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SCIENCE DIRECT
Estuarine, Coastal and Shelf Science 62 (2005) 183–192
ESTUARINE COASTAL AND SHELF SCIENCE
www.elsevier.com/locate/ECSS

Defining the foreshore: coastal geomorphology and British laws

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Received 19 April 2004; accepted 26 August 2004

Abstract

Definitions of the 'foreshore' are described as presented in various coastal geomorphological and related textbooks. To many geomorphologists, the term foreshore is considered synonymous with the intertidal zone. These definitions are compared with the legal definitions of the foreshore as exist in Britain under the three different property law regimes: English, Scottish and Udal law. The legal definitions and many of the geomorphological definitions are based on tidal data. The differences between the observed tides at a tide gauge and on a beach at a distance from the gauge are considered. It is concluded that the term foreshore has a very specific legal meaning in each property law regime, therefore the authors propose that the term 'foreshore' should be used to relate to the legally defined area of the coast and, unless specifically referring to the foreshore, scientists should use the term intertidal.

Keywords: foreshore; geomorphology; law; intertidal; definitions; Great Britain

1. Introduction

This paper provides a review of some of the geomorphological definitions of the foreshore as found in some earth science textbooks. These will then be compared with the legal definitions of the foreshore as found under the three property law regimes in Great Britain. The paper ultimately aims to highlight the variation in extent of the various legal and geomorphological definitions of the foreshore, illustrating the implications of the various definitions for the management of the coast.

The 'foreshore' is a term defined under British laws pertaining to an area at the coast. As part of the coastal zone, the foreshore area (under any of the definitions below) is dynamic in form, being the area of physical interaction between land and sea. This coastal area is unusual in character, being neither land nor sea and constantly alternating between being covered and uncovered by the sea. The rates of change in this zone can be substantial due to erosion and/or accretion. Such changes can take place across the whole area directly influenced by the tides, often beyond the legally defined foreshore, which has led to the boundaries of the foreshore being the focus of some of the earliest coastal law (Gibson, 2000), arising from property disputes in the courts relating to the location and extent of the foreshore and its uses.

Great Britain consists of the countries of Scotland, England and Wales. In these three countries there are three different property law regimes, English law covering England and Wales, Scots law (or Scottish law) which covers Scotland (except areas covered by Udal law) and Udal law which is a remnant of Norse law that still operates in parts of Orkney and Shetland, the northern Isles of Scotland (McGlashan, 2002). The

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doi:10.1016/j.ecss.2004.08.016

extent of the foreshore under each of these property law regimes is quite different. Each of these definitions has been an attempt to devise logical property boundaries in a dynamic environment.

The concept of the foreshore serves a number of inter-related purposes in Great Britain. The landward or seaward boundaries of the foreshore are usually the boundary between private property on land and Crown property at sea (depending on the legal system). Furthermore, unless a byelaw is enacted, the seaward extent of the foreshore acts as an administrative boundary for planning authorities and statutory conservation bodies. The foreshore is also an area where certain public rights exist including navigation, recreation and fishing.

2. Where is the foreshore?

To the layperson, the term 'foreshore' is probably synonymous with 'beach'. However, there are a number of different interpretations. Geomorphologists have tended to define the foreshore on the basis of the natural processes that operate in the intertidal zone. To solve property disputes and illustrate property, administrative and access boundaries, the boundaries of the foreshore are often presented on maps. Indeed, the Ordnance Survey has a legal obligation as the state mapping agency to illustrate the foreshore boundaries on their maps (Gibson, 1977). Given the dynamism that can occur at the coast, any boundaries illustrated on a map can only be a representation of the position of the boundary at the time of survey, and is not necessarily an accurate representation of the current or future boundary.

3. Tides

Many of the definitions of the foreshore (geomorphological and legal) are based on analysis of the tidal regime. Aurrocoechea and Pethick (1986) highlight that tides cause the vertical level of the sea to vary over time by anything from a few centimetres to in excess of 10 m. The largest tidal range in the world (15.6 m) is at the head of the Minas Basin in the Bay of Fundy, Canada (Komar, 1998).

A number of factors influence tidal heights (see Komar, 1998). The variation between spring and neap tides occurs approximately fortnightly (14.6 days, Fig. 1). There are however longer term astronomical cycles which impact upon the tides observed. The nodal cycle (changes in the position of the Moon's orbit) operates over 18.6 years (Pugh, 1987), with the next maximum expected in May 2006 (Bird, 2000). Indeed there are longer astronomical variations with cycles that exceed centuries that also impact upon the tidal heights recorded, but these operate at a variety scales beyond the scope of this work.

The heights of tides above a local datum can be calculated and predicted and are often presented in tide tables a year or more in advance. Predicted heights are however rarely the same as observed heights, as predictions assume average atmospheric conditions. There are a number of factors that can influence the height of the tide beyond the tidal generating mechanisms, which include:

- Air pressure variations. For every 10 mb fall in air pressure (i.e. as part of an atmospheric depression) the level of the sea raises by 0.1 m (Hansom, 1988). The converse occurs with high pressure. A particularly large atmospheric depression can result in significant heightening of the surface of the sea. Both Hansom (1988) and Komar (1998) use the example of the 1953 storm, which resulted in water levels 3 m above predicted in the southern North Sea.
- The direction and strength of the wind can also affect the water level at the coast. Particularly strong onshore winds can cause enhanced water levels on the coast, or in an inlet. Charlton et al. (1975) estimated a rise in water level of 1.9 m between Buddon Ness and Newburgh (c. 35 km) in the Tay

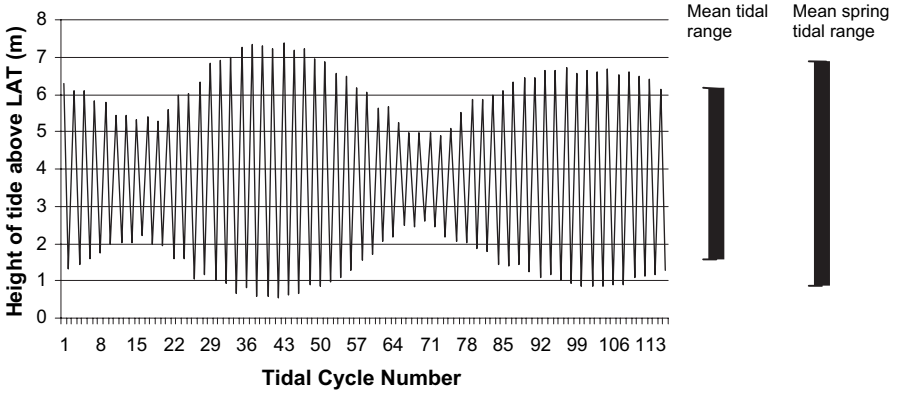

Fig. 1. An observed tidal month at Newhaven (March 2001) (data supplied by the British Oceanographic Data Centre).

Estuary, generated by a 25 m s^{-1} wind (10–11 on the Beaufort Scale: Wewetzer, pers. comm.).
- There are differences between the observed wet/dry line on the beach and the heights recorded by a tide gauge. This is because the high frequency variations in water level caused by waves are dampened or completely removed at the gauge site (Morton and Speed, 1998) via damping devices (Edwing, pers. comm.).
- The further the site of interest is from the nearest tide gauge, the less reliable the data will be.

4. Geomorphological definitions of the foreshore

A number of geomorphologists, earth scientists and engineers have used the term 'foreshore' in their introductory textbooks. A list of the definitions used and observations relating to the foreshore are presented below in chronological order (see also Fig. 2 and Table 1):

- Johnson (1919) recognised that the shore can be divided into two zones, "one of these lies between the ordinary high and low water marks, and is daily traversed by the oscillating water line as the tides rise and fall. This zone is known as the foreshore." Beyond this, "is the portion of the shore covered by water during exceptional storms only, which I propose to call the backshore."
- Creswell (1957) refers to High Water (HW) and Low Water (LW) as the boundaries of the foreshore, but does not clarify if these are spring, neap or tidal extremes. Creswell also highlights that the slope of the beach and the tidal range affect the extent of the foreshore, further noting that where there is no tidal range, there is no foreshore.
- King (1972) notes that the foreshore zone extends between tide levels to the limit of high water swash.
- Mather and Ritchie (1977) define the foreshore as the, "zone of beach between high and low water marks".
- Horikawa (1978) notes, "The lower and upper limits of the foreshore region are defined by the shoreline at mean low tide and the uprush limit of the breaking waves." This is quite a broad definition, extending well beyond the still water level of an average tide; including wave uprush can increase the foreshore area quite dramatically.
- Hardisty (1990) states that the foreshore is, "the sloping part of the beach between the berm and the low tide level."
- Lapidus and Winstanley (1990) define the foreshore (or beach face) as, "that zone of a shore or beach that is regularly covered with tidal water" and suggest comparison with the term 'backshore', which they define as (Lapidus and Winstanley, 1990), "the upper zone of a beach or shore, bounded by the high water line of mean spring tides and the upper line of shore-zone processes. Only usually big tides or severe storms affect this area." Therefore, the foreshore is the area below mean high water springs (MHWS) affected by regular tidal inundation.
- Ritter et al. (1995) highlight 'foreshore' as the zone between high and low water on an idealised beach profile diagram. However, they do not define the term in the text.
- Bird (1996) states, "The term shore (or foreshore) is defined as the zone between the highest and lowest tide levels".
- Trenhaile (1997) defines the intertidal foreshore or beach face as, "extending from the crest of the berm, or upper limit of uprush at the high tide level, to the ordinary low tide level".
- Komar (1998) describes the foreshore as "the sloping portion of the beach profile lying between a berm crest (or in the absence of a berm crest, the upper limit of wave swash at high tide) and the low water mark of the run-down of the wave swash at low tide. This term is often synonymous with the beach face, but is commonly more inclusive, also containing some of the flat portion of the beach profile below the beach face." He describes the beach face as, "the sloping nearly planar section of the beach profile below the berm, which is normally exposed to the swash of waves."
- Bird (2000) presents a diagram highlighting coastal terminology. In it, the position of the foreshore is

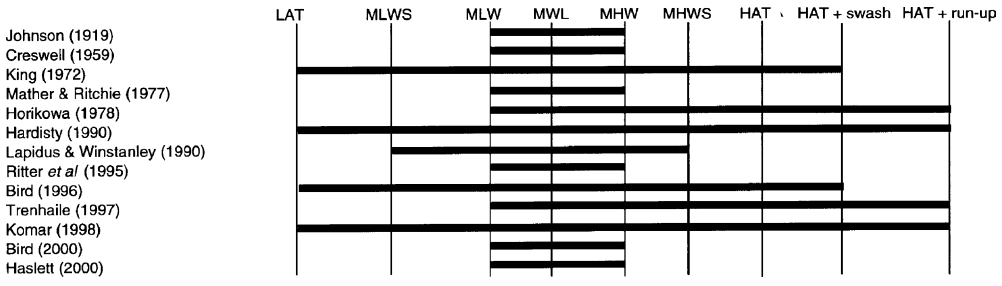

Fig. 2. Geomorphological representations of the foreshore (see Table 1 for abbreviations).

Table 1
Tidal abbreviations, their definitions, extents and ranges (source: McGlashan, 2002)

Name	Abbreviation	Definition
Highest astronomical tide	HAT	The highest theoretical tide reached under average atmospheric conditions
Mean high water springs	MHWS	Average of the spring high tides
Mean high water	MHW	Average of all high tides
Mean high water neaps	MHWN	Average of the neap high tides
Mean water level	MWL	Average water level
Mean low water neaps	MLWN	Average of the neap low tides
Mean low water	MLW	Annual average of all low tides
Mean low water springs	MLWS	Average of the spring low tides
Lowest astronomical tide	LAT	The lowest theoretical tide reached under average atmospheric conditions

different from the definition used in his 1996 book (above) in which the 'shore' and 'foreshore' describe the same area on the beach. Instead he now separates shore and foreshore, noting that the foreshore extends between high and low tide (intertidal zone), and that the shore includes this and the backshore area.

- Haslett (2000) designates the terms on his beach profile by wave processes and morphological change; the 'foreshore' is firmly in the latter category but is not further discussed in the text. It is however presented in a diagram (reproduced from Briggs et al., 1997) marking the area of the coast between the backshore and the inshore zone (approximately coinciding with the area between the high and low water marks).

Interestingly, and perhaps with good reason, the term foreshore has been largely ignored in a number of coastal geomorphological textbooks including Pethick (1984), Carter (1988), Hansom (1988), French (1997) and Nordstrom (2000). Indeed, Hansom (1988) uses the term intertidal zone to define the landward part of the nearshore zone.

5. The foreshore as a cadastral boundary in Great Britain

A cadastral boundary is one used in law to define the extent of property. Apart from the physical ownership of the foreshore, the extent of local authority planning powers stops at the seaward edge of the foreshore boundary in Great Britain. As a result, so does the extent of all terrestrial conservation designations which are based on the Special Sites of Scientific Interest (SSSI) network (McKenzie-Skene and Robertson, 2000; Reid, 2002). This terrestrial bias in the conservation designations has been raised by a number of authors (Ball, 1996; Warren, 1996; Reid, 2002). Furthermore, the Ordnance Survey (Great Britain's national mapping agency) is obliged to follow legal authority, marking the upper and lower extent of the foreshore on their larger scale maps. Gibson (1977) states, "the Ordnance Survey is responsible for producing statistics of the total area of foreshore in Great Britain, and of tidal water below low-water mark, but inside the administrative boundary; these are shown as separate parcels on 1:2500 scale maps." The method the Ordnance Survey uses to identify these areas is beyond the scope of this review (for further details see Ritchie, 1991; Ordnance Survey, 1998). The regularity of measurement and the scale at which this information is presented will however seriously influence the reliability of these data. The data can only be considered accurate on the day surveyed. Each legal system in Great Britain has a different definition of the foreshore, which is explored below.

5.1. Definition of the foreshore in English law

The foreshore in England and Wales (under English law) extends from Mean High Water (MHW) to Mean Low Water (MLW) of ordinary tides between the springs and the neaps. In the 19th Century, the definition of the foreshore was required to settle a number of cases (cf. Scratton vs. Brown, Lowe vs. Govett). In 1854, Lord Cranworth called upon two advisory judges in the case Attorney General vs. Chambers to settle the argument of the extent of the foreshore. When reporting back to the court, the advisory judges (Alderson B. and Maule J. in Attorney General vs. Chambers, p. 215) highlighted that the tide reached a different position on the beach on any day, "it is true of the limit of the shore reached by these tides that it is more frequently reached and covered by the tide and left uncovered by it. For about three days it is exceeded, and for about three days it is left short, and on one day it is reached." Lord Cranworth then examined each point in turn, and disregarded the use of spring tides to calculate the foreshore as they were not 'ordinary'. Lord Cranworth's decision resulted in the landward boundary of the foreshore being defined under English law as the high water line of 'ordinary' tides (i.e. the average of all tides). In a later case of Blundell vs. Catterall, Lord Cranworth's definition in Attorney General vs. Chambers was confirmed as the landward boundary of the foreshore. However, the seaward definition of the foreshore was agreed to follow the same definition, i.e. the low water line of ordinary tides (Fig. 3). Indeed, Marston (1981) states that the complementary definition should be applied to the seaward definition.

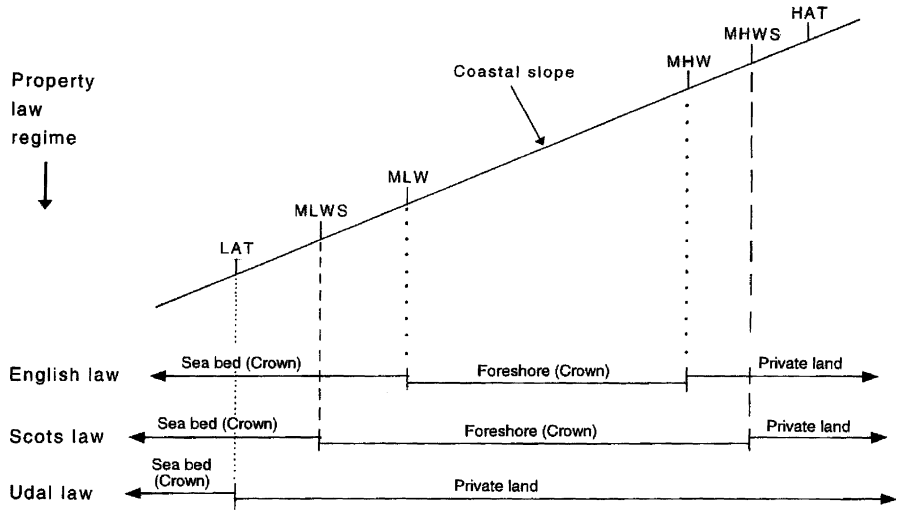

Fig. 3. Position of the foreshore and private/Crown property boundaries under English, Scots and Udal property law regimes.

It would appear that there has been an element of misconstruction regarding whether the tidal measurements should be taken over one year or one week (Gibson, 1977). Certainly, if the passage reproduced from the statement to the court from the advisory judges in Attorney General vs. Chambers (above) was viewed in isolation, it would be easy to assume that the measurements should be taken over a week. However, the advisory judges did also suggest to Lord Cranworth that the measurements be taken over one "quarter of a lunar revolution during the year" (Attorney General vs. Chambers, p. 215). Confusion arose in Tracy Elliott vs. Earl of Morley, until settled by the judge (Joyce J.), who stated that the calculation of the foreshore utilised tidal data following the annual mean, as opposed to a seven-day period. As Fig. 1 shows, judicious choice of the seven-day period could result in substantial differences in the tidal heights being used to define the foreshore boundaries. Furthermore, over a year the atmospheric effects should be averaged out. However, as stated above, the nodal cycle of the Moon's orbit results in an 18.6-year tidal cycle, therefore, measuring in the year of 2006 (when the nodal cycle is next at its maximum) as opposed to 1997 could result in measurable differences to property boundaries, but are likely to be insignificant where there is substantial erosion or accretion. The result of this definition is that a small zone in the middle of the intertidal zone is classified legally as foreshore with private property rights extending into the upper intertidal area, foreshore in the middle, and the lower intertidal area being defined as sea bed (see Fig. 3).

5.2. Definition of the foreshore in Scots law

In Scotland, the foreshore is more extensive than as defined under English law. Following the case, Fisherrow Harbour Commissioners vs. Musselburgh Real Estate Company Limited, the Scottish foreshore is settled as the area between the high and low water marks of ordinary spring tides (except where Udal laws apply, see below). This was despite Musselburgh Real Estate arguing that the English definition had settled the argument in Scotland. Lord Young disagreed clearly stating that although he could understand the desirability of a uniform definition, the law in Scotland was different and in his opinion the Scottish definition was better than the English definition. Indeed, Gibson (1977) suggests that the advisory judges in the English case Attorney General vs. Chambers hinted at a similar point.

Gibson (1977) proposes that legal precedent also suggests that the seaward definition of the foreshore follows the landward definition (i.e. the use of spring tides to calculate both boundaries, see Fig. 3). The definition of the Scottish foreshore appears to have been settled as the area between mean high water springs (MHWS) and mean low water springs (MLWS). This results in the upper area of the intertidal zone being designated as private property, but this area is less extensive than under English law, with a more extensive middle zone of foreshore than found under English law, and a small zone of sea bed being legally defined as foreshore at the lower level of the intertidal zone (Fig. 3).

5.3. Definition of the foreshore in Udal law

Udal law is a form of allodial landholding with an absolute right of property (Drever, 1933). It is beyond the scope of this review to examine the relationship between Udal and Scots law in any detail (see Drever, 1933; Ryder, 1989; McGlashan, 2002 for further details). Udal landholding applies to properties in Orkney

and Shetland which have not passed to the Crown at any point in the past. If an Udal title passes through the Crown it becomes feudal (i.e. it becomes part of Scots law).

Following the decision in Smith vs. Lerwick Harbour Trustees (p. 681), Udal property at the coast extends to the "lowest low water mark". Therefore, private property extends from land across the full extent of the intertidal zone. This is completely different to the rest of Great Britain, where the foreshore is owned by the Crown unless specifically disposed of through a Crown Grant (or the Duchies of Cornwall or Lancaster own the foreshore). However, beyond the private ownership rights to the intertidal area, this extends to the 'lowest low water mark'. If a line were to follow the lowest low water mark, it would be below MLWS (the Scottish seaward foreshore boundary). As the lowest low water mark is not generally considered as a descriptor of a position of the tide, it has been suggested that it corresponds to lowest astronomical tide (LAT: McGlashan, 2002). It is rare for the tide to reach LAT, usually occurring only once or twice a year. Therefore, under Udal law, there is no middle zone of property ownership (or foreshore that is Crown property as found under both Scots and English property law regimes), instead this area is in private ownership out to the lowest possible tide level. Thus the full extent of the intertidal area is under private ownership. Therefore, this is the only foreshore definition in Great Britain where the privately owned land abuts the sea bed (Fig. 3).

6. Discussion

Given the above discussion of the varying definitions of the word 'foreshore', both legally and from a geomorphological perspective, it could be argued that coastal geomorphological and coastal management textbooks should avoid the term 'foreshore' and should instead use terms linked to physical processes or morphological descriptors e.g. 'intertidal zone' or 'beach face'. Even these terms may however require more detailed investigation when identifying the specific location on the ground.

The term foreshore has been used in the titles of a number of research papers e.g. Attrill et al. (1999), Battjes and Groenendijk (2000), and Holland and Puleo (2001). In these cases, the term is not defined in the text, rather it is assumed to be the same as, or similar to, the beach. In many cases, the term 'intertidal' is used (e.g. Hansom, 1988; French, 1997; Nordstrom, 2000) instead of foreshore, probably because intertidal is a better descriptor of the process environment. Indeed a number of researchers have defined the foreshore as a morphological feature, and used mean high water (MHW) as the landward boundary, however, MHW is not a morphological feature (Pajak and Leatherman, 2002), as it usually lies seaward of the berm (Morton and Speed, 1998).

The word 'foreshore' appears to be a socially constructed term linked to the definition of legal boundaries, the position of which varies from country to country. Furthermore, the area in which the foreshore is designated lies at the coast, which is a dynamic geographic region, subject to change at a variety of scales. Lee (2001) notes, "the coastline has been the most dynamic element of the British landscape over the last 1000 years." These aspects, linked to the public perception of the foreshore, creates a legal boundary system, defined on the basis of natural processes, which cannot take into account the extremes of the coastal tidal regime.

The various geomorphological definitions of the foreshore may initially appear similar to the legal definitions. A number of them are however considerably more extensive than the British legal definitions. Approximately half of the geomorphological definitions noted above are quite vague (e.g. Johnson, 1919; Creswell, 1957; Mather and Ritchie, 1977; Lapidus and Winstanley, 1990; Bird, 2000; Woodroffe, 2002). The other geomorphological definitions are more specific and geographically more extensive. Bird's (1996) definition is close to the Udal definition of foreshore being between the highest and lowest tide levels. However, King (1972), Horikawa (1978), Hardisty (1990), Trenhaile (1997) and Komar (1998) all use more extensive definitions much more linked to processes, which include the landward extent being either the beach berm and/or the maximum limit of the uprush of wave swash on the beach (Fig. 2). The maximum limit of wave swash can be considerably higher than the observed (or predicted) still water level of high tide. Moreover, these definitions assume a steady-state environment.

Coutts (1989) highlights that there is an area on sandy coasts with dunes that may be considered to be a dynamic envelope which is the, "nearshore-beach-dune system which is in a constant state of movement". Coutts expands upon this by emphasising the cut and fill cycle, whereby calm periods result in a steady build up of sediment on the beach, which eventually makes its way into the dune system by aeolian processes and sand trapping by vegetation. With stormier seas the reverse takes place, resulting in sediment being moved offshore and waves often eroding the frontal dune. If a storm is particularly severe, the erosion may reach as far as the secondary dune ridge.

In such a dynamic environment, defining a boundary will always be difficult, whether based on geomorphological, botanical, hydrological or administrative methods. Crowell et al. (1991) state that the horizontal

positions of the mean high water line and instantaneous high water line are almost equivalent. This is however only the case where there is a small tidal range and a steep beach. Indeed, both the instantaneous wet/dry line and the vegetation line (amongst other indicators) have been used for mapping the position of MHW and identifying change over time (Dolan et al., 1991; Morton, 1991; Crowell et al., 1993; Thieler and Danforth, 1994), despite being inappropriate proxies (Morton and Speed, 1998). Indeed, the instantaneous high water line is often used to identify MHW when interpreting aerial photographs because it is easy to identify (Dolan and Hayden, 1983; Leatherman, 1983; Morton, 1991).

The definition of the foreshore as applied under English law is the least extensive in Great Britain (MHW to MLW). The result of this definition is that approximately 50% of the time the high tide will be above the MHW mark, and therefore above the foreshore into the private property area. At the seaward boundary of the foreshore there is a similar situation, whereby on 50% of low tides the tide is liable to fall short of the foreshore. This could generate problems where there are areas protected under byelaws or SSSIs, which generally extend only to the seaward limit of the foreshore. SSSI regulations will not then apply to the area between the seaward boundary of the foreshore and the lowest position of the low tide. Under both Scots and English laws, there is therefore an area of the intertidal zone exposed on a large number of low tides which is below the defined SSSI, yet functionally linked to it. Under English law, 50% of the predicted low tides would result in an area being exposed below MLW, and therefore below the area designated as an SSSI. In this area, operations could be undertaken which may result in damage to the SSSI, but are not covered by SSSI regulations. Although, the foreshore in Scotland is more extensive, half of the spring high tides will exceed the foreshore (MHWS) and affect private property. Similarly, at the seaward boundary of the foreshore (MLWS), half of the low spring tides will result in an area exposed below the level of MLWS, beyond any defined SSSI. It is only where there is an Udal title in Orkney and Shetland that the foreshore encompasses all the 'land' exposed at the lowest of tides. However, as there is no private property boundary at the landward edge of the foreshore under Udal law, there have not yet been any legal cases to define the landward extent of the foreshore. If Gibson (1977) is correct in applying the complementary definition between the seaward and landward boundaries of the foreshore, then the landward extent of the foreshore under an Udal title would be highest astronomical tide (HAT). Such a definition would however be meaningless from a private property perspective, as private property extends to LAT.

If these definitions are applied to tidal data, the actual height differences in the Crown/private property boundaries can be illustrated. Taking tidal data from the Port of Dundee in the Tay Estuary, Scotland, the height of the Crown/private property boundary is 4.94 m above LAT under the English foreshore definition (Table 2). With the Scottish definition, the Crown/private property boundary is 5.43 m above LAT (Table 2) and the Udal Crown/private property boundary lies at LAT (Table 2). In the vertical these represent substantial differences. However, what matters to a landowner is the difference 'on the ground', in the horizontal. Much of the Tay Estuary has a low angle coastal slope, characterised by sand flats. Shore profiles were measured across Tayport marsh, Fife, Scotland (OS Landranger sheet 59, Grid reference 4728) from the main channel to c. 6.5 m above Ordnance Datum using an automatic level for the onshore component and an offshore survey undertaken by linking differential GPS to an echosounder on 10 April 2002. The average inclination of the coastal slope over this survey is 1:241. Applying the English definition to the averaged uniform coastal slope derived from the Tayport marsh area, would therefore result in the landowner gaining a substantial area of land as the Crown/private property boundary would move 120.5 m in a seaward direction from the position of the line under the Scottish definition. The Crown would therefore lose that land under the English definition. In a similar situation in England or Wales, if the Scottish definition was applied, the landowner would lose (and the Crown would gain) by the same amount. However, if the Udal definition were applied to Tayport marsh (again assuming a perfectly uniform coastal slope), the landowner would gain substantially, as the Crown/private property boundary would move slightly more than 1.3 km in a seaward direction. Even if in practice the coastal slope is not uniform, the scope for significant differences is clear.

Under all of the British definitions of the foreshore, private property extends into areas that the geomorphologist would consider to be intertidal. As the foreshore boundaries (except Udal: McGlashan, 2002) are illustrated by the Ordnance Survey on their maps, and these are used for the purposes of land registration, there could be the confusion that some of these privately owned areas were 'dry' land, as opposed to part of the

Table 2
Altitude of the Crown/private property boundary using tidal data from the Port of Dundee, Tay Estuary, Scotland

Property law regime	Altitude above LAT (m)
Scots law	5.43
English law	4.94
Udal law	0

intertidal environment, regularly inundated by the tides. The legal boundary between the 'land' and the foreshore is not in the same place as the limit of tidal inundation under Scots and English laws. The legal landward limit of the foreshore under Udal law is untested in law, but may extent to either HAT or MHWS. If a uniform definition were to be applied across the whole of Great Britain, the Udal example of LAT for the seaward definition, extending to HAT would be the most appropriate definition to utilise in relation to the intertidal area (the area directly influenced by the tides). However, the extension of private property into this area may not be the most desirable situation from a management perspective.

From a geomorphological perspective, three of the previously noted geomorphological authors (King, 1972; Horikawa, 1978; Trenhaile, 1997) define the landward extent of the foreshore as extending to the limit of wave swash or wave run-up (Fig. 2). However, this definition is of more use to a geomorphologist than a lawyer, as the position of wave swash is constantly changing due to the variance in the tidal cycle and meteorological conditions. A similar problem can be identified with Hardisty's (1990) use of the beach berm as the landward extent of the foreshore. There is certainly room for debate as to the actual position of the berm on any beach on any day. One route is for geomorphologists and engineers to abandon the word foreshore, except where they mean to refer to it in its strictest legal meaning in a stated jurisdiction. Indeed, there are many definitions of foreshore in countries beyond Great Britain. Furthermore, in each country the meaning of the foreshore (both legally and in the perception of the public) may be different from one to another. As an alternative the term 'intertidal zone' is in common use by geomorphologists and natural scientists and this may better represent the area of interest to a geomorphologist than the term 'foreshore'.

Whilst there may be a geomorphologically ideal definition of the foreshore (or perhaps the intertidal zone), the foreshore exists in law for specific purposes. One of these is to define the extent of private property, another is to define an area at the coast where the public has a right of access and to undertake other specific activities. Whatever definitions of the foreshore are applied they must be useable and practical for lawyers to identify property boundaries, and the extent of public rights. Furthermore, they must also be practical for the Ordnance Survey to illustrate on their maps and for local planning authorities and conservation bodies to identify the extent of their boundaries. The foreshore boundaries that are used in Great Britain are based on tidal data, which may be better than basing the boundaries on morphological or botanical features that may be prone to rapid change. However, it must be borne in mind that the morphological features over which the tidal data are applied are subject to change. Indeed, these changes in the intertidal extent will be compounded by changes in the position of relative sea level (whether rise or fall) over time, perhaps contingent upon climate change.

The modern legal ideal of the foreshore is based on an 800-year-old construct that the intertidal area is 'waste land' and unusable. From a modern nature conservation or geomorphological functioning perspective the intertidal has real value and this suggests that the initial reason for the Crown ownership of the foreshore no longer applies, but could potentially have a valuable role in the natural functioning of the coastal environment. If the extent of the foreshore were to be re-examined, any land gained by the Crown could have a valuable role to play in conservation, land-use planning, and flood and erosion damage mitigation. Obviously, legal boundaries at the coast have an impact of the management of coastal resources. The variation in legislation between land and sea and the confusion in the coastal area for all aspects, not just property law, have been highlighted by a number of authors (Burbridge and Burbridge, 1994; Cleator and Irvine, 1995). Until legal complexities at the coast have been simplified, coastal management (particularly Integrated Coastal Zone Management) will struggle to be effective.

7. Conclusions

The word 'foreshore' would appear to be in common usage beyond the disciplines of law and geomorphology, and is commonly considered to be synonymous with the beach face or shore. Essentially, the foreshore is a term defined in law. However, each of the three British property law systems has its own definition of the foreshore. Furthermore, beyond law, different disciplines and the general public have their own opinions as to the extent of the foreshore, which rarely match the legally defined foreshore. From a geomorphological or natural process perspective, the ideal definition of the foreshore would be one that was the same as the intertidal zone, i.e. extending from LAT to HAT. However, changing any of the existing legal definitions of the foreshore would result in both private landowners and the Crown losing and/or gaining 'land'. There are various concepts attached to the foreshore particularly in relation to property law and public rights. If there are changes to the landownership aspects, this may have implications for public rights and land use.

It is suggested that geomorphologists, indeed, all non-lawyers, use the term 'intertidal zone' as opposed to 'foreshore', unless they are specifically referring to the section of the intertidal zone that is legally defined as the foreshore. In geomorphology, the use of the term 'foreshore' as applied to an area of the beach is

misleading in light of the many definitions used. The historic perception of the foreshore as an area of waste land may no longer be correct, but the value of the intertidal area could be conserved and enhanced with a modern interpretation of the legal definition of the foreshore which could have benefits for conservation, and potentially erosion and flood mitigation costs.

Acknowledgements

This work was undertaken whilst DJM was the recipient of funding through an interdisciplinary scheme from both the Economic and Social Research Council and the Natural Environment Research Council (award no. R42200034021). The authors wish to thank Jim Ford for drawing Fig. 3. The authors are also particularly grateful to one anonymous reviewer, Prof. W. Ritchie and Dr Jim Hansom for insightful comments on the manuscript. Publishers W. Green are thanked for their permission to reproduce Table 1.

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