Geogr. Fis. Dinam. Quat.
31 (2008), 187-194, 4 figg., 3 tabb.

VINCENT MAY (*)

INTEGRATING THE GEOMORPHOLOGICAL ENVIRONMENT, CULTURAL HERITAGE, TOURISM AND COASTAL HAZARDS IN PRACTICE

ABSTRACT: MAY V.J., *Integrating the geomorphological environment, cultural heritage, tourism and coastal hazards in practice.* (IT ISSN 0391-9838, 2008).

Millions of tourists visit places each year which combine spectacular and scientifically significant geomorphological locations with important cultural features. However, the dynamic nature of many of these locations means that they can be hazardous to visitors and buildings. This is especially true of coastal sites. Management has to balance the needs of conservation, safety and access with public education to ensure the sustained values of the sites. This paper examines this process of integration on the south coast of England where the Dorset and East Devon Coast World Heritage Site (the «Jurassic Coast»), 155 km of mainly cliffed coast, lies within an area with a resident population of more than 400,000 and over 17 million visitor nights each year. The coast includes some of the largest, most active and best investigated landslides anywhere. Property and visitors are at risk from a range of hazards which are managed by a variety of interventions from defence structures to public education.

KEY WORDS: Geomorphological processes, Coastal hazards, Landslides, Tourism, Integrated Coastal Zone Management (ICZM), Education, England, World Heritage.

INTRODUCTION

Many parts of the British coast are designated for their geomorphological and cultural importance, are important tourist locations and are affected by landslides, eroding beaches and retreating cliffs. Like many geomorphological sites, these locations are valued for different but related reasons (May, 1993; 2004). They are often identified as places for conservation and protection because of their intrinsic ecological, geological, geomorphological and archaeological significance and are recognised as important places for research. However, they are also valued because they have economic value as attractions for tourism and symbolic significance (historical, spiritual or cultural). They may also be of considerable educational importance because they are exemplars used for school and university visits, projects and textbooks. Because the geomorphological environment interacts with tourism as a resource and as an attraction, this poses questions for the management of coastal resorts and landscapes (May, 1993) and has led some planners to develop procedures for the assessment of the geoecodynamics of proposed tourist resort locations (Borja & Sanchez, 1993).

The coast of southern England demonstrates well how the growth of tourism in particular has stimulated the spread of settlement into dynamic geomorphological environments. As a result, hazard management has a high priority amongst the many management issues which have to be addressed on this coast. Between the mouth of the River Exe in Devon and Highcliffe on the shores of Christchurch Bay, a length of about 180 km, there is a permanent resident population of more than 400,000 and a group of tourist resorts with over 17 million visitor nights annually. Mostly cliffed, it also includes one of Britain's most important lagoons (The Fleet), one of the largest lowland natural harbours in Europe (Poole Harbour) and the most biodiverse 10 km square in England. Human settlement can be traced through evidence of active farming back to the Bronze Age and there were thriving ports in the Iron Age. Detailed investigations of landslides and beaches can be traced back into the early 19th Century. 155 km is designated as the Dorset and East Devon Coast World Heritage Site (the «Jurassic Coast») with to its east a further 26 km of open coast and about 105 km of estuarine shore, a total of 286 km administered by ten local authorities. Overall, the open coast comprises 124 morphosedimentological segments (European Commission, 1998), 79 within the World Heritage Site.

(*) *Bournemouth University, Talbot Campus, Fern Barrow, Poole, Dorset, BH12 5BB, U.K.*

International designations which recognise the importance of the coast's natural features include World Heritage Site (Dorset County Council & *alii*, 2000), Ramsar, European Special Protection Areas (SPAs for birds) and Special Areas of Conservation (SACs for habitats). Furthermore, UK conservation legislation protects the rural coast's landscapes, wildlife, geology and geomorphology as Areas of Outstanding Natural Beauty (AONB), Sites of Special Scientific Interest (SSSI) or National Nature Reserves (NNR). The geological and geomorphological importance of the area is recognised by the large number of sites included in the Geological Conservation Review (Ellis & *alii,* 1996; May & Hansom, 2003).

As a result, elements of this coast range from a predominantly natural cliff-beach system with very little human modification of the system but a high tourist and heritage value, for its landscape at a variety of scales (fig. 1), to a shoreline which is predominantly anthropogenic and within which geomorphological processes reflect the degree of intervention.

GEOMORPHOLOGICAL ENVIRONMENT

The coast is formed in sediments dating from the Triassic to the Quaternary and ranging from very resistant limestone to easily eroded clays and sands. Mean annual cliff-top retreat rates over the last 150 years range from less than 0.01 ma^{-1} to more than 1 ma^{-1}. Cliff retreat depends on their exposure to wave action, the geological structures and materials, mass movements which range from small frequent rock falls to landslides which are amongst the largest on the European coast (Cooper, 2007), and the extent to which coast defence structures are in place. Some landslides are very active and have been so for at least 2500 years. Others show little evidence of movement over the same timescale (May, 2003a). This coast, like many others, is a palimpsest of forms at many different time and space scales (tab. 1). There is nothing new in this statement, but the variety of coastal features and forms have different attractiveness for tourists and can present different hazards. For example, a landslide with a long event return period (e.g. more than 1 in 200 years) may provide an attractive undercliff through which paths develop and where the wild landscape and ecology are key attractions. In contrast, another (with event return period = 1 in 40 years) may be so dominated by mudslides that it is dangerous for recreational visitors.

Some landslides have been built on and occupied for several centuries despite the risks. Lyme Regis is the best known example where in 1533 the Mayor and Burgesses of Lyme Regis petitioned the Lord Chancellor, Thomas More, for assistance because the land on which the town stood was so badly «…undermined broken consumed and wasted…» that houses had been destroyed and more were likely to be lost «…unless speedy remedy be had…» (Royal Commission on Coast Erosion and Afforestation, 1911).

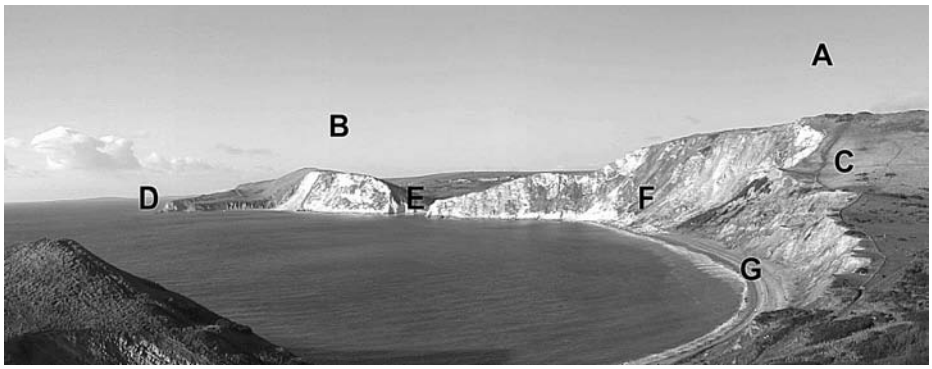

FIG. 1 - Worbarrow Bay, east of Lulworth Cove. Headland and bay coastline exposing strata from Portland Stone to Chalk. Features include A Iron Age hill-fort on chalk ridge, B recent landslides in chalk cliffs with talus extending below sea level, C coastal path at risk from cliff-top retreat, D stacks resulting from erosion of limestone steeply dipping strata which continue as a submerged ridge to the headland in the left foreground, E incised dry valley in chalk, F landslides in chalk, sands and clays, G shingle recreational beach with occasional landslides. The site is within a military training area.

TABLE 1 - Timescales of coastal geomorphological environment

Timescale	Geomorphological scale	Geomorphological feature	Example
Quaternary	*circa* 50 km^2	Breached anticline	Vale of Weymouth & Weymouth Bay
Holocene	*circa* 5 km^2	Coastal incised valleys	Winspit
	circa 5 km^2	Transgressive barrier beach	Chesil Beach
circa 6000 years	20 km^2	Submarine and shore platforms	Weymouth Bay and Kimmeridge
circa 2500 years	2 to 0.5 km^2	Landslides	Lyme Regis and the Undercliff
circa 500 years	1 km^2	Shore-normal micro-cuestas	Kimmeridge
		Shore-parallel ridge and platform	Ringstead
circa 400 years	0.1 km^2	Stack and arch	Ladram and Old Harry
circa 20 years	0.25 km^2	Landslides	Highcliffe

CULTURAL HERITAGE

The Oxford English Dictionary defines «culture» as the «arts and other manifestations of human intellectual achievement considered collectively». Although this coast has specific features which represent the past history of the area, such as Iron Age hill-forts and medieval field patterns, the landscape as a whole is recognised as being of national importance and is designated as an Area of Outstanding Natural Beauty (AONB). This designation recognises that such areas are in fact often largely the result of many centuries of human occupation of the underlying geomorphology. The coastal landscape formed by geomorphological and agricultural processes has subsequently been interpreted by art, music, literature and science. For example, one of the most important attributes of the World Heritage Site is its place in the history of science, for the formation of the coastal valleys was the focus of the great nineteenth century debate about catastrophism and diluvialism.

Artists and writers such as Constable, John Fowles and Thomas Hardy have been followed by more recent artists such as Jeremy Gardiner, some of whose works mimic the erosional processes as he gradually removes layers of paint and wood to reveal underlying structures. Both the geomorphologist and the creative artist attempt to interpret the nature and processes of the landscape, but in very different ways. These interpretations may be a means of attracting tourists or explaining the landscape which they visit.

TOURISM

For the tourism industry, landscape is a product to be promoted and sold. It is a place for recreational activity. Tourism marketing frequently uses distinctive individual features as attractors, for example, the dramatic and symbolic Ayers Rock or the sea stacks at Lagos on the Algarve coast. This is then reflected in the activity of the visitor in the location. Along the Dorset coast, there are a number of controls on visitor access, e.g., road access and the nature of the coastal paths. There are many types of visitors - resort-based beach users, walkers, educational groups. Most tourist activity is located or focussed, with varying visitor densities:

- at towns and villages where there is accommodation, most facilities and services and parking for cars;
- on beaches, for bathing, walking between access points at low tide levels and many other recreational activities;
- on shore platforms, rock-pooling, where shallow water shore ecology is affected by the structure and development of shore-normal micro-cuestas;
- at the cliff-foot, on rock-fall or landslide debris, fossil-collecting;
- selectively on paths through landslides and undercliffs, wildlife viewing, e.g., butterflies, insects, birds and flowers;
- on vertical cliff-faces and former quarries, locally rock-climbing;
- on cliff top paths, walking, scenic viewpoints and wildlife viewing, e.g., dolphins, peregrine falcons, puffins, butterflies and flowers.

Especially attractive geomorphological features of the coast are rare and distinctive. They include headlands from which extensive views are possible, but focus especially on stacks and arches (tab. 2) and geological and

TABLE 2 - Cave-arch-stack features and their use

Feature name	Landforms	Landscape context	Access	Visitors	Education use	Promotion	Risk
Ladram Bay	Red sandstone cliffs with stacks within bay	7 stacks Coastal views	Cliff top path or single path to beach	Moderate	Low	Low	Rockfalls
Stack Rock, Portland	Single Portland Stone stack	Major headland Extensive sea views and distant coast	Road and short walk	High	Low	Low	Slippery intertidal platforms
Bat's Head	Single chalk stack and headland arch	Within bay Coastal views from cliff-top	2 km walk along beach or cliff-top path	Low	As part of larger site, coincidental	Low	Rockfalls Falls from cliff-top
Durdle Door	Arch	Local headland Coastal views from cliff-top	Cliff top path or steps to beach	Very High	Very High	Very High	Falling over cliff edge -fenced Diving off arch
Mupe Rocks	Stacks	Local headland Coastal views from cliff-top	Cliff top walk - restricted access	Very Low	Minimal	Very Low	Remote site
Ballard Down	Individual stack-arch-cave	Individual headlands and bays. Extensive sea views and distant coast	Cliff-top path only	High	Low	Moderate	Cliff-top collapse
Old Harry Rocks	Complex chalk stack-arch-cave feature	Major headland Extensive sea views and distant coast	Cliff-top path only	High	High International textbook example	High	Narrow headlands Access at foot = risks of cut off by rising tide

historical features e.g., Lulworth Crumple, Fossil Forest, Flowers Barrow (Iron Age cliff-top fort). It is the geomorphological phenomenon which is the attraction.

The Jurassic Coast is thus one in which the geomorphological environment is key to its attractiveness as a tourism location and its scenic characteristics are used to promote the product. The existence of such features as Durdle Door is used by the landowners who expressly require any organisation filming or photographing the feature for commercial use to have permission and to pay a fee, i.e. the geomorphological feature has a commercial value. In addition, the importance of parts of the coast as field study areas for schools and universities brings an income from accommodation, transport and other services. Large numbers of visitors to an inherently dynamic coastline also introduce the possibility that, apart from the risks to property due to erosion, flooding or landslides, injuries or death may occur because of these same hazards as well as those from the sea itself (tab. 3).

COASTAL HAZARDS

There is a substantial literature dealing with coastal natural hazards, typically focussed on the risks arising from cliff erosion, beach erosion and rollover, landslides, coastal flooding and extreme oceanographic or atmospheric events e.g., tsunamis, hurricanes, storm surges. The tourism literature commonly has considered the effects of such events on the response of tourists. Characteristically, the industry is concerned about recovery of the market and visitor numbers. Tourist markets appear to be resilient depending on the level of damage to infrastructure, with recovery times often depending upon the ability of the community and businesses to rebuild or replace damaged facilities.

Along the case-study coast, the main hazards are landslides, storms and surges. There is a long recorded history of storms causing significant damage to buildings, shoreline structures and shipwrecks. These storms individually have return periods of about 1 in 4 years. More severe storms causing widespread and substantial damage have a return period of about 1 in 100 years, key events being storms in 1703 and 1824. A very damaging storm in southeast England in 1987 only affected the eastern part of the Dorset coast. Records of very intense events show that they affect coastal lengths up to about 15 km, the most intense being the Martinstown rainfall of 280 mm in less than 24 hours in July 1955.

Property is at risk from such intense localised events, coastal flooding and landslides. However, some of the results of these events become visitor attractions, either immediately after the event or because the resultant landforms provide very biodiverse wild landscapes. Geomorphological events, such as rock falls, have killed and injured visitors, fortunately rarely (tab. 3). Shoreline and nearshore deaths also occur as a result of infrequent very large waves. Accidents during recreational diving, cliff rock-climbing and boating are regular events but small in number. There is a higher risk of boating accidents where «races» occur over extended submarine platforms associated with headlands e.g., Old Harry, St Aldhelm's Head and Portland Bill. A small number of accidents have affected educational visits, but schools are now required to carry out risk assessments and have effective procedures. Despite the localised risks from rock-falls, casual visitors are regularly observed sitting in such locations.

INTEGRATING AND MANAGING FOUR ELEMENTS

The earliest documented link between coastal geomorphological features and risk management is the identification by mariners of headlands both as hazardous areas and as navigational aids. Many early navigational charts include sketches of the distinctive features. On land, these same headlands were sometimes the sites of religious buildings, such as chapels, invoking protection by God or in thanksgiving for safe returns to port. They were also the focus of local pilgrimage. So there has long been an integration of the geomorphological feature, tourism and hazard protection.

TABLE 3 - Examples of accidents in Purbeck (Sources: various)

Location	Geomorphological Event	Date	Accident
White Nothe		2006	Walker died after fall from cliff
Durdle Door	Rockfall	1975	Woman killed
Durdle Door		2007	Man injured diving off arch («tombstoning»)
Stair Hole	Rockfall	2002	14 year old girl with head injuries
Lulworth Cove	Rockfalls	1957	9 injured
Lulworth Cove	Landslide	1977	3 dead, 3 injured
Lulworth Cove		2003	2 boys washed off rocks and drowned
Swanage	Rockfall	1971	9 yr girl with head injuries died
Swanage	Rockfall	1975	Boy seriously injured
Swanage	Rockfall	1976	Boy died
Ballard Down		1967	Young man drowned after being trapped below cliffs

In modern times, specific landforms have become major attractors for large numbers of educational visits. Locations such as the coast around Lulworth Cove, widely described in school and university texts, are identified as exemplar sites within the English National Curriculum and so are particularly heavily used. The coastline of the Purbeck District is cited as the most intensively used field studies location in Europe (Dorset County Council & *alii*, 2000).

There are several issues to consider in managing in integrated ways such a variety of phenomena and activities, including first:

- the magnitude and frequency of geomorphological, oceanic and meteorological events;
- the physical scale of specific landforms;
- the quantity and quality of information about both specific landforms and feature forming events.

On their own, these issues have been very well addressed by geomorphologists and this coast has been central to the development of geomorphological science (Dorset County Council & *alii*, 2000). However, the cultural and tourism aspects of this coast pose a second set of issues, namely:

- the importance of specific landscapes and coastal forms as attractions, and their value as elements of tourism marketing;
- the values attached to these attractions which range from tangible, e.g. with a specific monetary value, to intangible, e.g., expressed as spiritual, wilderness or tranquillity;
- the numbers of visitors who go voluntarily to a specific feature. This may be a function of the marketing, information about the feature, its position (e.g., on a headland or within a bay) or accessibility;
- the number of visitors who are led to a specific feature, mainly educational or interest groups, because of its scientific importance;
- the risks that exist when visitors are attracted to areas of active landsliding or rock falls;
- the risks arising from the proximity of paths to eroding cliff-tops.

If these two sets of issues are combined then not only are particular parts of the coastline more visited but also specific landforms and processes are observed more. This may increase the risks of accidents as a result of natural events, such as rock falls or large waves (tab. 3). Their variation is exemplified using a qualitative scale to illustrate the range of cave-arch-stack features and their use (tab. 2). Visitor numbers along part of the most intensively used coast (fig. 2) show wide seasonal and inter-site variation (fig. 3).

Even at this localised scale, there are a range of risk levels. Narrow headlands with vertical cliffs offer excellent views of the features at Ballard Down and Old Harry Rocks, but the headlands are both narrowing and being undercut by the erosion processes which give rise to the site's attractiveness. On this site, assessment of the risk is left to the judgement of individual visitors. In contrast, at Durdle Door, the access path lies immediately above a near-vertical cliff-face and is fenced to avoid accidents by slipping from the path. The estimated visitor numbers are about half those at Old Harry Rocks (fig. 3).

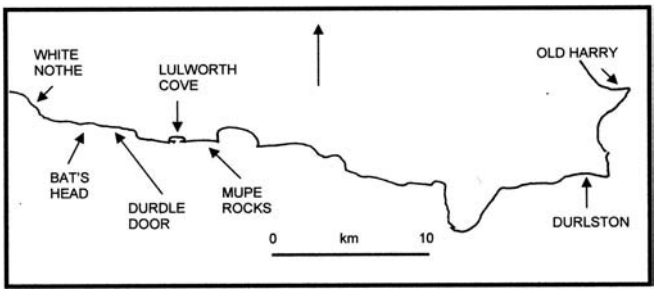

FIG. 2 - Coastal locations along the eastern part of the Dorset and East Devon Coast World Heritage Site.

Direct anthropogenically-induced geomorphological change is revealed on steep slopes where valleys are truncated by the coast. Paths parallel to the cliff-top become eroded, develop into narrow gullies, are abandoned and new paths develop to landward of the original path. As a result, these hill-slopes are patterned by series of sub-parallel, sometimes slightly sinuous, narrow gully systems. In many locations, such paths would normally develop as meandering patterns to reduce the angle of slope of the path. Here, however, this is not possible because of landholding patterns which restrict access to a narrow coastal strip. On some slopes, steps have been constructed to aid access, but localised gullying and soil movement around the steps does lead to avoidance of the steps and additional erosion. The steepness of these paths (often in excess of 35°) limits

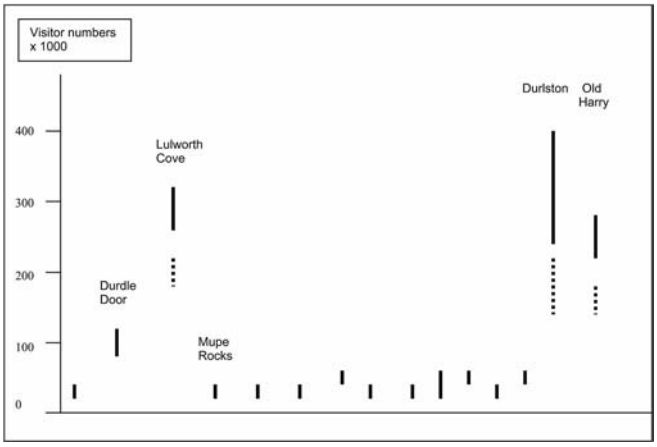

FIG. 3 - Visitor numbers at south-east Dorset coastal sites. Number of visitors (thousands) in sample 2 km lengths of coastline. Bars show range of estimated numbers. Solid bars show total visitors between May and October. Dashed bars show total visitors between November and April. Based on data from Market Research Group 2007.

visitor access. This in turn may reduce risks of accidents because the less active or fit visitors avoid them. Because of the potential damage to the paths and of the risks to other users, access for mountain-biking is prohibited.

The management of these problems is spatially localised but very important for the overall quality of the visitor experience. There is a continuing debate about the appropriate levels of visitor numbers, with opinions ranging from maintenance (or even reduction) of the existing numbers to widening access for all.

Given this complexity and the increased human activity in dynamic coastal and other environments, it is not surprising that there is increasing debate about how to integrate the geomorphological (and other) environments with the human world. For example, Cendrero & *alii* (2006) identify a need for a better understanding of the relationships between socio-economic and geomorphic processes because landscape change attributable to anthropogenic landscape has accelerated in recent decades. Rivas & *alii* (2005) go further and propose a transition from «pre-industrial» to a «post-industrial» geomorphological model, arguing that there should be a greater integration of anthropogenic geomorphological processes within this model. Kamphuis (2007) and May (2007) have argued independently that coastal engineers and managers need to understand better the sub-cultures of coastal management and how their knowledge and information are used (and their limitations). Kamphuis (2007) is specifically concerned that coastal engineering has become increasingly complex because of the uncertainties resulting from approval processes which involve many stages and stakeholders. This is at least partly because coastal engineers have been reluctant to become embedded in the socio-politico-economic systems (May, 2007). Both coastal engineering and geomorphology have sometimes found it difficult to communicate the inherent uncertainties in scientific information and to find ways in which they can work with rather than in conflict with the many other components of the coastal management system. This is not surprising when the complexities of partnership working are considered.

Along the Dorset coast, there are a number of different partnerships, each having a statutory, advisory or management role at the coast and including stakeholders from many different backgrounds and with different expectations. The physical landscape, and its geomorphological environment in particular, is seen through many different eyes, and is not usually regarded as the fundamental foundation for most of the other states and processes which form the overall landscape. This manifests itself most strikingly in statements that coastal erosion along the World Heritage Site is a problem when it is the coastline's very dynamics that has made it such an important global site for both geology and geomorphology. Furthermore, it is such perceived risks which could cause management decisions to be made on the basis of socio-economic judgements rather than an understanding of the geomorphological realities.

The management of the Dorset coast has been very effective in integrating this understanding of the geomorphology with the needs of tourism, heritage and hazard (fig. 4). However, the predictive tools for management of this coast under pressure from both anthropogenic and

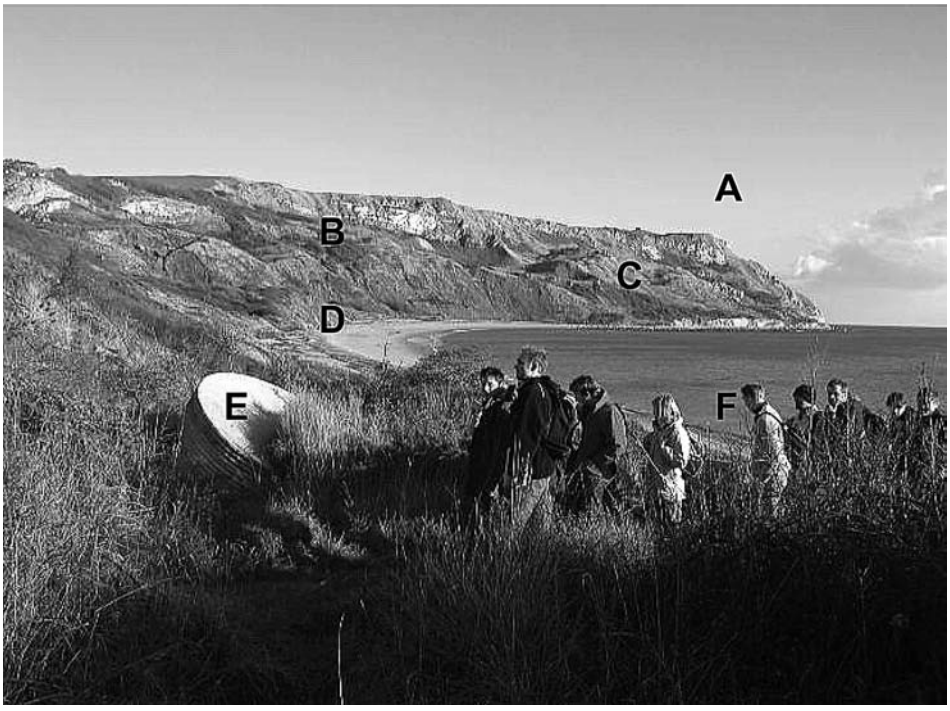

FIG. 4 - Ringstead and White Nothe. A complex site designated at all levels from World Heritage Site to Site of Special Scientific Interest. A Geological Conservation Review site for Coastal Geomorphology. Features include A archaeological features from medieval to Second World War on headland, B active landslides, C multiple relic rotational landslides, D remote recreational beach, E active landslide with former military structures, F used for university and school field classes.

natural forces over long time periods are not yet well developed. Much depends upon the ability of those working in the different sectors to communicate with each other and to be willing to learn. Coastal partnerships within which the geomorphological voice is heard develop at their best when they function as «learning communities» in which both the «expert» and «non-expert» are listened to. This local environmental expertise provides a means by which management can be community-driven. However community-driven management needs to be managed within an effective institutional framework, based upon effective communications between the different partners. Learning by experience is often slow so it needs to be linked with science-based approaches. This takes time, and sometimes considerable patience, but, if as well-managed as it has been in the case-study area, provides a base upon which to build truly integrated and adaptive coastal management.

This coast's management concerns a complex, dynamic, and co-adapting system in which human activities are interwoven with the natural system. The system adjusts constantly to internal and external pressures and forces. Some aspects of this integrated coastal system function over long-time scales, others at very short timescales and some are typified by high magnitude low frequency events which leave forms to which geomorphological adjustment may take place only very slowly but anthropogenic adjustment is typified by rapid responses such as path closure or construction of coast defence structures. Much of this coastal landscape also includes the footprint of many centuries of human occupation, although the cliffs and landslides remain the least directly affected by human activity. These landscape-forming features may be as disparate as a large landslide, the establishment of a pattern of field boundary ridges or the development of a new resort. Each such change crosses geomorphological thresholds to establish a new state, for example, different drainage systems, but interventions at one scale may bring about alterations at another scale because of a combination of nested hierarchical structures linked and networking at many different scales (May, 2007).

CONCLUSIONS

The management of this coast is based on a substantial science base as evidenced by the GCR and by the science-based designation of most of the coastline for conservation. The risks to coastal property have been assessed by the national Shoreline Management Plan programme (currently entering a second phase) and judgements published about the future needs for coast protection. The landscape quality is managed through the Area of Outstanding Natural Beauty (AONB) and the spatial planning procedures at both strategic and local levels. As a result, the natural scenic quality, access and information available provide a robust tourist product. The industry recognises that damage to this product will damage the value of the location for tourism with commensurate implications for incomes and employment. However, there is a conflict between the need to protect property and the need to allow the coast to remain dynamic. These conflicts will remain. They are resolved at the present time through the planning procedures as far as new development is concerned. However, with the potential for greater risks resulting from increased storminess and more intense rainfall events superimposed on sea level rise, the conflicts are also likely to become more intense at the boundaries between the active, designated and attractive coasts and the urbanised coastal environments.

The most important single action has been the establishment of patterns of partnership working in which the scientific issues are recognised as being the key to the long-term sustainability of the coastal economy. A high priority has been given to the development of both formal (school) and informal (public) education, with well-developed interpretation resources (e.g. the Jurassic Coast website). Management of the World Heritage Site is based on an agreed management plan implemented on a day-to-day basis not only by a dedicated team, but also within the procedures of other agencies which have statutory responsibilities, such as the Area of Outstanding Natural Beauty and the local government planning committees. The Dorset Coast Forum has a wider remit than the World Heritage Site and is recognised as an effective organisation through which such different pressures on the coast as tourism, military training (fig. 1) and resource extraction can be (and are) reconciled. There are, of course, differences of opinion about appropriate actions and strategies, but these are usually reflections of different ways to achieve the overriding aim which is to ensure that this coast retains its natural qualities and remains at the core of thriving and sustainable human communities. Arguably this coast has developed a protocol to «ensure that proper land-use management policies and practices, respectful with the nature and dynamics of geomorphic systems, are implemented» (Cendrero & *alii*, 2006). It is not yet fully developed and it certainly lacks the range of predictive tools which fully integrated management of this area requires. Nevertheless, extensive and regular monitoring of some aspects of the coast is now in place and further development of models linking this data to the human activities is possible.

REFERENCES

BORJA J.F.C & SANCHEZ M.M. (1993) - *Geodynamic assessment to improve the landscape tourist resources in Cancun, Yucatan Peninsula, Mexico*. In: P.P. Wong (Ed.), «Tourism vs Environment: the case for coastal areas». Kluwer, Dordrecht, 55-65.

CENDRERO A., REMONDO J., BONACHEA J., RIVAS V. & SOTO J. (2006) - *Sensitivity of landscape evolution and geomorphic processes to direct and indirect human influence.* Geografia Fisica Dinamica e Quaternaria, 29, 125-137.

COOPER R.G. (2007) - *Mass Movements.* Geological Conservation Review Ser. 33, Joint Nature Conservation Committee, Peterborough, 348 pp.

DORSET COUNTY COUNCIL, DEVON COUNTY COUNCIL & THE DORSET COAST FORUM (2000) - *Nomination of the Dorset and East Devon Coast for inclusion in the World Heritage List.* Dorset County Council, Dorchester, 150 pp.

ELLIS N.V., BOWEN D.Q., CAMPBELL S., KNILL J.L., MCKIRDY A.P., PROSSER C.D., VINCENT M.A. & WILSON R.C.L. (1996) - *An Introduction to the Geological Conservation Review.* Geological Conservation Review Series, No. 1, Joint Nature Conservation Committee, Peterborough, 131 pp.

EUROPEAN COMMISSION (1998) - *CORINE érosion cotière.* Commission of the European Community, Luxembourg, 170 pp.

KAMPHUIS J.W. (2007) - *Beyond the limits of coastal engineering*. In: J.M. Smith (Ed.), «Coastal Engineering 2006». Singapore, World Scientific Publishing Pte. Ltd., 1938-1950.

MAY V. (2004) - *Coastal earth science conservation and ecogeotourism*. In: A. Micallef & A. Vassallo (Eds.), «Proceedings of the First International Conference on Management of coastal recreational resources: beaches, yacht marinas and coastal ecotourism». Malta; Euro-Mediterranean Centre on Insular Coastal Dynamics, Foundation for International Studies, Valletta, 251-256.

MAY V. (2007) - *Sustainable management of a high value high risk coast: the role and effectiveness of technological interventions*. In: J.M. Smith (Ed.), «Coastal Engineering 2006». Singapore, World Scientific Publishing Pte. Ltd., 1925-1937.

MAY V.J. (1993) - *Coastal tourism, geomorphology and geological conservation: the example of south central England.* In: P.P. Wong (Ed.), «Tourism vs Environment: the case for coastal areas». Kluwer, Dordrecht, 3-10.

MAY V.J. (2003a) - *Ballard Down, Dorset*. In: V.J. May. & J.D Hansom (Eds.), «Coastal Geomorphology of Great Britain». Geological Conservation Review Series, No. 28, Joint Nature Conservation Committee, Peterborough, 176-181.

MAY V.J. (2003b) - *The Dorset Coast: Furzy Cliff to Peveril Point*. In: V.J. May. & J.D Hansom (Eds.), «Coastal Geomorphology of Great Britain». Geological Conservation Review Series, No.28, Joint Nature Conservation Committee, Peterborough, 624-642.

MAY V.J. & HANSOM J.D. (2003) - *Coastal Geomorphology of Great Britain.* Geological Conservation Review Series, No. 28, Joint Nature Conservation Committee, Peterborough, 735 pp.

RIVAS V., CENDRERO A., HURTADO M., CABRAL M., GIMENEZ J., FORTE L., DEL RIO L., CANTU M. & BECKER A. (2005) - *Geomorphic consequences of urban development and mining activities; an analysis of study areas in Spain and Argentina.* Geomorphology, 73, 185-206.

ROYAL COMMISSION ON COAST EROSION AND AFFORESTATION (1911) - *Final Report*. His Majesty's Stationery Office, London.

(Ms. presented 28 April 2007; accepted 30 August 2008)