

AIR, LAND AND SEA: AN INTEGRATED APPROACH TO ENGLAND'S COASTAL HERITAGE

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Abstract: Management of the coast of England involves many parties with interests in the natural and historic environment, as well as those with commercial interests. English Heritage has developed a policy and guidelines for the heritage aspects of the coast and undertakes and promotes survey work to provide the data to allow informed decisions to be made about how to manage the coast. This discussion illustrated the way in which aerial survey is used as part of that process.

The coast of England is varied in structure, appearance, history and fragility and any response to the study and management of the coastal heritage must take into account these variations. The techniques used to help understand coastal heritage need to be tailored to fit the specific needs of certain areas, and similarly the response to coastal management must be equally varied and pragmatic.

English Heritage is only one of the UK government bodies involved with coastal studies and management in England. The Department for Environment, Food and Rural Affairs (Defra) is responsible for the management of flooding and coastal erosion. Defra provides funding to the Environment Agency and local authorities to carry out the necessary work to maintain England's coast. Bodies such as Natural England (formerly English Nature) have had a strong input on policies to protect or enhance the natural environment whilst English Heritage formulates the policy for the coastal heritage and provides guidance both at a strategic

and a practical level. English Heritage also commissions and undertakes research to improve understanding and conservation of historical remains in the coastal zone.

Managing the coast

Those studying coastal processes have provided a structure that can be used to aid study and management based on identified patterns of erosion and deposition termed 'sediment transport cells' and sub-cells. There are 49 cells and sub-cells around the coast of England and these are used as the basic units for Shoreline Management Plans, the key documents that define how the coast can realistically be managed. The first stage is identification of the key elements of a given stretch of coastline and a definition of the importance of these elements in terms of the benefits they provide for nature conservation, landscape character, human environment (including current and future land-use) and heritage. Following this a Shoreline Management Plan provides '*a large-scale assessment of the risks associated with coastal processes*' and presents '*a policy framework to reduce these risks to people and the developed, historic and natural environment in a sustainable manner*' (Defra, June 2001). Within each unit decisions are made to define one of five possible options for each stretch of coast.

- Hold the line
- Advance the line
- Managed realignment
- Limited intervention
- No active intervention.

In order to inform these decisions English Heritage has been actively encouraging survey and research on coastal heritage for many years (English Heritage 1996).

Understanding Coastal Heritage

English Heritage's strategy for making our past part of our future is to create a cycle of understanding, valuing, caring and enjoying.

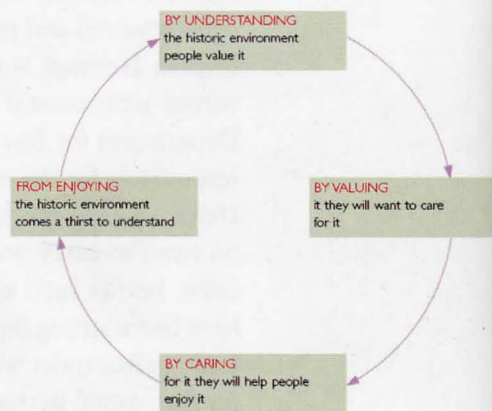


Figure 1. The Heritage Cycle

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As a statement of national strategy and to inform those concerned with coastal management, English Heritage has published a guidance note on *Coastal Defence and the Historic Environment* (English Heritage 2003). Underpinning any management plan to ensure the best possible future for the coast must be an understanding not only of the processes of erosion and deposition that affect coastal landscapes but also of the range, quality and value of the historic environment in this zone. Therefore, taking as a starting point this need for Understanding, English Heritage has developed with partners a series of Rapid Coastal Zone Assessment Surveys. These provide the basic data and interpretation of the historic resource to provide the understanding to allow value judgments to be made. The basic process is in two stages. Phase 1 is a *desk-based assessment* that gathers information from existing Historic Environment Records, including the National Monuments Record and local sources, but also involves the identification and mapping of new information from historic maps and the interpretation of aerial photographs. Phase 2 is the *field assessment* in the form of a rapid walk-over survey verifying features noted in Phase 1, identifying new features not identified in Phase 1 and also assessing significance and vulnerability. Sites identified as significant and at risk may subsequently be recorded in more detail.

Figure 2. Tintagel Castle, Cornwall, UK. The legendary home of King Arthur. The ruins stand above dramatic sheer cliffs formed of hard rocks where erosion is a relatively slow process. (NMR18251_12, © Crown Copyright.)



Uses of Aerial Photography in the Coastal Zone

Aerial photographs have a wide application in the management and understanding of coastal environments and are well used by

those involved with both the historic and natural aspects of the environment.

The simple illustrative value of aerial photography should not be underestimated as a vital tool in aiding both management and understanding. A single image can capture the drama, beauty or fragility of the coastal heritage in a unique way that can help to enthuse and inform a wider au-



Figure 3. Blackpool, Lancashire, UK. Pleasure Piers and Towers were all part of the nineteenth-century seaside experience. (NMR17760_2, © English Heritage.)

dience. Aerial photographs can be used to identify features that are difficult (or dangerous) to record in any other way. They also serve to encourage the researcher to look at the wider landscape and to gain a fuller understanding of an individual site in its broader context.

The standing built heritage should also be considered and English Heritage has recently been looking at the architectural heritage of seaside towns. Aerial photographs were used to assist both the survey process and the illustration of the final volume (Williams 2005).

Historical aerial photography is a valuable source of information on landscape change. In England there is comprehensive coverage of the whole coast dating back at least fifty years. A simple visual comparison of photographs taken fifty years apart can dramatically demonstrate the threat to the historic record provided by coastal structures.

However, one of the greatest values of aerial photography can only be realised through careful photo interpretation, leading to the accurate recording of archaeological sites and landscapes and the discovery of many

Figure 4. Coastal gun battery, Kilnsea, East Riding of Yorkshire, UK. This battery, built during the First World War, was originally 90m from the cliff face. The coast of East Yorkshire is the most rapidly eroding coast of England, with about 2m lost every year. It is currently the subject of a National Mapping Programme project as part of a Rapid Coastal Zone Assessment Survey. (NMR17429_22, © English Heritage.)



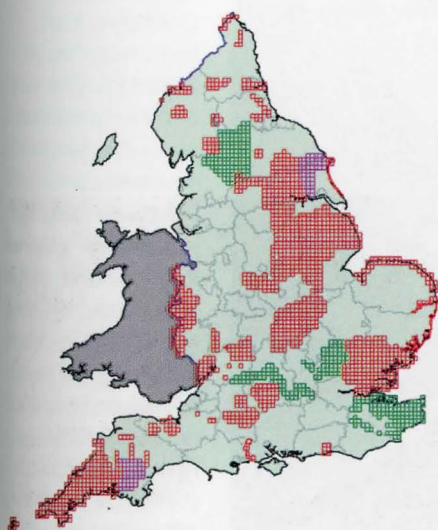
Figure 5. Heritage Mapping Programme. This battery, built during the First World War, was originally 90m from the cliff face. The coast of East Yorkshire is the most rapidly eroding coast of England, with about 2m lost every year. It is currently the subject of a National Mapping Programme project as part of a Rapid Coastal Zone Assessment Survey. (NMR17429_22, © English Heritage.)

previously unknown sites. As part of Phase 1 of the Rapid Coastal Zone Assessment Survey different methodologies have been tried for the use of aerial photographs, for example using single sources of photographs rapidly assessed for new sites, but the methodology adopted by the National Mapping Programme has proved the most valuable.

English Heritage's National Mapping Programme

The National Mapping Programme (NMP) is a series of linked projects aiming to produce a base-level map of all archaeological features in England that are visible on aerial photographs (Bewley 2001, 2002, 2003). The coast has become an important element in NMP and is now one of the major priorities as the value of the work undertaken has been confirmed. All readily available photographs are carefully examined, stereoscopically where possible, and the archaeological features are mapped and recorded in a standardized way, in a GIS format. Photographs are sourced from the National Monuments Record (English Heritage's own archive, which holds 700,000 oblique aerial photographs and over 2 million vertical photographs) along with the collection held by the Unit for Landscape Modelling at Cambridge University and any other local sources with a relevant collection.

Figure 5. The English Heritage National Mapping Programme (NMP) has so far covered 34% of the country and has specifically targeted some of the most active coasts on the east of England.



NMP projects are normally targeted to large areas, as this ensures the most effective use of resources, particularly in handling the thousands of oblique and vertical photographs that are available. Where projects were already in place, as in the county of Norfolk in Eastern England, the order of mapping of the project was changed to provide information for the Rapid Coastal Zone Assessment Survey, but the mapping unit remained the 5km x 5km block that is the usual standard for NMP. Other projects specifically designed to support the Survey have looked at only a narrow corridor of 1km inland from

the coast, providing a minimal context for recording the sites. Projects record all features visible on aerial photographs on the shore and inter-tidal zone and occasionally slightly beyond (eg: when wrecks are visible in clear water).

Analysis of the photography reveals an amazing range of archaeological features, of all periods. Sometimes the features are directly related to exploiting coastal resources and management whilst others may relate to past land-use where a coastal location had no bearing (and due to a change in the coastline the sites may not have originally been on the coast). Since earliest times the coast has been exploited for fishing, and fish traps dated to the early medieval period and later have been identified and recorded through aerial photography, most notably in Essex in the east and the Severn Estuary in the west. These mainly take the form of extensive V-shaped traps constructed of posts, wattle panels or stonework which work by funnelling the fish into the apex of the trap as the tide goes out.

Salt has been extracted over a long period using a variety of techniques and has left widespread evidence. The exploitation of salt in the Roman period in Essex is characterised by a process that leaves a red mound of burnt material that can be identi-



Figure 6. Fish trap, Cleethorpes, North-East Lincolnshire, UK. This tidal fish trap is of a type known in other parts of England that have been dated back into the early medieval period. Identified from the air, this was the first to be discovered in the Humber Estuary; it lies near Grimsby, a major fishing centre of the nineteenth and early twentieth centuries. (NMR17116_23, © English Heritage.)

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Figure 7. Salt-processing mounds near Marshchapel, Lincolnshire, UK. The irregular-shaped mounds, seen here as earthworks and cropmarks, result from the deposition of large quantities of shoreline silt from which salt has been extracted in the late medieval period. This extract from an RAF vertical photograph taken in 1946 reveals detail of the various water channels and processing structures in an area then surviving under pasture. Since the photograph was taken all these sites have come under the plough, obliterating this sort of detail. (RAF CPE_UK_1746 5013, 21-Sep-1946, NMR.RAF collection, © Crown copyright.)

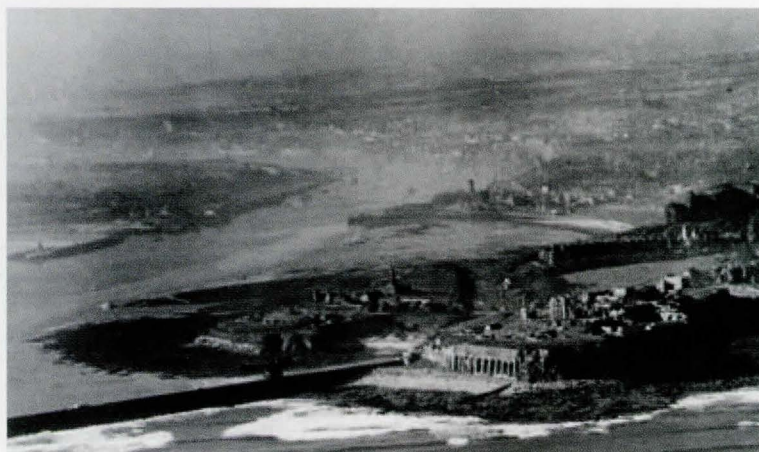


fied through aerial reconnaissance; recent work has doubled the number of these so-called 'Red Hills' in Essex and has extended the pattern of distribution into southern Suffolk. The medieval industry in Lincolnshire left even more extensive remains and resulted in large areas of land being reclaimed (Grady 1998).

Much of the coastal heritage of England is related to defence, making the photography taken by the Royal Air Force during the

Figure 8. Tynemouth Priory, Tyneside, UK, 21 October 1941.

This military oblique photograph is one of thousands showing the coastal defences of England during the Second World War. The black dots are barrage balloons, not photo blemishes. (NZ3769_64_MS031272_PO046, NMR RAF collection. © Crown copyright.)



Second World War and immediately afterwards an extremely valuable resource. Not only does this photography reveal the landscape as it appeared before the massive mechanisation of agriculture that has occurred in the second half of the twentieth century, it often shows military sites still in active use, with much detail that has since been lost. Military aerial photography such as this exists for much of Europe and is a vital aid to research into the historic environment.

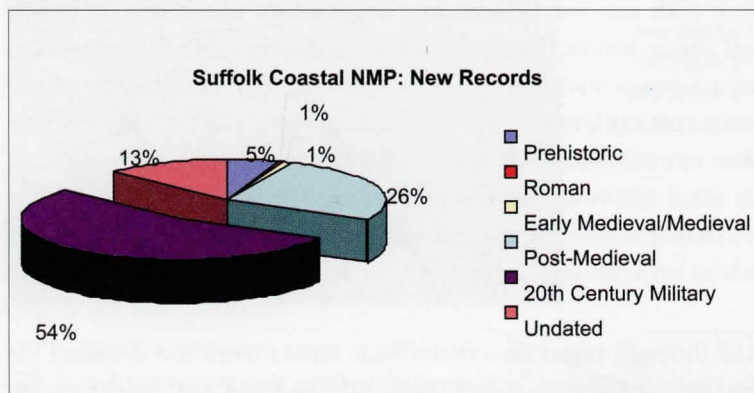


Figure 9. Records created through the NMP project on the Suffolk coast of Eastern England were particularly important in documenting twentieth-century military activity.

More than half of the sites recorded by NMP projects have not previously been recorded and this has had a dramatic effect on archaeologists' ability to understand and manage the heritage of the coastal zone. One third of the coast of England has already been mapped and projects are currently underway or in the detailed planning stage to complete the mapping of the East coast. Other projects will follow.

Special sites – two case studies

Air photo interpretation is a valuable tool for archaeological survey and for providing the necessary base information for the development of shoreline management plans. However, some site and landscape areas require more detailed research, either solely because of their heritage value or because they are under threat from erosion by the sea or will be damaged by the building of coastal defence works. Aerial survey still

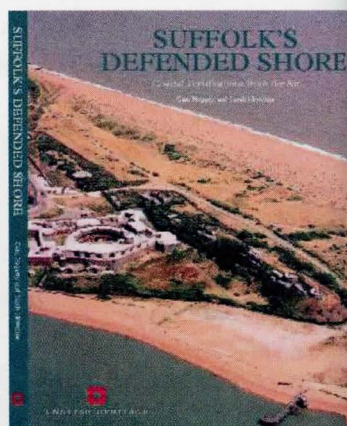


Figure 10. There is a wide audience for twentieth-century military history and archaeology and so some of the results of the Suffolk Coastal NMP have been published in an approachable format (Hegarty, Newsome 2007).

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Figure 11. Kettleness, North Yorkshire, UK. Alum was the basis of a major industry in the eighteenth and nineteenth centuries but the remains are now being destroyed by coastal erosion. (NMR17216_28, © English Heritage.)



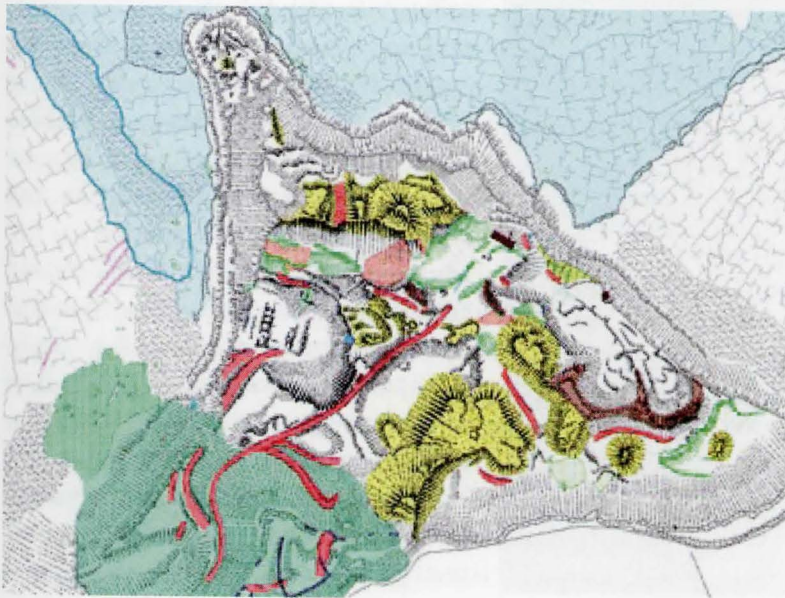
has a contribution to make to assist the more detailed ground evaluation that is usually required.

Because England has coastal photography going back fifty years (and sometimes longer) it is possible to use the photography to measure rates of erosion and to consider the implications for the archaeological resource. Historic map analysis allows this to be extended even further into the past. As part of the Hadrian's Wall NMP project an area of the north-west coast of England near the Roman fort at Beckfoot was carefully examined to consider the likely impact and timescale of destruction of a Roman cemetery. A relatively quick examination of the aerial photography for 700m of coast showed that the erosion was episodic and variable in nature over this length but that in the vicinity of the cemetery about 19m had been lost since 1946. Mitigation work can now take into account predictions based on this data.

Another project required a much more detailed approach. The remains of the alum industry on the north-east coast of England are gradually eroding and there is no viable means to protect them. The industry involved the large-scale extraction and processing of alum shale, the coastal location allowing ready access to the minerals for quarrying and also access to sea transport for additional processing materials (seaweed, coal and stale urine) and for the export of the finished product. In order to understand the development of the industry, and to record the remains before they finally disappear, a coordinated programme of survey was undertaken on a number of sites such as Boulby, Kettleness and Loftus. Analytical field survey was complemented by ground-based photogrammetry of standing structures, along with



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Figure 12. Alum workings, Kettlewell, North Yorkshire, UK. Using digital photogrammetry to support field survey results in a variety of products to aid interpretation and visualisation: a) an orthophoto, b) the interpretative plan resulting from aerial and ground survey, and c) a still image from a 3-dimensional fly-through of the site. (© English Heritage.)

detailed aerial photogrammetry and analysis of the full extent of the remains on the clifftop and the inter-tidal zone. High-quality vertical photography was specially commissioned for this project to ensure the excellence of the resulting survey and also to provide an objective record for future research. This use of aerial photography was of particular benefit in that it allowed survey to extend into areas normally considered too dangerous for field-work (such as the steeply sloping cliff faces) but it also minimised the time needed to complete recording on the ground in difficult situations such as the foreshore under the cliffs which are only accessible at low tide (Jecock *et al.* 2003; Hunt 2004).

Conclusions

In keeping with the aims of the Klaipėda seminar this discussion has concentrated on the value of aerial photographic evidence and the methodology used for its assessment to aid understanding of the historic environment. The field survey element is equally important for coastal studies and can help to provide a depth of understanding and detail about the sites discovered from the air. More significant, though, is the wealth of complementary data that field survey provides, identifying structures and artefacts that cannot be identified from the air. Of particular significance on the English coast are buried landscapes eroding out in the inter-tidal zone, often with well-preserved artefact scatters, timber structural elements and associated environmental remains. The enormous potential of these sites is exemplified by the Stumble, in

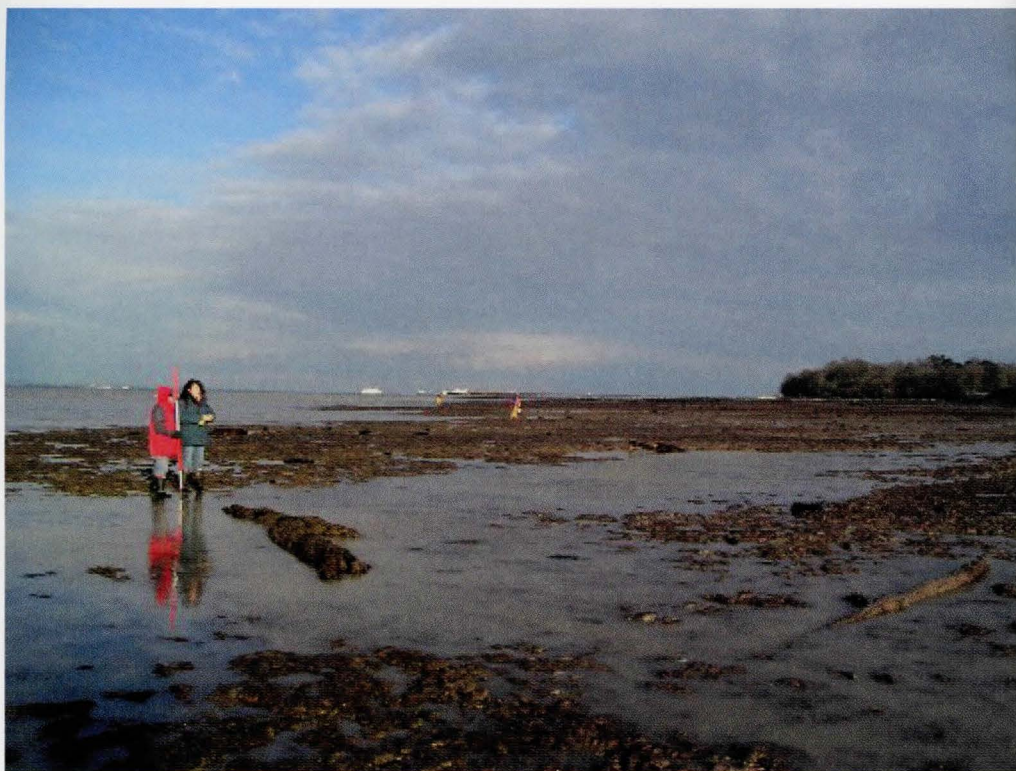


Figure 13. Recording fallen trees, part of the Neolithic submerged forest at Wooton-Quarr beach on the Isle of Wight. Photo by Peter Murphy.

the Blackwater Estuary in Essex, which was surveyed and selectively excavated in the 1980s and revealed an extensive exposure of Neolithic land surface littered with artefacts (Wilkinson, Murphy 1995 and in prep).

For those wanting to understand and manage the historic coastal environment it is therefore important to remember that the real value comes from bringing all the sources of information together and making them available to a wide audience.

Public interest in coastal archaeology in England is high: a day school in 2005 on the results of the Suffolk Coast mapping project attracted more than 200 members of the public, and more had to be turned away. It is clear that the coast is valued for a variety of reasons: for many individuals an appreciation of the past is an important part of their enjoyment of these special landscapes (and seascapes). Some of the results of the Suffolk project, along with further research, have been put together into a book aimed at the general public, *Suffolk's Defended Shore* (Figure 10). Hopefully, this will allow a much wider audience to enjoy the coastal heritage of England from an aerial perspective.

References

- Bewley R. 2001. Understanding England's Historic Landscapes: an Aerial Perspective, *Landscapes* (2001), 1, pp. 74-84.
- Bewley, R 2002. Aerial Survey: Learning from a Hundred Years of Experience?, in Bewley R., Rączkowski W. (eds.). *Aerial Archaeology - Developing Future Practice*, Proceedings of the NATO Advanced Research Workshop on Aerial Archaeology, 15-17 November 2000, NATO Life Sciences Series 337, pp. 11-18.
- Bewley R. H. 2003. Aerial survey for archaeology, *The Photogrammetric Record*, Vol 18 Issue 104, pp. 273-292.
- English Heritage 1996. *England's Coastal Heritage. A statement on the management of coastal archaeology*, English Heritage and the Royal Commission on the Historical Monuments of England.
- English Heritage 2003. *Coastal Defence and the Historic Environment*, English Heritage Guidance (available as a pdf from <http://www.english-heritage.org.uk/>)

upload/pdf/CoastalDefenceEH.pdf). A summary is also available at http://www.english-heritage.org.uk/upload/pdf/coastal_defence.pdf.

Grady D. M. 1998. Medieval and Post Medieval Salt Extraction in North-East Lincolnshire, in Bewley R. (ed.) 1998, *Lincolnshire's Archaeology from the Air*, pp. 81-95.

Hegarty C., Newsome S. 2007. *Suffolk's Defended Shore*, English Heritage.

Hunt A. 2004. *Loftus alum works, Cleveland: an archaeological and historical survey*, English Heritage Report [AI/2/2004].

Jecock M., Dunn C., Carter A., Clowes M. 2003. *The Alum Works and other industries at Kettlewell, North Yorkshire*, English Heritage Report [AI/24/2003].

Wilkinson T. J., Murphy P. L. 1995. *Archaeology of the Essex Coast, Volume I: the Hullbridge Survey*, No 71 in the series *East Anglian Archaeology*, Archaeology Section, Essex County Council. ECC: Chelmsford. And *Volume 2 Investigations at The Stumble*, in preparation.

Williams P. 2005. *The English Seaside and Its Architecture*, English Heritage.

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