.Anemones are common including elegant anemones, dahlia anemones and plumose anemones.

SS.SBR.SMus.MytSS
Blue mussel (Mytilus edulis) beds in shallow mixed sediment often with common starfish, whelks and dahlia anemones.

SS.SBR.PoR.SspiMx
Sublittoral reefs of ross worms (Sabellaria spinulosa) on mixed sediments in a range of exposures and tidal streams.

SS.SSa
Clean medium to fine sand or slightly muddy sand in areas with some tidal current or wave action which limits silt content.

SS.SSa.IFiSa
Infralittoral fine sand either on the open coast or in tide swept channels.

SS.SSa.ImuSa.ArelSa
Infralittoral muddy sand containing lugworms (Arenicola marina) with hermit and harbour crabs, sandmasons etc.

SS.SCS
Coarse sediment (Unstable cobbles, pebbles, gravel and coarse sand)

SS.SCS.ICS
Coarse sand, gravelly sand and gravel in the infralittoral zone. Moderately exposed and subject to disturbance by wave action or tidal streams.Sandmasons may be abundant.

SS.SCS.ICS.SSh
Sparse fauna on extremely exposed or exposed clean rounded unstable pebbles and stones

SS.SCS.CCS
Tide swept coarse sand, gravel and pebbles in the circalittoral zone.

SS.SMx.CMx
Circalittoral mixed sediment containing mixed muddy gravelly sands or a poorly sorted mixture of shells, cobbles and pebbles embedded in or lying on mud.

SS.SMx.CMx.FluHyd
Hornwrack and hydroids on boulders cobbles and pebbles with gravel and sand. This is transitional between scoured rock (or wrecks) and true sediment habitats. Other hydroids, dahlia anemones, dead mens fingers and finger bryozoan may also be present.

SS.SMx.IMx.IMx
Shallow mixed sediments with various animal dominated communities and few seaweeds.

10.2 Additional Seasearch biotopes

When not enough info is present to assign a JNCC biotope from the key these Seasearch biotope codes appear as shorthand for the subject habitat.

SLA Sediment with life apparent
SAT Short animal turf on rocks
TAT Tall animal turf
MS Mixed seaweeds

11 Survey Dive Information

The following list including all the dives considered during this report and additionally those carried out in Norfolk during 2010. For drift dives, which have a start and end location, the exit point follows the start and survey information in red.

To conserve space **Rec**ord has been abbreviated and indicates either **Obs**erver or **Sur**veyor type.

Date	Site name	Position (Lat / Long) (end of drifts in Red)		BAP habitat	Seabed type	Biotope code (2010 only)	Rec
28/10/07	West Runton	52 57.208N	01 16.317	chalk	chalk reef with boulders, cobbles, gravel and sand		Obs
19/07/08	Alice Taylor wreck, Sea Palling	52 49.530N	01 39.120E	other	gravel, shell gravel, sand		Sur
02/08/08	Nubia wreck, Sea Palling	52 50.590N	01 32.030E	other	gravel, shell gravel, sand		Sur
02/08/08	Alice Taylor wreck, Sea Palling	52 49.530N	01 39.120E	sabellaria	boulders, cobbles, pebbles and sand with Sabellaria reef		Obs
17/08/08	Fulgens wreck, Sea Palling	52 49.130N	01 36.360E	sabellaria	boulders, cobbles, pebbles and sand with Sabellaria reef		Obs
23/08/08	Cley beach	52 57.968N	01 03.236E	other	boulders, cobbles and pebbles		Obs
07/09/08	Ilse wreck, Sea Palling	52 49.424N	01 39.589E	other	Cobbles, pebbles, sand and gravel		Obs
20/09/08	Weybourne gullies	52 56.945N	01 09.500E	chalk	chalk reef with boulders, cobbles, gravel and sand		Sur
20/09/08	Weybourne gullies	52 56.945N	01 09.500E	chalk	chalk reef with boulders, cobbles, gravel and sand		Obs
28/09/08	Vera wreck, Cley	52 57.965N	01 03.230E	other	Sand and gravel		Obs
28/09/08	Rosalie wreck, Weybourne	52 57.099N	01 07.995E	other	Boulders, cobbles, pebbles and sand		Obs
19/10/08	Weybourne gullies	52 57.041N	01 10.245E	chalk	chalk reef with boulders, cobbles, gravel and sand		Obs
12/06/09	Sheringham, Cliff Lane	52 56.741N	01 12.861E	chalk	chalk reef with boulders, cobbles, gravel and sand		Sur
16/06/09	Vera wreck, Cley	52 57.968N	01 03.236E	other	Cobbles, pebbles, sand and gravel		Obs
16/06/09	Vera wreck, Cley	52 57.968N	01 03.236E	other	Sand and gravel		Obs
21/06/09	Vera wreck, Cley	52 57.968N	01 03.236E	other	Cobbles, pebbles, sand and gravel		Obs
21/06/09	Sheringham Esplanade	52 56.810N	01 12.530E	chalk	chalk reef with boulders, cobbles, gravel and sand		Obs
21/06/09	Sheringham Esplanade	52 56.807N	01 12.483E	chalk	chalk reef with boulders, cobbles, gravel and sand		Sur
04/07/09	Sheringham Esplanade	52 56.799N	01 12.527E	chalk	chalk reef with boulders, cobbles, gravel and sand		Obs
04/07/09	Sheringham Esplanade	52 56.807N	01 12.483E	chalk	chalk reef with boulders, cobbles, gravel and sand		Obs
04/07/09	Sheringham Esplanade	52 56.807N	01 12.483E	chalk	chalk reef with boulders, cobbles, gravel and sand		Sur
04/07/09	Sheringham Esplanade	52 56.807N	01 12.483E	chalk	chalk reef with boulders, cobbles, gravel and sand		Sur

Date	Site name	Position (Lat / Long) (end of drifts in Red)		BAP habitat	Seabed type	Biotope code (2010 only)	Rec
05/07/09	**Sheringham Esplanade**	**52 56.799N**	**01 12.527E**	**chalk**	**chalk reef with boulders, cobbles, gravel and sand**		**Obs**
05/07/09	**Vera wreck, Cley**	**52 57.965N**	**01 03.230E**	**other**	**Sand and gravel**		**Obs**
05/07/09	**Vera wreck, Cley**	**52 57.968N**	**01 03.236E**	**other**	**Cobbles, pebbles, sand and gravel**		**Obs**
05/07/09	**Sheringham Esplanade**	**52 56.807N**	**01 12.483E**	**chalk**	**chalk reef with boulders, cobbles, gravel and sand**		**Sur**
07/07/09	**Vera wreck, Cley**	**52 57.968N**	**01 03.236E**	**other**	**Boulders, cobbles, pebbles and sand**		**Obs**
07/07/09	**Rosalie wreck, Weybourne**	**52 57.099N**	**01 07.995E**	**other**	**Cobbles, pebbles, sand and gravel**		**Obs**
01/08/09	**Rosalie wreck, Weybourne**	**52 57.101N**	**01 07.997E**	**other**	**Cobbles, pebbles, sand and gravel**		**Obs**
01/08/09	**Rosalie wreck, Weybourne**	**52 57.101N**	**01 07.997E**	**other**	**Sand and gravel**		**Obs**
01/08/09	**Rosalie wreck, Weybourne**	**52 57.099N**	**01 07.995E**	**other**	**Cobbles, pebbles, sand and gravel**		**Obs**
01/08/09	**Sheringham Esplanade**	**52 56.807N**	**01 12.483E**	**chalk**	**chalk reef with boulders, cobbles, gravel and sand**		**Obs**
01/08/09	**Sheringham Esplanade**	**52 56.832N**	**01 12.534E**	**chalk**	**chalk reef with boulders, cobbles, gravel and sand**		**Sur**
02/08/09	**Vera wreck, Cley**	**52 57.968N**	**01 03.236E**	**other**	**Cobbles, pebbles, sand and gravel**		**Obs**
08/08/09	**Vera wreck, Cley**	**52 57.968N**	**01 03.236E**	**other**	**Cobbles, pebbles, sand and gravel**		**Obs**
10/08/09	**Sheringham Esplanade**	**52 56.807N**	**01 12.483E**	**chalk**	**chalk reef with boulders, cobbles, gravel and sand**		**Obs**
10/08/09	**Rosalie wreck, Weybourne**	**52 57.099N**	**01 07.995E**	**other**	**Boulders, cobbles, pebbles and sand**		**Obs**
16/08/09	**Sheringham, Cliff Lane**	**52 56.741N**	**01 12.861E**	**chalk**	**chalk reef with boulders, cobbles, gravel and sand**		**Sur**
21/08/09	**West Runton**	**52 56.691N**	**01 15.506E**	**chalk**	**chalk reef with boulders, cobbles, gravel and sand**		**Obs**
23/08/09	**Mussel bed, Sea Palling**	**52 48.843N**	**01 35.561E**	**mussel**	**Boulders, cobbles, pebbles and sand**		**Obs**
23/08/09	**Mussel bed, Sea Palling**	**52 48.543N**	**01 35.361E**	**mussel**	**Boulders, cobbles, pebbles and sand**		**Obs**
23/08/09	**Mussel bed, Sea Palling**	**53 48.543N**	**01 35.361E**	**mussel**	**Boulders, sand, exposed clay with piddocks**		**Obs**
23/08/09	**Mussel bed, Sea Palling**	**52 48.843N**	**01 35.561E**	**mussel /clay**	**Boulders, cobbles, pebbles and sand**		**Sur**
		52 49.568N	**01 34.103E**				
27/09/09	**Ilse wreck, Sea Palling**	**52 49.424N**	**01 39.589E**	**other**	**Sand and gravel**		**Obs**
27/09/09	**Mussel bed, Sea Palling**	**52 48.882N**	**01 34.903E**	**mussel /clay**	**Boulders, sand, exposed clay with piddocks**		**Obs**
		52 48.406N	**01 35.349E**				
27/09/09	**Ilse wreck, Sea Palling**	**52 49.424N**	**01 39.589E**	**other**	**Cobbles, pebbles, sand and gravel**		**Obs**
25/04/10	Unknown wreck, Sea Palling	52 53.417N	01 44.431E	other	barren sand	CR.FCR.FouFa	Obs
01/05/10	Corchester wreck, Sea Palling	**52 55.538N**	**01 34.291E**	sabellaria	sabellaria reef on sand and gravel	CR.FCR.FouFa, SS.SBR.PoR. SspiMx	Obs

Date	Site name	Position (Lat / Long) (end of drifts in Red)		BAP habitat	Seabed type	Biotope code (2010 only)	Rec
22/05/10	Galatea wreck, Sea Palling	52 52.210N	01 54.732E	clay	sand and gravel, some exposed clay	CR.FCR.FouFa	Obs
23/05/10	STD wreck, Sea Palling	52 51.748N	01 50.629E	other	sand and gravel	CR.FCR.FouFa	Obs
06/06/10	Alice Taylor wreck, Sea Palling	52 49.379N	01 39.142E	sabellaria	sabellaria reef on sand and gravel	SS.SBR.PoR. SspiMx	Obs
23/06/10	Artemesia wreck, Sea Palling	52 51.666N	01 36.383E	other	sand and gravel	CR.FCR.FouFa, SS.SMX.CMx. FlyHyd	Sur
26/06/10	Sheringham Esplanade	52 56.799N	01 12.527E	chalk	chalk reef with boulders, cobbles and pebbles	CR.MCR.SfR	Obs
27/06/10	Vera wreck Cley	52 57.968N	01 03.236E	other	sand and gravel	IR.FCR.Ifou, SS.Ssa.IMuSa. ArelSa, IR.MIR	Obs
27/06/10	Cley drifts	52 57.953N	01 04.012E	chalk	chalk reef with overlying sand	SAT	Obs
		52 57.993N	01 03.619E				
27/06/10	Vera wreck Cley	52 57.968N	01 03.236E	other	sand with pebbles, cobbles and boulders	IR.FCR.Ifou, SS.Ssa.IMuSa. ArelSa, IR.MIR	Sur
27/06/10	Cley drifts	52 58.061N	01 03.283E	chalk/clay	exposed clay and chalk reef with boulder cobbles and pebbles	CR.MCR.SfRPid , CR.MCR.SfR	Sur
		52 58.163N	01 02.822E				
27/06/10	Cley drifts	52 58.163N	01 02.822E	chalk/clay	exposed clay and chalk reef with boulder cobbles and pebbles	CR.MCR.SfR, CR.MCR.SfR. Pid, SS.Ssa.IMuSa	Sur
		52 58.076N	01 03.182E				
27/06/10	Cley drifts	52 58.056N	01 03.649E	chalk	chalk reef with boulders, cobbles, gravel and sand	SS.Ssa.IMuSa, IR.MIR, CR.MCR.SfR	Sur
		52 58.023N	01 03.735E				
27/06/10	Vera wreck Cley	52 57.965N	01 03.230E	other	sand and gravel	IR.FIR.Ifou, SS.Ssa.IMuSa. ArelSa, IR.MIR	Obs
27/06/10	Rosalie wreck, Weybourne	52 57.101N	01 07.997E	other	sand and gravel	CR.FCR.FouFa. AdigMetsen	Obs
27/06/10	Cley drifts	52 58.061N	01 03.283E	chalk/clay	chalk reef with overlying sand and exposed clay	CR.MCR.SfRPid ,CR.MCR.SfR	Sur
		52 58.163N	01 02.822E				
27/06/10	Cley drifts	52 58.159N	01 03.206E	clay	sand and gravel with exposed clay	SLA	Sur
		52 58.127N	01 03.029E				
27/06/10	Vera wreck Cley	52 57.968N	01 03.236E	other	sand and gravel	IR.FCR.Ifou, SS.Ssa.IMuSa. ArelSa, IR.MIR	Sur
02/07/10	Vera wreck Cley	52 57.765N	01 03.230E	other	sand with pebbles, cobbles and boulders	SAT	Obs
03/07/10	East Runton beach	52 56.253N	01 16.478E	chalk	chalk reef with overlying sand	SS.SSa.IMuSa. ArelSa, IR.HIR.KFaR. FoR.Dic, CR.MCR.SfR	Sur
04/07/10	East Runton drifts	52 56.850N	01 16.103E	chalk	chalk reef with boulders, cobbles, gravel and sand	CR.HCR.Xfa, IR.MIR, SS.SCS.ICS	Obs
		52 56.852N	01 16.351E				

Date	Site name	Position (Lat / Long) (end of drifts in Red)		BAP habitat	Seabed type	Biotope code (2010 only)	Rec
04/07/10	East Runton drifts	52 56.677N	01 17.138E	chalk/clay	exposed clay and chalk reef with boulder cobbles and pebbles	CR.MCR.SfR	Obs
		52 56.579N	01 17.685E				
04/07/10	East Runton drifts	52 56.507N	01 17.294E	chalk	chalk reef with boulders, cobbles, gravel and sand	CR.MCR.SfR	Obs
		52 56.476N	01 17.659				
04/07/10	East Runton drifts	52 56.569N	01 18.101E	chalk	chalk reef with boulders, cobbles, gravel and sand	CR.HCR.Xfa.By ErSp, CR.MCR.SfR	Sur
		52 56.515N	01 18.540E				
04/07/10	East Runton drifts	52 56.515N	01 18.540E	chalk	chalk reef with boulders, cobbles, gravel and sand	IR.MIR.KR. XFoR, SS.SMx.IMx, IR.MIR	Sur
		52 56.413N	01 18.778E				
04/07/10	East Runton drifts	52 56.850N	01 16.103E	chalk	chalk reef with boulders, cobbles, gravel and sand	CR.HCR.Xfa, IR.MIR, SS.SCS.ICS	Sur
		52 56.852N	01 16.351E				
04/07/10	Fulgens wreck, Sea Palling	52 49.130N	01 36.360E	other	sand and rock (?)	IR.FIR.Ifou	Obs
06/07/10	Ethel wreck Sea Palling	52 53.740N	01 31.689E	other	sand and gravel	CR.FCR.FouFa. AdigMsen	Obs
09/07/10	Rosalie wreck, Weybourne	52 57.099N	01 07.995E	other	sand and gravel	CR.FCR.FouFa	Obs
10/07/10	Vera wreck Cley	52 57.968N	01 03.236E	other	sand and gravel	IR.FIR.Ifou	Obs
10/07/10	Vera wreck Cley	52 57.968N	01 03.236E	other	sand and gravel	IR.FIR.Ifou	Obs
10/07/10	Vera wreck Cley	52 57.968N	01 03.236E	other	sand and gravel	IR.FIR.Ifou	Obs
10/07/10	Vera wreck Cley	52 57.965N	01 03.230E	other	sand and gravel	IR.FIR.Ifou	Obs
10/07/10	Rosalie wreck, Weybourne	52 57.099N	01 07.995E	other	sand and gravel	IR.FIR.Ifou	Obs
11/07/10	Sheringham Esplanade	52 56.799N	01 12.527E	chalk	chalk reef with boulders, cobbles, gravel and sand	IR.FIR.Ifou	Obs
11/07/10	Sheringham Esplanade	52 56.791N	01 12.525E	chalk	chalk reef with boulders, cobbles, gravel and sand	IR.FIR.Ifou	Obs
11/07/10	Sheringham Esplanade	52 56.791N	01 12.525E	chalk	chalk reef with boulders, cobbles, gravel and sand	IR.FIR.Ifou	Obs
11/07/10	Sheringham Esplanade	52 56.791N	01 12.525E	chalk	chalk reef with boulders, cobbles, gravel and sand	IR.FIR.Ifou	Obs
11/07/10	Sheringham Esplanade	52 56.803N	01 12.525E	chalk	chalk reef with boulders, cobbles, gravel and sand	MS	Obs
11/07/10	Fulgens wreck, Sea Palling	52 49.130N	01 36.360E	other	sand and gravel	CR.FCR.FouFa. AdigMsen	Obs
11/07/10	Sheringham Esplanade	52 56.799N	01 12.527E	chalk	chalk reef with boulders, cobbles and pebbles	IR.FIR.Ifou	Obs
11/07/10	Sheringham Esplanade	52 56.799N	01 12.527E	chalk	chalk reef with boulders, cobbles, gravel and sand	IR.FIR.Ifou	Obs
17/07/10	Clansman wreck, Sea Palling	52 51.160N	01 35.770E	other	sand and gravel with broken shells	CR.FCR.FouFa. AdigMsen, SS.SMx.CMx	Sur
17/07/10	Mussel bed, Sea Palling	52 49.851N	01 33.861E	mussel	Mussel bed over gravel and boulders	SS.SCS, CR.HCR.Xfa. FluCoAsSmAs, SS.SBR.Smus. MytSS	Sur

Date	Site name	Position (Lat / Long) (end of drifts in Red)		BAP habitat	Seabed type	Biotope code (2010 only)	Rec
		52 49.329N	01 34.880E				
17/07/10	Clansman wreck, Sea Palling	52 51.160N	01 35.770E	other	sand and gravel	CR.FCR.FouFa. AdigMsen, SS.SMx.CMx	Obs
17/07/10	Mussel bed, Sea Palling	52 49.851N	01 33.861E	mussel	Mussel bed over gravel and boulders	SS.SMx.CMx. FlyHyd, SS.SBR.Smus. MytSS	Obs
		52 49.329N	01 34.880E				
17/07/10	Mussel bed, Sea Palling	52 49.850N	01 33.860E	other	cobbles, pebbles, sand and gravel	SS.SCS.CCS	Obs
		52 49.320N	01 34.920E				
18/07/10	Vera wreck Cley	52 57.968N	01 03.236E	other	sand and gravel	IR.FIR.Ifou	Obs
19/07/10	East Runton beach	52 56.389N	01 16.149E	chalk	chalk reef with overlying sand	IR.HIR.KFaR. FoR	Obs
19/07/10	East Runton drifts	52 56.997N	01 13.788E	chalk	chalk reef with boulders, cobbles, gravel and sand	IR.MIR.KR. XFoR, SS.SCS.ICS. SSh	Obs
		52 56.997N	01 13.791E				
19/07/10	East Runton drifts	52 56.966N	01 13.109E	chalk	chalk reef with gullies, boulders and cobbles	IR.HIR.KFaR. FoR.Dic, CR.MCR.SfR	Obs
		52.56 968N	01 13.112E				
19/07/10	East Runton beach	52 56.259N	01 16.482E	chalk	chalk reef with boulders, cobbles, sand and gravel	IR.HIR.KFaR. FoR	Obs
19/07/10	East Runton drifts	52 56.878N	01 13.604E	chalk	chalk reef with boulders	IR.HIR.KFaR. FoR	Obs
		52 56.853N	01 13.937E				
19/07/10	East Runton drifts	52 56.931N	01 14.569E		chalk reef with gullies, boulders and cobbles	IR.HIR.KFaR. FoR	Obs
		52 56.860N	01 14.995E				
19/07/10	East Runton drifts	52 56.997N	01 13.788E	chalk	chalk reef with boulders, cobbles, gravel and sand	IR.MIR.KR. XFoR, SS.SCS.ICS. SSh	Sur
		52 56.969N	01 14.168E				
19/07/10	East Runton drifts	52 56.966N	01 13.109E	chalk	chalk reef with very few boulders. Very rugged.	IR.HIR.KFaR. FoR.Dic, CR.MCR.SfR	Sur
		52 56.937N	01 13.198E				
20/07/10	Rosalie wreck, Weybourne	52 57.099N	01 07.995E	other	sand and gravel	IR.FIR.Ifou, SS.Ssa.IMuSa. ArelSa, SS.SMx.CMx	Sur
20/07/10	Rosalie wreck, Weybourne	52 57.099N	01 07.995E	other	sand and gravel	CR.FCR.FouFa. AdigMetsen	Obs
21/07/10	Sheringham Esplanade	52 56.799N	01 12.527E	chalk	chalk cobbles, boulders and reef with sand patches	IR.HIR.KFaR. FoR.Dic, IR.HIR.KFoR, CR.MCR.SfR	Obs
21/07/10	Sheringham Cliff Road	52 56.741N	01 12.860E	chalk	chalk reef with overlying sand	IR.FIR.Ifou, CR.MCR.SfR	Obs

Date	Site name	Position (Lat / Long) (end of drifts in Red)		BAP habitat	Seabed type	Biotope code (2010 only)	Rec
21/07/10	Sheringham Esplanade	52 56.807N	01 12.483E	chalk	chalk reef with gullies, boulders and cobbles	IR.HIR.KFaR. FoR.Dic, IR.HIR.KFoR, CR.MCR.SfR	Sur
21/07/10	Sheringham Esplanade	52 56.799N	01 12.527E	chalk	chalk reef with boulders, cobbles, sand and gravel	IR.HIR.KFaR. FoR.Dic, IR.HIR.KFoR, CR.MCR.SfR	Sur
21/07/10	Sheringham Cliff Road	52 56.741N	01 12.860E	chalk	chalk reef with overlying sand	IR.FIR.Ifou, CR.MCR.SfR	Sur
22/07/10	Sheringham drifts	52 57.381N	01 12.363E	chalk	chalk cobbles and boulders on sand	CR.MCR.EcCr.UrtScr, CR.HCR.Xfa. ByErSp.Sag, CR.MCR.SfR	Sur
		52 57.323N	01 11.576E				
22/07/10	Sheringham drifts	52 57.015N	01 12.555E	chalk	chalk plain with ridges, cobbles and boulders	IR.HIR.KFaR.FoR,IR.HIR.KFaR. FoR.Dic	Sur
		52 56.945N	01 13.033E				
22/07/10	Sheringham drifts	52 57.438N	01 12.449E	other	sand with pebbles, cobbles and boulders	SLA	Obs
		52 57.412N	01 12.150E				
22/07/10	Sheringham drifts	52 57.315N	01 12.076E	other	sand with pebbles, cobbles and boulders	TAT	Obs
		52 57.337N	01 11.844E				
22/07/10	Sheringham drifts	52 57.029N	01 12.515E	chalk	chalk reef with gullies, boulders and cobbles	Cr.MCR.SfR	Obs
		52 56.994N	01 12.592				
22/07/10	Sheringham drifts	52 57.381N	01 12.363E	other	sand with pebbles, cobbles and boulders	CR.MCR.EcCr. UrtScr, CR.HCR.Xfa.ByErSp.Sag, CR.MCR.SfR	Sur
		52 57.323N	01 11.576E				
22/07/10	Sheringham drifts	52 57.027N	01 12.512E	chalk	chalk gullies with boulders, cobbles and gravel	CR.MCR.SfR	Obs
		52 57.009N	01 12.983E				
22/07/10	Sheringham drifts	52 57.026N	01 12.641E	chalk	chalk gullies with boulders, cobbles and gravel	CR.MCR.SfR	Obs
		52 57.015N	01 12.555				
28/07/10	Corchester wreck, Sea Palling	52 55.538N	01 34.291E	other	sand and gravel	CR.FCR.FouFa. AdigMetsen	Sur
31/07/10	Aberhill wreck, Sea Palling	52 54.924N	01 43.863E	other	barren sand	SS.SSA.CFiSa, CR.FCR.FouFa, CR.FCR.FouFa. AdigMetsen	Obs
31/07/10	Aberhill wreck, Sea Palling	52 54.924N	01 43.863E	other	barren sand	SS.SSA.CFiSa, CR.FCR.FouFa, CR.FCR.FouFa. AdigMetsen	Obs
31/07/10	Aberhill wreck, Sea Palling	52 54.924N	01 43.863E	other	barren sand	SS.SSA.CFiSa, CR.FCR.FouFa, CR.FCR.FouFa. AdigMetsen	Sur
01/08/10	Rosalie wreck, Weybourne	52 57.101N	01 07.997E	other	sand and gravel	CR.FCR.FouFa. AdigMetsen	Obs

Date	Site name	Position (Lat / Long) (end of drifts in Red)		BAP habitat	Seabed type	Biotope code (2010 only)	Rec
04/08/10	Rosalie wreck, Weybourne	52 57.099N	01 07.995E	other	sand and gravel	CR.FCR.FouFa. AdigMetsen	Obs
06/08/10	Fulgens wreck, Sea Palling	52 49.130N	01 36.360E	other	sand and gravel	CR.FCR.FouFa	Obs
12/08/10	Sheringham Esplanade	52 56.799N	01 12.527E	chalk	chalk cobbles, boulders and reef with sand patches	IR.HIR.KFaR. FoR.Dic, IR.HIR.KFoR	Sur
12/08/10	Sheringham Esplanade	52 56.799N	01 12.527E	chalk	chalk reef with boulders, cobbles, gravel and sand	IR.HIR.KFaR. FoR.Dic, IR.HIR.KFoR	Obs
12/08/10	Sheringham Esplanade	52 56.799N	01 12.527E	chalk	chalk reef with boulders, cobbles and pebbles	IR.HIR.KFaR. FoR.Dic, IR.HIR. KFoR	Sur
12/09/10	Artemesia wreck, Sea Palling	52 51.700N	01 36.290E	sabellaria	Wreck on Sabellaria, sand and gravel	CR.FCR.FouFa, SS.SBR.PoR.Ss piMx	Obs
22/09/10	Trimingham shore	52 53.480N	01 24.919E	chalk	Chalk reef	SS.SSA.IMuSa. ArelSa, CR.MCR.SfR. Pid	Obs
22/09/10	Trimingham shore	52 53.480N	01 24.919E	chalk	chalk reef with sand	SS.SSA.IMuSa. ArelSa, CR.MCR.SfR. Pid	Sur
22/09/10	Trimingham shore	52 53.480N	01 24.919E	chalk	chalk reef with sand	SS.SSA.IMuSa. ArelSa, CR.MCR.SfR. Pid	Sur
23/09/10	Trimingham drift	52 54.341N	01 23.556E	chalk/clay	chalk reef and exposed clay	IR.MIR.KR.XFo R, CR.MCR.SfR. Pid	Sur
		52 54.756N	01 22.711E				
23/09/10	Trimingham drift	52 53.931N	01 25.135E	clay	exposed clay with sand and flints	SS.Ssa.IFiSa.IM uSa,CR.MCR, CR.MCR.SfR. Pid	Sur
		52 54.172N	01 24.585E				
23/09/10	Trimingham drift	52 53.810N	01 25.458E	other	sand	SS.Ssa.IFiSa, IR.HIR.KFaR. FoR	Sur
		52 53.806N	01 25.292E				
23/09/10	Trimingham drift	52 54.036N	01 24.377E	chalk/clay	chalk, exposed clay and sand	Cr.MCR, CR.MCR.SfR. Pid	Sur
		52 54.365N	01 23.379E				
23/09/10	Trimingham drift	52 53.807N	01 25.424E	other	Fine sand and cobbles	SLA	Obs
		52 53.924N	01 25.201E				
23/09/10	Trimingham drift	52 53.822N	01 24.776E	chalk/clay	Exposed clay with chalk and sand	CR.MCR.SfR. Pid	Obs
		52 54.044N	01 24.291E				

12 Seasearch East species list 2010

A complete list of the animals recorded during the 2010 Survey. Location and abundance information is available online through the NBN Gateway.

12.1 Sponges

Scypha ciliata
Halichondria panicea
Haliclona oculata
Dysidea fragilis
Amphilectus fucorum
Cliona ciliata
Leucosolenia spp
Oscarella lobularis
Steligera rigida
Haliclona cinerea
Clathrina coriacea
Suberites ficus
Poymastia penicillus
Unknown purple crust
Grantia compressa

12.2 Cnidarians

Feathery hydroids
Nemertesia antenina
Nemertesia ramosa
Tubularia indivisa
Tubularia larynx
Hydractinia echinata
Corynidae hydroids
Unknown Obelia spp
Metridium senile
Sagartia elegans
Sagartia troglodytes
Sagartiogeton laceratus
Actinia equinus
Urtica felina
Actinia fragaria
Diadumene cincta
Alcyonium digitatum
Pleurobrachia pileus
Auralia aurita

12.3 Worms

Pomatoceros spp
Lanice conchilega
Sabella pavonina
Cirratulus cirratus
unknown 'bootlace'
Filograna implexa
Salmacina dysteri
Polydora ciliata
unknown scaleworm
Serpula vermicularis
lugworm casts
Sabellaria spinulosa

12.4 Crustaceans

Barnacle spp
Jassa falcata
Unknown tube amphipod
Unknown amphipod in Tubularia
Caprella spp
Idotea spp
Crangon crangon
Palaemon serratus
Pandalus montagui
Mysid spp
Galathea squamifera
Pagurus bernhardus
Pagurus spp
Homarus gammarus
Cancer pagurus
Liocarcinus depurator
Necora puber
Carcinus maenas
Hyas araneus
Inachus spp
Macropodia spp
Ebalia tumefacta
Hyas coarctus

12.5 Molluscs

Patella spp
Calliostoma zizyphinum
Buccinum undatum
Crepidula fornicata
Chiton spp
Gibula cineraria
Nucella lapillus
Ocenebra erinacea
Janolus cristatus
Flabellina pedata
Onchidoris bilamellata
Acanthodoris pilosa
Ancula gibbosa
Doto coronata
Dendronotus frondosus
Catriona gymnota
Aeolidia papillosa
Eubranchus tricolor
Eubranchus pallidus
Cadlina laevis
Archidoris pseudoargus
Aeolidia sanguinia
Facelina auriculata
Goniodoris nodosa
Tritonia hombergi
Coryphella lineata
Modiolus modiolus
Mytillus edulis
Pholas dactylus
Alloteuthis subulata

12.6 Bryozoans

Flustra foliacea
Bugula spp
Electra pilosa
Alcyonidium diaphanum
Cellopora pumicosa
Crisia spp
Bugula purpurotincta
unknown branching
Securiflustra securifrons

12.7 Echinoderms

Asterias rubens
Crossaster papposus
Ophiura spp
Ophiura albida
Henricia spp
Ophiothrix fragilis

12.8 Sea squirts

Clavelina lepadiformis
Didemnum maculosum
Botryllus schlosseri
Botrylloides leachi
Diplosoma spongiforme
Diplosoma listeri
Distaplia rosea
Perophora japonica
Morchellium argus
unknown white solitary
Pycnoclavella stolonialis
Styella clava
Ciona intestinalis
Unknown cream solitary
Molgula spp
Sidnyum turbinatum

12.9 Fish

Anguilla anguilla
Callionymus lyra
Liparis liparis
Taurulus bubalis
Pomatoschistus minutus
Ammodytes marinus
Ammodytes tobianus
Pholis gunnelis
Crenilaris melops
Chelon labrosus
Ctenolabrus rupestris
Symphodus melops
Labrus bergylta
Gobiusculus flavescens
Trisopterus luscus
Trisopterus minutus
Echiicthys vipera
Syngnathus acus
Thorogobbius ephippiatus
Dicentrarchus labrax
Pleuronectes platessa
Platichthys flesus
Myxocephalus scorpius
Gadus morhua

12.10 Algae

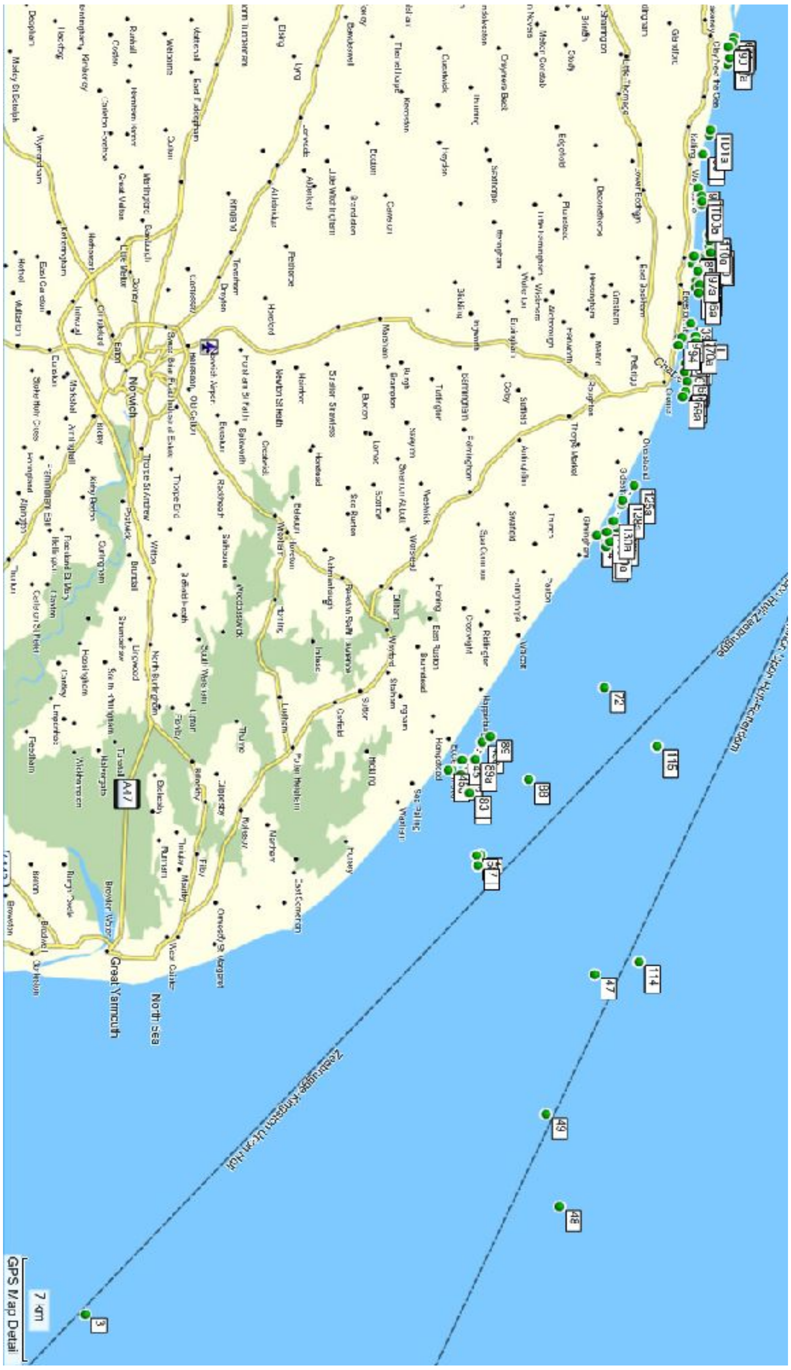
Ulva lactuca
Ulva linza
Bryopsis plumosa
Dictyota membranacea
Dictyota dichotoma
Osmundea spp
Fucus serratus
Pink encrusting
Corallina officianalis
Chondrus crispus
Palmaria palmata
Polysiphonia spp
Polyides rotundus
Plocamium cartilaginum
Caliblepharis ciliata
Drachiella spectabilis
Cladophora rupestris
Laurencia obtusa
Furcellaria lumbricalis

12.11 Total Species Counts

Sponges	15
Cnidarians	19
Worms	12
Crustaceans	23
Molluscs	30
Bryozoans	9
Echinoderms	6
Sea squirts	16
Fish	24
Algae	19
Total	**173**

13 Dive positions and paths

13.1 Seasearch chalk dives plus all 2010 Norfolk dives



Seasearch East – 2010 Norfolk dives plus those conducted in the chalk survey area from previous years.

13.2 Seasearch dives in the chalk survey area 2007-2010

Seasearch East - Dives in the chalk survey area

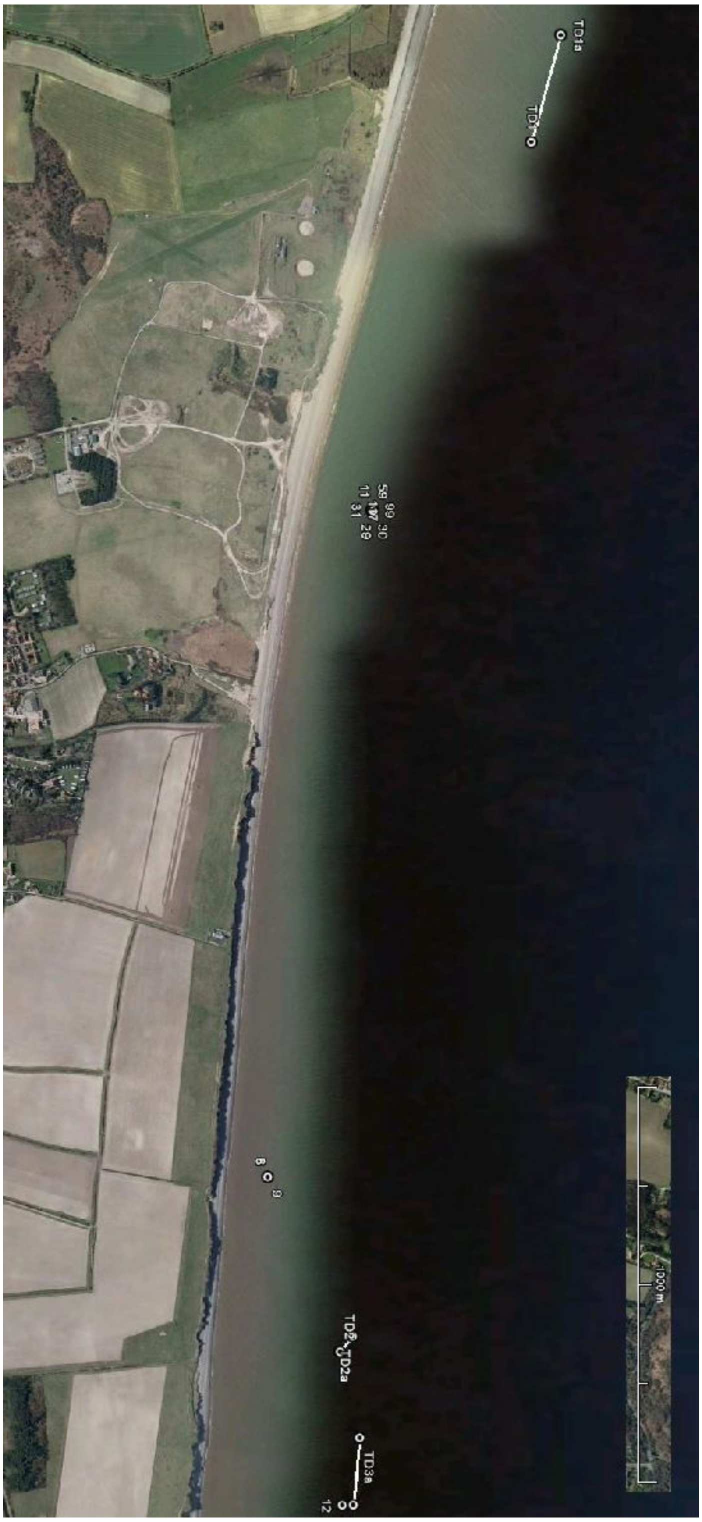
13.3 Dives near Cley - in context, Blakeney to Weybourne

Seasearch East – dive positions and paths around Cley, location context

13.4 Dives near Cley – close up

Seasearch East – dive positions and paths near Cley, local detail

13.5 Dives near Weybourne

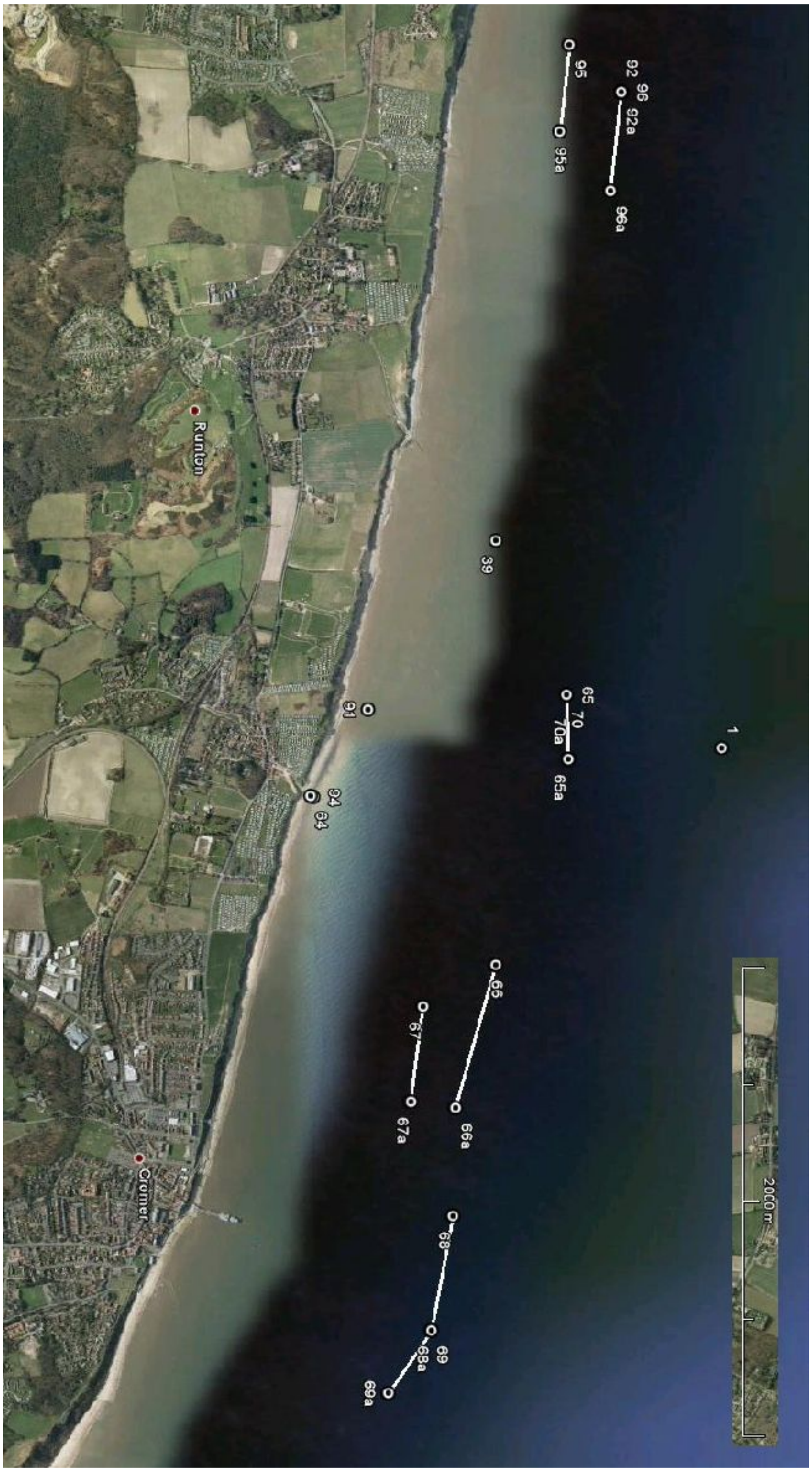


Seasearch East – dive positions and paths around Weybourne

13.6 Dives near Sheringham

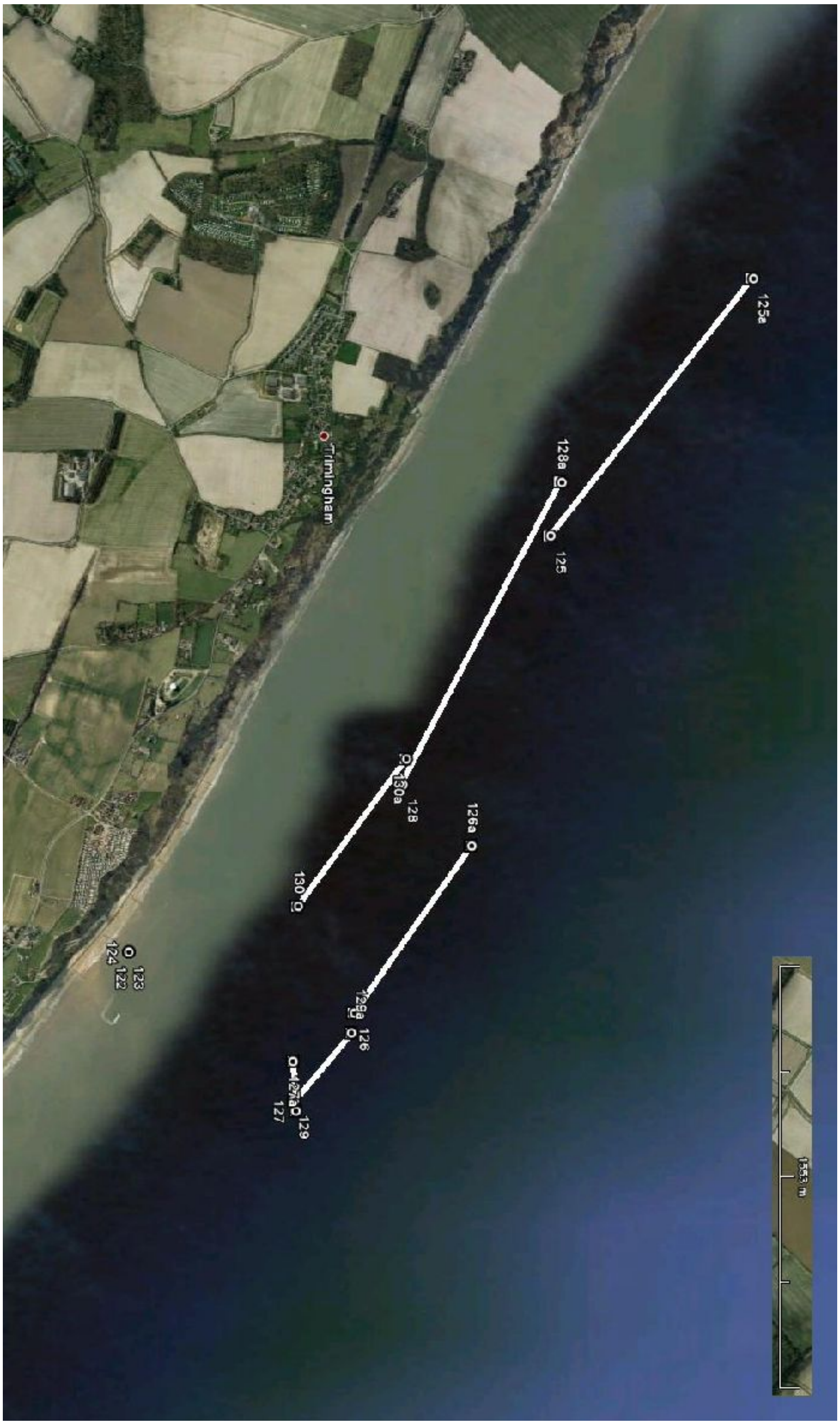
Seasearch East – dive positions and paths around Sheringham

13.7 Dives from Beeston Regis to Cromer



Seasearch East – dive positions and paths between Beeston Regis and Cromer

13.8 Dives near Trimingham



Seasearch East – dive positions and paths around Trimingham

14 Additional Information

Images of cocoliths (chalk forming phytoplankton):
INA - The International Nanoplankton Association
http://www.nhm.ac.uk/hosted_sites/ina/
http://www.nhm.ac.uk/hosted_sites/ina/terminology/3coccoliths.htm

Public access to Seasearch records:
National Biodiversity Network (NBN) website - www.nbn.org.uk

Background to Norfolk's geology:
Norfolk's Earth Heritage - valuing our geodiversity
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15 Seasearch Steering Group

Seasearch is co-ordinated by the Marine Conservation Society on behalf of the Seasearch Steering Group which comprises the Marine Conservation Society, Wildlife Trusts, Joint Nature Conservation Committee, Natural England, Countryside Council for Wales, Scottish Natural Heritage, Environment and Heritage Service Northern Ireland, Environment Agency, Marine Biological Association, Nautical Archaeological Society, British Sub Aqua Club, Sub Aqua Association, Professional Association of Diving Instructors, Scottish Sub Aqua Club, Irish Underwater Council and independent marine life experts.

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