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Predictive assessment as a tool in Dutch maritime heritage management

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Introduction

Background

As a complement to outright protection, archaeological heritage management is more and more concerned with mitigation of adverse effects of all sorts of activities. It applies to maritime heritage no less than to other heritage categories and it applies both to known and to yet unknown archaeological sites. This may be simply said, but it is one of the major challenges of any mitigation strategy: how, can one take into account what one does not know? Moreover, paradoxically, what one does know in detail, has, at least partially been destroyed by research and excavation. In order to address these challenges one can choose a predictive approach. Predictive modelling has it risks, but it also has its assets in situations where far-reaching decisions have to be taken based on meagre evidence. Under those circumstances, predictive models can be a useful tool. To the background of such considerations, a predictive archaeological map has been developed for archaeological heritage management in the Netherlands, by the National Service for Archaeological Heritage, ROB. Although the map renders both terrestrial and maritime archaeological values, this paper is concerned with the maritime aspects only.

In the development of a predictive management tool, different models had to be used for different situations. A quantitative approach was feasible for that part of the Netherlands where the research tradition and cumulative knowledge extend over two centuries. For the submerged, underwater areas we can only hope that such a longstanding tradition will develop in the future. For now we have to base ourselves on a qualitative approach. Such differences in approach highlight the fact that predictions can be good or bad, but that they are never perfect. New information will induce adjustments. The test of predictions, after all, is in archaeological practice. The present map is a tool for the situation, based on present perceptions. The present approach will hopefully stir up a lot of interest and discussion in order that we emulate our present perceptions and prepare better tools in the future.

The Netherlands

One of the typical characteristics of the Netherlands is that it borders on the sea and that it features a lot of water (Fig. 1). Areas that were previously dry land have been lost to it, whereas on the other hand whole stretches of water have been reclaimed as land. For archaeological heritage management this is an important factor. The reclamation works in the former Zuiderzee, for instance, have brought a wealth of archaeological shipwreck sites within the scope of dry-land archaeology. In addition, previously drowned Atlantic landscapes, featuring the remains of extensive use by human populations were suddenly disclosed. A balanced assessment, characterising the specific archaeological value of water, reclaimed areas, land and drowned landscapes remains to be elaborated. In fact, it has only been during the last two decades that Dutch waters have been given serious archaeological attention.

In maritime planning the need for an indicative measure of relative archaeological wealth for different areas, has presented itself at least as urgently as in urban and rural planning. For a start, the area that is covered in water is no less than twice as extensive as the area of traditional planning concern. Secondly, large-scale construction and rearrangement of infrastructure derives most—if not all—of the indispensable building materials from the underwater environment. Rearrangement on dry land thus implies rearrangement in watery parts. Mitigation of the impact of development on the archaeological 'resource' is deficient if it does not cover it all, including the locations where sand or gravel is to be extracted. Also, the scale, at which hydraulic construction, dredging and reclamation affect the underwater heritage, probably exceeds the scale at which the traditionally acknowledged archaeological values are being affected by development. In order to balance heritage interests with other interests, it has become more and more important to indicate which areas are archaeologically important and which are less so, both under land and under water.

The underwater environment to be addressed features both drowned landscapes and remains of maritime activities such as wreck. Both either have been disturbed by later developments or have kept their integrity. In order to present an indicative assessment of the archaeological value of both, a combined system has been developed and integrated in the so-called Indicative Map of Archaeological Values (IKAW).

Maritime heritage lacks the insights issuing from a long-standing tradition of research. This may be a disadvantage, but not exclusively so. Heritage management in a maritime and underwater environment can profit from experiences elsewhere, but is not burdened by traditional biases. New ideas have to be developed and have to be tested. Confronting these with the ideas developed to predict archaeological values in extensively surveyed, dry land, areas is highly stimulating. In fact the IKAW is the result

of such a confrontation and may be seen as an invitation to continue the debate. It is not a final assessment. The reasoning behind the map is presented, as well as some of the problems and lessons resulting from its drafting and the confrontation of its several component parts.

Quantity or quality

The distribution of finds

> ...for it is probable that a greater number of monuments of the skill and industry of man will, in the course of ages, be collected together in the bed of the ocean than will be seen at one time on the surface of the continents (Sir Charles Lyell, 1832: 322).

In those words the eminent founding father of geology, Sir Charles Lyell, expressed what might well be the earliest predictive statement on the archaeological potential of the underwater world (Lyell, 1832 [1997]: 322). In his discussion on taphonomy Lyell puts great emphasis on all underwater environments and on the fact that human remains, both physical and cultural, stand a very good chance of preservation in those environments. He includes the formation of shipwreck sites in his discussion. In the first volume of his 'Principles' he laments the fact that the scientific fieldworkers cannot expand their taphonomical observations to the underwater world:

> ...there can be little doubt, although the reader may, perhaps, smile at the bare suggestion of such an idea, that an amphibious being, who should possess our faculties, would still more easily arrive at sound theoretical opinion... (Lyell, 1830 [1997]: 32).

A diving geologist or archaeologist indeed smiles reading this, but for a slightly different reason: we diving archaeologists can put his suggestion to the test. The quantitative drift of Lyell's statement largely finds its basis in the specific qualities of both the cultural and the geological systems. On the one hand one could say that mankind's dependence on water and the fact that 'anything that can submerge will submerge' (after Edward A. Murphy Jr., U.S. Air Force, 1949) is the guarantee for a rich original distribution of remains. On the other hand, the fact that water basins large and small are accumulative rather than erosive environments will warrant preservation.

However, the existence of 'monuments of the skill and industry of man' is not the same thing as the distribution of finds. For the latter, it is as much essential that things be found as that they exist. And that is just one of the biases. Any distribution of finds and observations is subject to a whole series of processes. Some of these are simple and easily understandable. Others are more complex. We are only starting to objectify those factors in theory. It is, for instance, easily understood that nothing is found where nobody ever looks (a non-trivial factor in underwater archaeology!). That is just a simple observation. A whole range of factors, however, contributes to the formation processes of the 'maritime' archaeological record. Understanding this is a major challenge of present-day underwater archaeology.

In order to assess the distribution of 'archaeological values', the present distribution of finds is indicative only in a very limited way. In fact, it can only be accepted as predictive if two serious conditions are met. Firstly, the original distribution of phenomena over a large area should be a random one. At least, one should be able to surmise that it approaches randomness. Secondly, a substantial part of that same area should be opened up as completely as to dependably reveal the distribution. Under those two conditions, a simple extrapolation can be used to make quantitative predictions for other parts of that area. Neither condition, however, is unproblematic. Discussions related to the quantitative approach of the first generation IKAW show as much (Deeben, *et al.*, 1997, 2002; Kamermans & Wansleeben, 1999). The practical exception, perhaps, is the specific category of shipwreck sites in the distal part of the Zuiderzee area, which will be discussed below. This extensive 'lagoon' has partly been reclaimed as land. The planning and development of these 'polders' has taken up most of the 20th century. When, in the late 1970s, the later renounced reclamation of the so-called Markerwaard, the present Markermeer, was still under preparation, it was proposed to estimate the archaeological consequences and the necessary budget on the basis of the density of (ship-) archaeological finds in the adjacent reclamation areas, using statistical extrapolation. Such an inductive approach seems to be adequate for that specific purpose. Under most circumstances, however, even the distribution of accidents, such as shipwreck, is far less randomised. In developing a generalised predictive assessment of archaeological values in Dutch waters, the actual distribution of finds is therefore used with a lot of caution and certainly not as the decisive clue.

Landscape reconstruction

The example above well illustrates the fact that the distribution of finds can only be interpreted in relationship with an interpretation of palaeogeography. Moreover, one could say that reconstruction of successive geographical developments is the inevitable prerequisite for any predictive statement regarding the potential archaeological wealth of a particular landscape. One can address this in various ways. One can, for instance, combine environmental reconstruction with the modelling of behaviour and cultural preferences of past societies. In the development of a strategy for protection of Stone Age settlement sites along the presently submerged Stone Age coastline of Danish fjords, this has successfully been done (Fischer, 1995).

The Danish example is somewhat different from the situation in the Netherlands. The extent of the drowned zones in Denmark is determined by the undulating

contours of the Pleistocene landscape that likewise determine the geomorphology of today. By contrast, such landscapes are far less directly 'legible' in the present morphology of the Netherlands. Because in large part they have been formed and transformed through ongoing sedimentation and erosion during the Holocene, they are more problematic to unravel. This may appear to be a handicap. However, this problem is directly linked to the deep sedimentation and its specific qualities, which—as will be argued below—are to be assessed positively. The super- and juxtaposition of fossilised elements of successive landscapes is, therefore, in itself extremely relevant for present-day archaeological management. This is as true for current maritime zones as it is for the current terrestrial area.

That landscape reconstruction is important for the assessment of settlement opportunities in a particular period may be self-evident. The same will apply to the opportunities for economic activities such as putting up fish weirs and logistic opportunities such as for fords, anchorages and landing-places or bridges, piers and quays. The examples chosen here, are all consciously related to the maritime cultural landscape in order to stress a line of thinking often alien to most settlement archaeologists (Westerdahl, 1992; cf. Maarleveld, 1998: 37–54). In respect of the 'opportunities' for shipwreck to occur and archaeological site-formation to ensue, landscape reconstruction is just as relevant. It is certainly no less problematic and again it is subject to physical as well as cultural factors.

The cultural dimension of the location of sites resulting from accidents may not immediately be evident, but can neither be repudiated. In fact it is rather influential both in preferred trade routes and in curative behaviour: in order to avoid shipwreck, to reduce risk and to reduce loss in cases where disaster is unavoidable a sailor will take deliberate action. As a consequence, he chooses or influences an eventual place of loss. In dealing with those factors in predictive assessment, however, one could advocate a 'nautical uniformitarianism': the proposition that a mariner's interaction with environmental factors like tides and winds, may be variable according to his experience and according to the size and propulsion of his craft, but will essentially be the same, regardless of his position in time or culture (cf. Irwin, 1992; McGrail, 1993).

Adopting this uniformitarian approach has the consequence (and the practical advantage) of giving even more weight to (palaeo-)geography. For the rocky coasts of the Mediterranean the concentration of wreckage and dumped material at the cliff-foots of shipping hazards—reefs, isolated islets, projecting headlands—has long determined the search agenda and continues to do so (Diolé, 1952; Dumas, 1972; Gibbins, 1990; Parker, 1992). For the Netherlands and the maritime expanses covered by its present extent, the reconstruction of previous land- and seascapes may be an extremely problematic challenge. The usefulness of 'nautical uniformitarianism' in predicting the specific location of wreck sites, however, is demonstrated on a day-to-day basis by a battery of navigators turned archaeological hobbyist specialising in wreck survey. Their results emphasise how detailed a maritime 'landscape reconstruction' should be for predictions at site level and how little of this has been elaborated in published material.

The historical record

Despite major historical-geographical studies addressing cultural interference with the maritime landscape in the Netherlands, it is quite clear that the information is biased. It is far more detailed with respect to those areas presently managed as land than with respect to the greater bodies of water. Where charts exist or waterways can be reconstructed in maps, the detailed location in a projection or modern map grid is hardly ever unequivocal at a detailed scale, let alone at site level. Nevertheless, the historical record, including navigational and tidal data is an important aid in maritime landscape reconstruction. For the assessment or accentuating of archaeological consequences of coastal rearrangement projects historical-geographical reconstruction can be of great use (Maarleveld, 1986). The flaw is the limited time-depth of the historical record. For that reason, the historical record is insufficient for a general assessment of archaeological values.

The situation is even worse in regard to historical information on 'shipwreck'. On the one hand the historical record is an extremely rich source. On the other, one must concede that it is very strongly biased in several ways. Firstly, it is biased to what happened in recent times. Secondly, it is biased to what happened close to shore. In particular, moreover, the historical record registered those incidents with an extensive aftermath. More has entered into the historical record on wrecks that have been salvaged and demolished than on those that conserve integrity. As a basis for an overall conservation policy the historical record is consequently inadequate. This thesis contrasts sharply with the endeavours of the Royal Commission on the Historical Monuments of England (RCHME 1996). It is also contrary to many strategies chosen for conservation of maritime heritage in Australian waters in which preservation of sub recent wrecks is high on the agenda. Rather than that the thesis implies disapproval of such strategies it illustrates differences in emphasis which are fundamental to the appreciable worldwide diversity of approaches to heritage management (Maarleveld 2003: this volume).

The terrestrial model

Elements of the approach chosen for the development of the Indicative Map of Archaeological Values (IKAW) in the terrestrial area are very useful for its maritime complement. For instance archaeological and palaeogeographical 'provinces' have been defined that can be treated as

a unit for a uniform approach (Groenewoudt, 1994). The definition of these so-called archaeoregions runs parallel with the differential approach chosen to address the problems of heritage management in Dutch waters since 1980. Other elements, such as the quantitative assignment of value to units of specified soil type and groundwater class, are useless in a maritime setting. The inadequacy starts wherever Holocene watercourses have produced sedimentation. Also, the problems encountered in assessing those regions with a deep Holocene build-up of successive landscapes are relevant for the maritime zones and *vice versa*. So are some of the solutions. Focussing on successive fossilised tidal inlets and estuaries seems to be the way ahead. All in all, however, the primary quantitative basis of the terrestrial model cannot be used. For one, the quantitative data regarding the distribution of finds in the maritime environment is far too biased (and differs in its bias from the archaeological record in general). For two, geo-scientific maps with adequate resolution do not exist for the maritime expanses. Instead of generalising detailed information, as the terrestrial model tries to do, the approach for the maritime environment has so far been to refine a very rough general picture emanating from the first decades of experience.

Preservation potential

The really exceptional factor in the 'embarrassment of riches' (Maarleveld, 1993a) that the Dutch maritime archaeological record represents since the inception of its exploration, is the quality of preservation. The subsiding subsoil, the rising sea level and the fine-grained soft sedimentation, offsetting those movements in the estuarine and tidal inlet areas, have warranted wonderful anaerobic preservation conditions. This applies both to remains embedded in submerged occupation surfaces and to remains that have sunk. In both instances the most fragile organic materials have been preserved in close correlation. In both cases it is the specific quality of preservation that is to be valued most. As a consequence the guiding principle for developing an assessment of the relative importance of various zones is to be sought accordingly.

For the remains issuing from spot-bound activities, it is evident that their relative preservation quality is to be evaluated in relationship to the preservation of surfaces that were originally suitable for their coming about. Although the input data is different, modelling the presence and condition of submerged and covered landscapes underneath the present IJsselmeer and other bodies of water should aim at the same general objectives as have been set out for other, presently dry parts of the Holocene area.

For the remains issuing from shipwreck, the conditions favouring the quasi-integral encapsulation of ship and contents are to be valued most. Although in other contexts it is understandable that the relative importance of scattered wreck sites is vindicated (Muckelroy, 1975; Gibbins, 1990), these are to be considered second rate in the Netherlands. In other words, it is integrity, as much as preservation of fragile organic materials that is to be valued.

For ship-remains, seeking a guiding principle for generalised assessment of integrity and quality of preservation has quite a few consequences. It means, for instance, that preservation is given stronger weight than age as a primary criterion. With the complex patchwork of sedimentary units that we are looking at, that seems to be a reasonable approach. All are recent in a geological sense. They are, however, of different ages on a historical time-scale. Dating comes second for two reasons. The first is of a practical nature: too little data is presently available to assign dates to batches of layers at a discriminatory resolution. More fundamental, however, is the fact that we are looking at developing a tool for archaeological heritage management. A shipwreck site of great integrity dating from the 6th or 11th century AD is hardly less valuable from an epistemological point of view than a similarly well-preserved site from the Bronze or Iron Ages. Both have the potential to thoroughly influence our construction of the past. From a managerial point of view, it is therefore impossible to attribute a greater value to either the one or the other. Both Dark Age and prehistoric vessels have been preserved in the deep Dutch sediments. The great challenge to be met is not to fail in their discovery during mitigatory management. That is a purely practical mission.

With preservation potential as guiding principle it is still *the greatest density of high quality* that is to be given the highest rating. The present distribution of finds, the historical record and landscape reconstruction, as far as that goes, are used as corroboration for a primarily environmental model. A first assessment of environmental factors involved was presented in 1995 (Maarleveld, 1995; also Maarleveld, 1998: 55–71). By combining the available information for the various environments in Dutch waters, a somewhat more detailed general assessment can now be mapped and presented as an integral part of the second generation IKAW (Deeben, *et al.*, 2002).

Resolution and scale factors

Seven aquatic regions

A growing body of information is becoming available regarding the subsoil of Dutch waters. Nevertheless the inferences are based on a far smaller number of observations per square mile than are available for dry land regions. The ratio between theory and deduction on the one hand and data and induction on the other is forcibly different. Also, the resolution of the maritime complement to the Indicative Map of Archaeological Values is less fine-grained and varies from one zone to another.

For archaeological management in Dutch waters seven zones have been defined (Fig. 1). In indiscriminate order

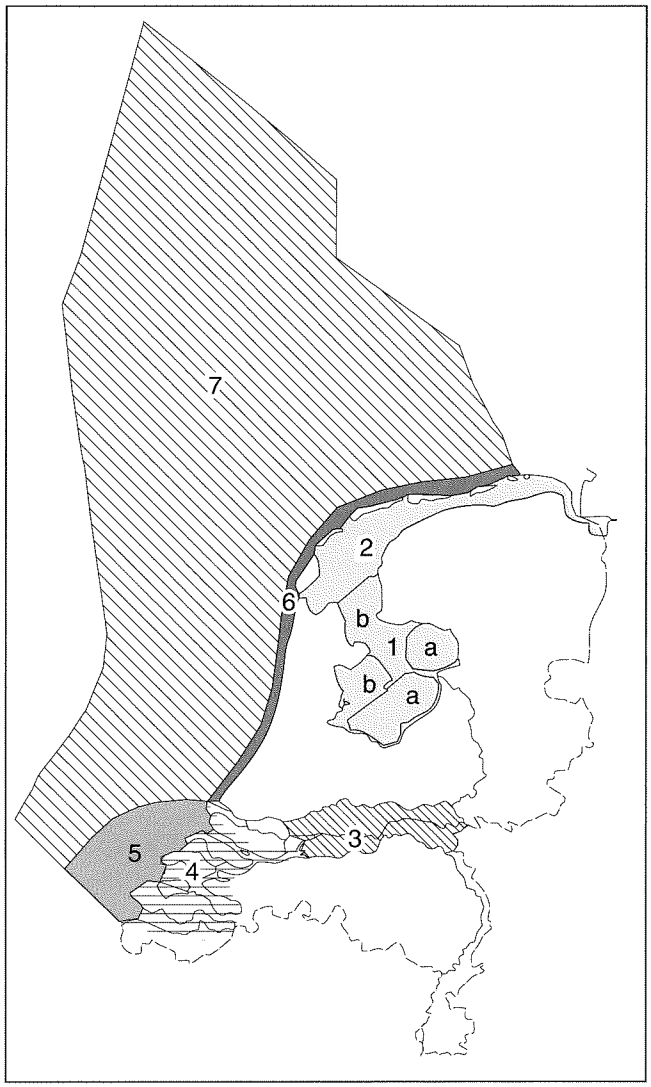

Figure 1. Map showing the seven maritime heritage-management zones discussed in the text. Legend: 1 IJsselmeer (*a* reclaimed polders, *b* remaining IJsselmeer and Markermeer); 2 Waddenzee; 3 Central river area; 4 Zeeland delta; 5 outer delta; 6 coastal zone; 7 Netherlands Continental Shelf.

they are:

- IJsselmeer (a–reclaimed polders, b–remaining IJsselmeer and Markermeer);
- Waddenzee;
- Riverine area;
- Zeeland-delta;
- Outer delta;
- Coastal zone;
- North Sea bottom.

In distinguishing between these seven zones, practical, managerial arguments have been decisive. In other words, incongruous factors have been combined. The first level of distinction, however, is based in geology and will be explained hereafter. At that more theoretical level it is five—more extensive—regions that can be distinguished. They are: the area in which successive tidal basins have been active in the North (including the convex ebb-tidal deltas connected to these); the deeper—estuarine—tidal basins in the South (including their Outer Delta); the coastal zone in those parts with a steep and concave shore-face; the generally flat North Sea bottom; the central river area.

The second level of distinction is a function of present use. In the North it is obvious that it is useful to distinguish between the dynamic tidal environment of the Waddenzee, the limnologic conditions of the dammed parts of the former basin and those large areas that have been reclaimed. In the South a not wholly dissimilar distinction imposes itself for the extensive Outer Delta, the embanked Westerschelde River, the dammed inlets and the patchwork of silted and reclaimed former bodies of water. The central river area, in conclusion, needs a far more detailed approach and is not—presently—divided in meaningful smaller managerial units. The five genetic regions are elaborated in the discussion below.

The coastal zone

Despite its dynamics, the coastal zone is perhaps the most uniform of all archaeological management zones in the Netherlands. It features a sandy shore-face that is generally steep. The morphology offshore and the tide- and weather-controlled hydraulic processes determine constant change. This change, however, results in reworking and homogenisation of its content. For the present purpose the estuarine delta in the South and the ebb-tidal deltas in front of tidal inlets in the North, both of which feature better conditions for long-term preservation, are classified with their parent tidal basins and will be discussed therewith. This leaves us with a coastal zone in which the seasonally changing cross-section of the shore-face is concave; in which—despite seasonal and secular variations—the present trend is a retreating shore-face. If not with equilibrium, we are dealing with erosion rather than sedimentation. This applies both for the west coast to the South of the Texel High and for the coasts of the Frisian islands to the North-east thereof. In the latter parts, where the offshore fetch for north-westerly gales is extremely great and the presence of an offshore zone of barriers—the so-called '*gronden*'—emphasises the dynamism of the high-energy zone, the cross-section and local variations may be a bit more complex. Nevertheless, reworking outweighs stasis and preservative qualities are low.

In present coastal management the short-term changes are constantly monitored. Coastal retreat and coastal accretion are registered in detail. Dynamic management is the approach to coastal defence. It features large-scale

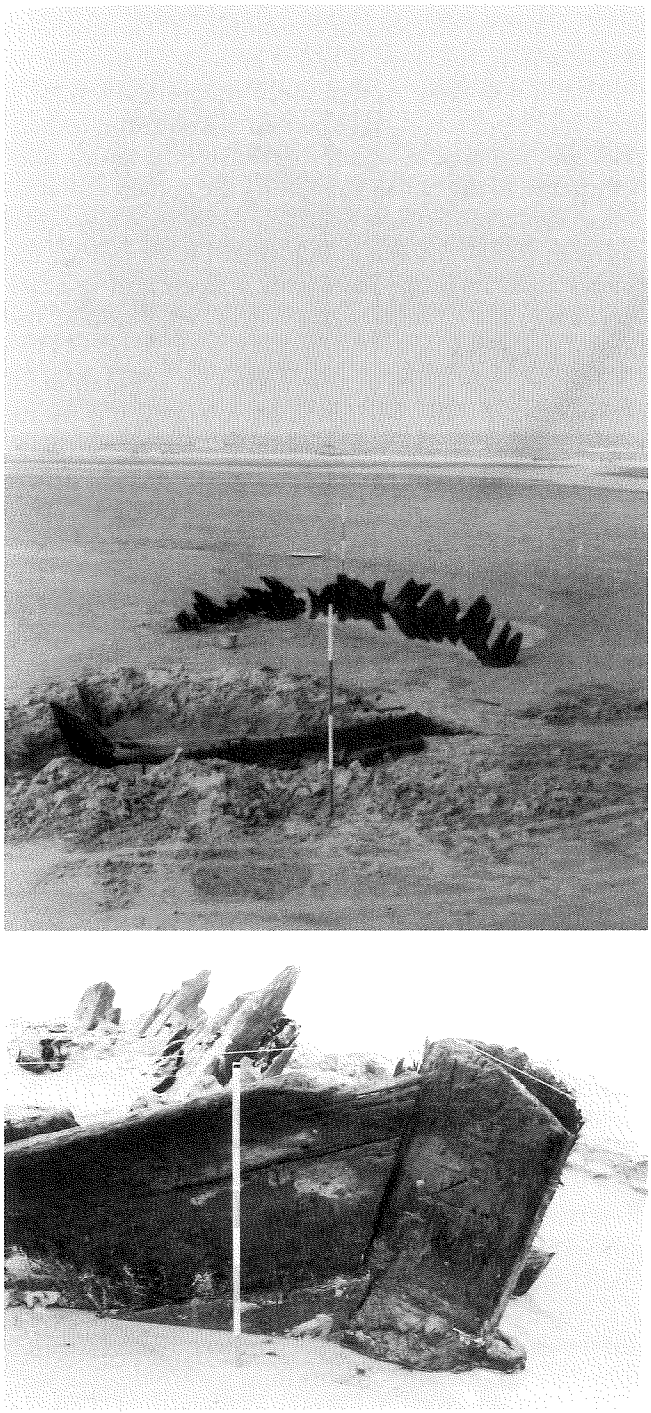

Figure 2. The coastal zone regularly reveals substantial pieces of wreck. The dynamics of their movements are poorly understood. Fluidisation of the shore-face in extreme conditions is certainly a factor. This 18th century wreck on the Terschelling beach (paal 19/20) emerged overnight after a February storm in 1981. Note the 5 feet depth mark on the stern-post.

sand-suppletions both at beach-level and at the heel of the shore-face. The necessary material, coarse sands of mostly Pleistocene date is extracted further offshore. In its present and long-term scale this activity—unmitigated at present—will certainly affect archaeological values; remains at the Pleistocene—Holocene interface on the one hand and wreck sites on the other, will be impaired.

The homogenisation referred to above, result in a low assessment of long-term preservation of archaeological integrity in the coastal zone. Given the fact that the deltas have been excluded, no distinction at a finer resolution seems to be possible or necessary. Also, the low assessment tallies with observations of archaeological features in this area during the last twenty years. That is to say, it tallies in a qualitative sense. Archaeological discoveries in this zone are a function of reworking and homogenisation itself. Although one is often confronted with considerable pieces of structure, it is always isolated bits (Fig. 2). Association of several categories of finds, such as ship and cargo or inventory hardly ever occurs. Remains issuing from 'occupation layers' occur as isolated secondary finds, or, occasionally, in eroding patches of compacted soil which are exposed by the retreating dunes and beach that constitute the shore.

In a quantitative sense, the scores are definitely different. The frequency of discoveries is relatively high. Findings are very varied. For instance, the beach is the area most frequented by detector-hobbyists. In fact, the narrow beach-line may well display a greater overall density of findings than any other unit in the pedological map. From a 'nautical uniformitarian' standpoint this is no surprise. The exposed beaches to the lee of the predominant westerly winds are an evident shipping hazard. Moreover, on the basis of purely physical processes a lee shore amasses a residual of jetsam, flotsam and wreck. If one reasons on the basis of the historical record, the relative frequency of finds is no surprise either. For those periods that feature reliable written records, the concentration of documented wreck in the coastal zone is impressive (Fig. 3). Occupation layers eroding in the coastal zone occur in the position where they were originally formed (*in situ*), as well as in displaced patches. Generally, they display little coherence that can be protected.

Despite the rich historical record and despite the frequency of exposures and discoveries of structural fragments and other items of considerable age, it seems reasonable not to select this zone as requiring much attention in archaeological heritage management. The reason is the quality of the preserved remains. These score lowly on the criteria of integrity of construction and of integrity of archaeological deposit. The archaeological value of the zone is homogeneous and has indicatively been charted as low: interesting surprises may occur, but no great density of high quality is expected.

Tidal basins in the North

The former Zuiderzee and the present Waddenzee are the most conspicuous outcome of a range of processes that date back a long way. The formation and evolution of extensive tidal basins, behind successive inlets in the sandy coastal barriers is one of the most characteristic features in the Holocene development of the Netherlands

Figure 3. The coastal zone displays a far greater density of wreck than the tidal inlets do, as is shown on this classical wreck-map by Frans Schot. The map is based on historical data and therefore has limited time-depth. On the basis of 'nautical uniformitarianism' similar differences in overall frequency of accidents can be inferred for all periods. The present interpretation of post-depositional processes leads, nevertheless, to a higher valuation of the more sheltered tidal environments than to the high-energy zone. It is not the highest frequency of phenomena, but the greatest density of high quality that counts in heritage management.

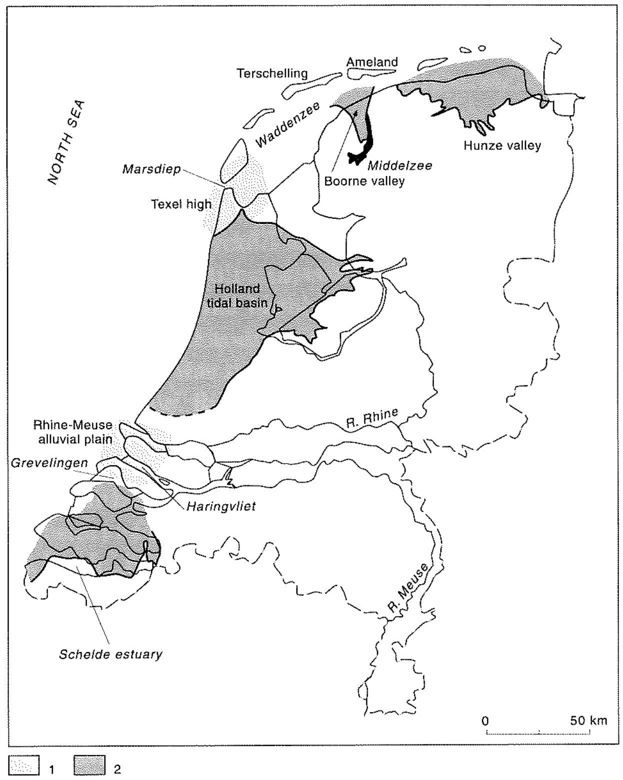

Figure 4. Map showing subsequent tidal basins that are fossilised in the Holocene sediments of the Netherlands (after Van der Spek, 1994). Legend: 1 former eroding headlands, seaward extent uncertain; 2 former tidal basins.

(Van der Spek, 1994). Corresponding coastal land- and seascapes have succeeded each other. The succession of tidal basins has determined the present outcome of highly dynamic processes. On the one hand, preceding situations were obliterated by erosion. On the other hand, deep sedimentation has warranted a remarkable accumulation. As a result, the present build-up of sediments is highly transected, but features remarkable conservation.

In the North of the Netherlands, the chain of interconnected tidal basins that now constitute the Waddenzee presently set the scene. In assessing the archaeological potential, however, one should be aware of the fact that their present extent is a function of sub-recent developments and of artificial measures for coastal protection. Reclamation has isolated the presently occupied spaces from the maritime zones. The Afsluitdijk of 1932 transformed the inner reaches of the Zuiderzee basin to a lacustrine environment, thus reducing the surface of the tidal basins in the North by about 60%. Underneath the present surface that is covered in water, and extending underneath the adjacent land, scours of previous tidal basins are filled with successive layers of gully- and flat-deposits (Fig. 4). Two of these previous basins, the Hunze valley tidal basin and the successive Boorne valley / Middelzee basins are precursors of the present system, for which a more or less continuous development can be asserted. The Altlantic Holland tidal basin has specific relevance in this discussion. This is because its distal parts extend underneath IJsselmeer, Markermeer and IJsselmeerpolders, the successors of the shallow, lagoon-like, distal part of the Zuiderzee-basin.

From the time of its formation, the Zuiderzee had a very determining influence on the development of society. The inland sea was intensively exploited for fishing. More importantly, however, shipping across its expanses was the essential linking pin in the interdependence of Medieval and post-medieval towns and agrarian as well as industrial regions. It was the central stretch in the regional infrastructure, which was completely based on waterways. For want of natural harbours, moreover, the deeper tidal inlets are the only practicable entrances to seaward. In consequence, all shore-based activities

relating to overseas traffic had to be concentrated along the shores of tidal basins or the rivers discharging into them. It is only in the context of those three influential factors that the location and development of towns and harbours in the Netherlands can be explained (Reinders, 1999; Sigmond, 1989). A similar pivotal function in the maritime cultural landscape and consequently in contemporary societies should be attributed to the earlier tidal basins of the Middelzee, the Hunze valley, the Boorne valley and the Atlantic Holland tidal basin. The fact that this maritime perspective has not generally been acknowledged in archaeology is purely a function of developments in the history of arts and sciences, including archaeology itself (Maarleveld, 1998: 37–54; cf. Westerdahl, 1992).

The attribution of a pivotal function to earlier tidal basins is to be understood in combination with the theorem of 'nautical uniformitarianism'. For the assessment of the present-day archaeological potential of these areas, it is a relevant proposition. It supports the choice for preservation and integrity rather than dating as primary assessment criterion.

So far the maritime archaeological experience has systematically disclosed information that indicates two, differing, environments displaying highly favourable preservation conditions following wreck within the tidal basins of the former Zuiderzee and the Waddenzee.

In the shallow, semi-enclosed, lagoon-like inland reaches it is those areas with an originally soft, unsettled, bottom which scores better than those areas with sandy shallows. The reason is simple gravitational sinking in of wreck into the unsettled slurry. This assessment is based on information on a great many sites discovered during earth-moving for the reclamation and development of the polder area.

Closer to the tidal inlets grain-size of the sediments is not a determining factor. Most archaeological sites displaying wreck with great integrity have so far been discovered in the mostly cross-bedded channel deposits resulting from contemporary gullies. The discoveries typically occur as larger present-day gullies erosively migrate. The remains then start to outcrop from the erosive bank of such a gully. The location is normally deeper than 6 m below ordnance datum. The remains are exposed as a result of erosive migration of present gullies, but in fact, they are part of the deposits of earlier gullies.

In drafting the present map indicating archaeological values, the several different environments favourable for the conservation of archaeological sites have been assessed separately. The presence of terrestrial surfaces underneath marine sediments is one of these. As such, it offered opportunities for human occupation and activities: habitable space. If such a surface has not been eroded away, it offers possible preservation of important remains. The presence of a sedimentary cover enhances the chances. With regard to navigable space, the presence of soft unsettled sediments below shallow expanses of open water offers possibilities for the preservation of wreck and so does the presence of cross-bedded channel deposits. All these have been charted as separate units. In a final assessment all units have been integrated in order to display three general values: low, middle and high (Fig. 5). High indicates the presence of an environment with good preservation potential. Low indicates the absence of such a specific environment. Important archaeological discoveries can occur, but are not presently believed to occur in great density. The middle value is less outspoken.

Tidal basins in the South and their Outer Delta

A substantive difference between the tidal basins in the North and those in the South of the Netherlands is that (tectonic) subsiding has been far more pronounced in the south-western Netherlands than in the North. As a consequence deeper sedimentation has occurred. In addition, the tidal range is much greater as a consequence of the general layout of the North Sea and the Channel. The greater tidal range combines with tidal asymmetry and must have characterised the area as soon as that general layout was effected by the early Holocene sea-level rise. In recent times, the tidal celerity within the basins has certainly increased, due to artificial delimitation of their surface by dikes. Since the disastrous flood of 1953, large tracts have been isolated from the sea through the deployment of artificial barriers.

The evolution of these basins has been determined by greater subsidence, deeper sedimentation, larger tidal range and tidal asymmetry (Van der Spek, 1994). Unlike the Zuiderzee and unlike the Atlantic Holland tidal basin they do not feature extensive shallow basins in their distal parts. Tidal currents have been more intense. As a consequence, the navigational situation in the '*Zeeuwse en Zuid-Hollandse stromen*' has been more alike to those areas of the Waddenzee that feature deeper channels close to deep inlets, than to the wide southern Zuiderzee further inland. In one respect, however, the southern tidal basins differ from the Waddenzee: the inlets are wider. Shifting sands and shallow bars have made them no less awkward to negotiate.

The present Westerschelde is a classic example of a 'funnel shaped tidal basin' (Van der Spek, 1994: 129–50). The same may have been true for its smaller—now blocked—counterparts and for its predecessors. For our present discussion it is highly relevant that their ebb-tidal deltas have merged into a continuous stretch along the coast, broadening from the estuary of the Meuse, towards the Flemish Banks, south of the Westerschelde estuary.

The development of the tidal basins has fundamentally determined the navigational and the occupational history of the area (Vos & Van Heeringen, 1997). The deep subsiding has locally caused early Holocene peat and clay to be protected underneath 18 to 25 m of marine sediments. Strongly compacted, these layers of Boreal

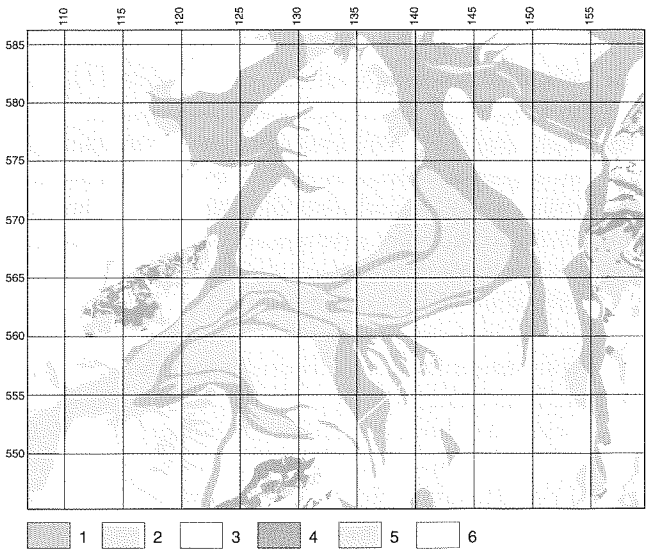

Figure 5. The IKAW of the western part of the Waddenzee. Legend: 1 high-value area under water; 2 middle-value area under water; 3 low-value area under water; 4 high-value area on land; 5 middle-value area on land; 6 low-value area on land.

age have produced plentiful Mesolithic hunting gear during recent disruption (Verhart, 1995). The build-up of marine sediments in the Outer Delta exhibits a deep three-dimensional mosaic of channel-deposits interfacing with horizontally layered barrier and shoal-deposits. It has a depth (or rather thickness) of 15 m at a minimum and up to 45 m where it cuts right through the compacted base and into the Pleistocene layers. All channels and shoals that are reflected in these sediments date from different Atlantic, Subboreal and Subatlantic phases.

In the Outer Delta, the resolution of the assessment of archaeological values is quite detailed. As a function of the intensity of present-day economic activity geo-technical, geological and geomorphologic information is relatively rich and detailed. Also, archaeological field-observations and mitigatory interventions have corroborated preliminary archaeological impact studies, related to large-scale adjustments of waterways and other infrastructure (Adams *et al.*, 1990). In drafting the indicative map, many different units could be distinguished. Adding up their qualities has resulted in a rather uniform score in the simple scheme of three values. Indeed, the assessment is a rather continuous area of high values, however subdivided it may actually be. The Mesolithic, semi-terrestrial discoveries are a valuable add-on.

The channel-deposits that can be surmised to contain wreck-sites of their respective post-Mesolithic ages are the specific asset of this region. If the present—admittedly crude—density indicators are only 20% true,[1] the area is still of utmost importance, especially because of its wide range of potential dating. The inner reaches of the Westerschelde are, by contrast, deeply eroded, ever since the late Middle Ages. At some places present erosion cuts into the tertiary deposits.

The Netherlands Continental Shelf

The Netherlands Continental Shelf or Dutch North Sea Sector, as agreed under a series of delimitation agreements with the other North Sea states on the basis of the Convention on the Continental Shelf of 1958, is an extensive area (cf. Fig. 1). At specific locations interglacial and early Holocene peats and clays have been preserved which are known to hold both Pleistocene faunal remains and remains of human activity predating the flooding of this part of the Continental Shelf (Laban, 1995). Since the North Sea came into existence, it has been a receptacle of erosion products and of all sorts of 'submerged' 'monuments of the skill and industry of man'. Since its origin, it has sustained regular traffic and cultural exchange. In recent times, it has been one of the busiest shipping lanes and fishing grounds of the world. It is no surprise, therefore, that it should be a rich maritime archaeological entity.

Nevertheless, present data indicate that the density of archaeological phenomena is less than close to shore.[2] Also, by comparison with the extreme integrity displayed by the best archaeological shipwreck assemblages in the Dutch tidal basins and deltas, the quality of preservation is much lower. Of course, the only assemblages presently scrutinized by archaeologists, are assemblages that are exposed and protrude from the sea floor. Presumably, they have been exposed for a long time. As such, they have been subject to intense bio-chemical degradation, as well as to mechanical damage by industrial trawl fishing. There is no doubt that our present assessment is biased by that limited view. It is certain that exceptional sites exist (Maarleveld, 1993b) and by comparison with rocky, sediment-lean environments preservation is still very good. All in all, however, comparing the conditions in this area with those prevailing in the richest areas under Dutch management leads to the conclusion that the general signature for the North Sea bottom is to be that for low density of high quality.

Very specific features are the deep sub-glacial valleys of Weichselian age in the extreme North of the Dutch Sector. Reaching to depths of around 20 m below the seafloor and presently filled with younger silts, these valleys must truly have been a very protective receptacle for anything submerging at that spot (Fig. 6). For that reason, they are being given a higher value than the rest of the continental shelf.

The river area

The resolution of information in the central river area is definitely far greater than on the Continental Shelf. Intensive study has revealed detailed information on its genesis. Detailed study has revealed a highly complex tapestry of sedimentary units (Berendsen & Stouthamer, 2001). It is the sheer complexity that prejudices predictive modelling and that sets the pitfall of not reckoning with the unknown.

So far, the archaeological analysis of the area has concentrated on its occupational history (Maarleveld,

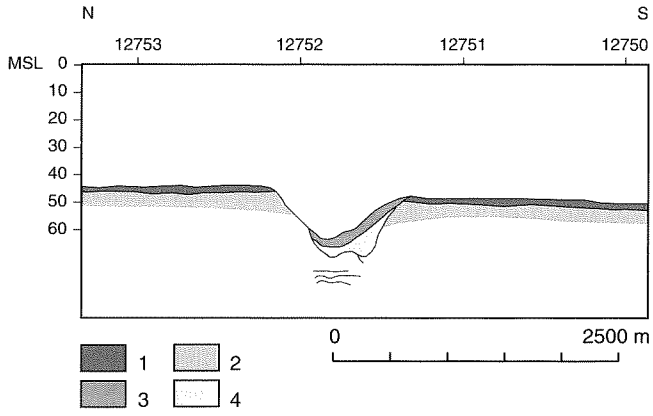

Figure 6. Section of sub-glacial valleys of Weichselian age in the extreme north of the Dutch sector of the continental shelf. Reaching to depths of around 20 m below the seafloor and presently filled with younger silts, these valleys must have been a very protective receptacle for anything submerging at that spot (after Verbers *et al.*, 1999). Legend: 1 Bolders Bank Formation; 2 Dogger Bank Formation; 3 Holocene sediment (undifferentiated); 4 Botney Cut Formation.

1998: 37–54; Deeben *et al.*, 2002). Looking at the area from a completely maritime or navigational perspective will produce a different (but equally distorted) picture. It will not take habitable space as a starting point for inferences but navigable space. The formation processes of archaeological wreck sites will have to be taken into account. Also, deeper and coarser sediments will have to be attributed archaeological value. It is quite clear that wreck of great integrity, resulting from sinking in relatively deep water can be preserved and found where deep channels have filled and not where channels have never existed.

Of course, an integrally useful assessment of archaeological values in the central river area will take account both of remains of sedentary occupation and of the remains related to infrastructure and passing transport. At present a lot remains to be done in order to apply both the systematic and thinking of the terrestrial IKAW, the palaeo-geographical reconstruction and the systematic and thinking used to assess the maritime heritage to this highly diversified zone. It is partly for this reason that the meandering channel deposits have been given a high value in the second generation IKAW. However parcelled the zone may be, the disparate evidence of the last two decades is that it certainly features a relatively high density of high quality. In June 2003, for instance, immediately after the successful excavation of a Roman river barge (Fig. 7) two other such vessels were discovered in the near vicinity. We should be aware that the rivers themselves are the arteries of the area, both in a physical and in a cultural sense. It was only in the last century that this latter role was taken over by railways and motorways.

Caveats and challenges

Intrinsic qualities

The indicative assessment of the relative archaeological wealth of different maritime areas, as integrated in the second generation IKAW, is no more and no less than the elaboration of the ideas presented above. Data relative to the distribution of finds and of field observations, relative to the interpretation of geological genesis and of land- and seascape reconstruction, relative to the interpretation of historical activities and of cultural preferences and data relative to the processes determining site formation and preservation have been brought together. A strong emphasis has been laid on preservation potential. It is inevitable, however, that our present model for preservation will want adjustment, as more data that is specific becomes available. Investigations during planning and realisation of large-scale interventions can take the present model as their basis. Such investigations will produce site-specific information. At the same time, however, they should also aim at adjustments at the level of general processes. It is inconceivable that site-specific information will ever be enough. With general processes in mind, one should beware of accepting site-specific information as encompassing, especially in those areas where deep sedimentation should be interpreted as promising more. The challenge of not failing in, for instance, the discovery of Bronze and Iron Age shipwreck sites during mitigatory management has already been mentioned (cf. Firth, 2002: 38).

The present state of development of ideas is such that those areas that have attracted archaeological attention are far better understood than those areas where hardly any archaeological work has been done.

For instance, the western part of the Waddenzee can be rendered with far more discrimination than the eastern part. The great density of high quality that it conveys can be attributed to relatively limited zones within the general area. The eastern part does not display such distinction. Deep gullies, presently uncovering remains of the past, are lacking. The deep scours of previous inlets have filled with protective sediments. Their great archaeological value can be inferred from similar deposits in the West. They are omnipresent. No reasons can be found to isolate zones to which a lesser value can be attributed. This example is relatively straightforward. On theoretical grounds, there is no exception to the high archaeological value that is to be given to the channel-deposits between Marsdiep in the West and Ems in the East.

More problematical is the transition between the Waddenzee environments close to the tidal inlets and the more sheltered environments further inshore. In the former, good preservation is known to occur at depths greater than 6 m. This general figure is thought to be related to the depth-limit of destructive action of waves under extreme conditions. Terrestrial remains are not preserved unless excluded from marine erosion. For ship remains, tidal scouring is thought to be the principal agent

bringing them to a deeper rest (Maarleveld, 1998: 62–3). In the lagoonal environments inferred for the distal ends of tidal basins, good preservation occurs at significantly lesser depths. At present, it would be preposterous to suggest that we can model the transition in any detail. Many factors are involved. A crude gradient has been used as a secondary criterion in the drafting of the present map.

Most problematical, perhaps, is the fact that the present inferences as used for the general assessment can be applied to the river area only at a very detailed resolution. This calls for a lot of detailed study that is lacking in the present draft. For the river area, the indicative values of the map call for detailed study in the context of planning any large-scale intervention.

Artificial boundaries

The integrated indicative map has obvious inadequacies. A very conspicuous feature is the inconsistency in valuation at artificial boundaries that separate water and (reclaimed) land. Reasoning on the basis of terrestrial units and reasoning on the basis of the maritime approach leads to such inconsistencies. Preoccupation with preserved habitable area and preoccupation with navigable space and potential preservation in deep sediments are hardly fully compatible. It is a feature stressing the inherent strengths and weaknesses of the two approaches to modelling that have been used.

The most evident examples of such artificial boundaries are the dikes around the recently reclaimed IJsselmeerpolders. In fact, draft indicative maps for this area were prepared on the basis of both approaches. For the development of the maritime approach, this has been an essential step. The 435 shipwreck sites within the reclaimed area are the largest sample of such sites on which both archaeological and environmental information has been collected. This information was used as a basis for inference for environments still covered in water. For the representation of the reclaimed *polders* on the actual map, it was of course decided to treat them as land, rather than as water.

A perhaps even more striking example of an area where the two approaches are conflicting is the series of polders in the Boorne valley. The polders were reclaimed from the former Middelzee, from the mid-eleventh century onwards. By 1300 AD, the distal part of the basin had already been totally reclaimed. In 1505, construction of the large polder of 'Het Bildt' practically completed the reclamation. When, in previous periods, the tidal basin had still been active; regular flooding of its banks had created shore-parallel levees (Van der Spek, 1994: 97–128). Obviously, these levees have been identified as preferred spots for settlement. Also, a great many Iron Age and early medieval settlements on these and on artificial mounds (*terpen*) have been discovered along both sides of the former basin. Taking these as a starting point, the shores of the former Middelzee display a particular high density of high value in the IKAW. By contrast, the reclaimed area is represented with a low value. The terrestrial approach does not deal with late and post-medieval remains and the maritime point of view has been absent. Reasoning from what we presently know about archaeological sites and site-formation in the adjacent Waddenzee, the in-filled scours of the former Middelzee should be deemed a very preservative environment for ship-archaeological remains with great integrity, especially at deep locations. Moreover, it is inconceivable that the maritime trade, associated with Pre- and early historic settlement of Friesland and particularly along the Middelzee banks, would have gone without wreck. The inconsistent contrast between the high assessment of value on the Waddenzee-side of the artificial boundary and the low valuation on the landside is an icon of the present state of development of predictive tools.

Figure 7. Excavation of 2nd century Roman barge *De Meern 1* in the bedding of a Rhine branch in April / May 2003.

The inconsistencies that are so well illustrated by the example of the Middelzee in Friesland are at least as inconvenient with regard to the 'new' and 'old' land in Zeeland. The historical geography of this province in the estuary of Rhine, Meuse and Scheldt displays a sequence of reclamation, erosion, collapses and rebuilding of dikes. Medieval villages and towns have been submerged and their remains have been covered. For earlier periods, similar loss of settlement areas to submersion has occurred. Deep scours of tidal gullies, which are known to have been used as shipping channels, have left their scars in the present landscape. Similar scours are present of which this function can only be inferred. At places, such scours have filled completely. At other places, depressions or sweet water lakes ('*restgeulen*') are their recognisable remains in reclaimed areas. The total Holocene build-up of sediments is in excess of twenty meters deep. The scours are far deeper. As one can infer from all discussion above, the present representation of this area in the integrated IKAW is not conclusive. It is indicative only of some presently known phenomena. It is not satisfactory as a

whole. An integrated assessment of the archaeological values present both in shallow and in deep positions is a difficult challenge. In its scale and variety however, this is an excellent area for further research.

Refinement, extension or subdivision

In spite of the effort invested in the drafting of the IKAW it is certainly not a conclusive document. Obvious inconsistencies are a good reason for rethinking present approaches to modelling, as well as to valuation and heritage policies in general. In the further development, one can follow several paths: refinement, extension and subdivision.

With regard to maritime archaeological heritage the indicative picture presented is very general indeed. It is in need of refinement. It is, however, questionable whether such refinement should be an objective in itself. Refinement can also be part of preliminary research as a direct function of the planning processes for environmental and spatial interventions. The limited objectives of such specific preliminary research are perhaps more suitable for specific fine-tuning than an encompassing assessment such as an indicative map of all Dutch waters.

The spatial scope of the assessment of maritime archaeological values can also be extended. It should include archaeological values concealed in deep sediments that fill former waterways in presently reclaimed areas. Adequate assessment, however, calls for a very detailed analysis of the patchy sedimentary situation, especially in the South and in the central river area. Subdivision in order to address several categories of archaeological phenomena or periods separately is a next step. It may also be necessary to separate between superficial values and values that are deeply embedded and therefore less accurately assessable without thorough investigation. The primary objective of the predictive map and its future development is to use scientific data and scientific models in order to create a general and indicative management tool. It should be up to date and as accurate as possible. It can never be comprehensive and conclusive. Subdivision in order to predict specific phenomena at a finer resolution may well overshoot the mark. Such detailed predictions or constructions are perhaps best left to preliminary research for specific interventions or to specific research with more limited objectives.

Use

Discriminate zones

The IKAW has been designed for a general purpose. Archaeological heritage management depends on the evaluation of information at several levels of resolution. This map is meant to give no more than a general indication of the expected density of archaeologically valuable phenomena concealed in Dutch soil, both in dry land areas and under Dutch waters. As a first indication this is a tremendous help, both in defining protection or attention zones and in the planning of activities that will impact the heritage.

The indicative representation of the present assessment is similar for the terrestrial archaeo-regions and for the seven aquatic regions. As the map and the values indicated are especially meant for the development of general policies, this similarity can be accepted as more or less commensurate. It is essential to be aware of the fact that 'low value' is by no means identical to archaeologically sterile. Less expected discoveries can occur and by virtue of unexpectedness, such discoveries may be quite valuable. This applies to the complete integrated map. Due caution has to be taken with regard to apparent inconsistencies, as have been discussed above. Here again, caution is to be taken in the terrestrial and aquatic regions alike.

However, the similarity in representation is not the same thing as equivalence. The approach to a general assessment has been slightly different for each of the discriminate zones. It had to be. Even within one and the same zone there are differences in resolution. There are simply too many differences in the level of basic information and too many differences in circumstances that need to be taken into account in modelling. In using the map, one should be aware of this. The map can be a useful tool as long as it is not seen as conclusive and as long as one realises that there are differences between the different parts of the map. The representation is a relative one.

Policy boundaries

In using the clues of the indicative map it is probably useful not to restrict oneself to too small a scale. Comparing the specific area one is interested in, with its broad surroundings will do justice to the relativity of the map. It is particularly useful to give specific attention to the influence of policy boundaries surrounding the area of interest. This caution applies both to the boundaries defined in heritage policy, such as the boundaries in between the respective archaeo-regions or the seven aquatic zones, and to boundaries of administration. Such boundaries may not as such seem to be relevant for the archaeological values with which one is concerned. More often than not, however, they have influenced the ways in which information on archaeological values has been collected. It is useful to be aware of this. As long as consistency exists across all sorts of surrounding boundaries, there is no apparent need to challenge the values indicated in map.

Similarly, the boundaries between the high or lower assessments of archaeological value are indicated as sharp lines. As we are dealing with an indicative, rather than an absolute map, it is no use to accept these sharp lines as a rigid delimitation in the field. In practical use the indicative boundaries can be used for policy decisions. They can be used as input for future policy boundaries. They cannot be accepted as absolute in themselves.

Conclusion

In the present, second, generation of the indicative map of archaeological values in the Netherlands (IKAW) the dry land area and the maritime zones have been integrated. The exercise is deemed to be useful, as more and more general policy decisions simultaneously affect archaeological values on land and underwater. The same holds true for large-scale interventions. For the development of general policies for the management of archaeological heritage, the map is one of the basic instruments. For the planning of sensible archaeological mitigation the indicative map is an essential tool.

In order to develop the map, predictive models had to be integrated. The predictive approach to the maritime expanses has been different to that for regions far inland. The result is indicative. It is not conclusive. Several inconsistencies call for further development. Nevertheless, the map summarizes present thinking on the predictive assessment of archaeological values in the Netherlands. As such, it can be used as a basis for discussion both on future research and on present policy decisions.

One should be aware that the map is meant as a general tool. It can be used for general planning purposes. It cannot replace specific preliminary research as a function of more specific planning. Nor can it replace inventories for specific scientific problems.

Although its general purpose is incompatible with a very detailed resolution, refinement of the map is to be a constant effort. Feedback from regional studies and detailed research is essential. As a generalised and up-to-date assessment of archaeological values, the map can play an important part in a considerate and forward-looking management-policy.

A similar endeavour to combine detailed archaeological information with a generalised approach and modelling of one's knowledge will definitely be useful in any other area where mitigation is the greatest chance and challenge for archaeological heritage management. Testing it on more data will definitely contribute to the scientific debate regarding formation processes and other aspects of Middle Range Theory that are essential to the development of maritime archaeology.

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Endnotes

[1] The indications are 1 shipwreck-find per 3 000 000 m^3 of Holocene channel- or tidal basin deposits. The rough figure is derived from the experience of dredging in delta deposits (Oostvoornse Meer: at least 14 wrecks in 66 000 000 m^3, of which roughly 60% Holocene, equals 1 / 2 850 000; Slufter: 6 in 35 000 000 m^3, of which roughly 50% Holocene, equals 1 / 2 900 000 m^3) and is corroborated by the reclamation of the Zuiderzee (> 350 in 1 450 000 000 m^2, roughly surveyed to an average depth of < 1 m, with a probability of discovery that cannot be estimated at better than 70 %, equals 1 / 2 900 000 m^3). Taking cubic rather than square meters as a basis, is not of great consequence for shallow waters like the Zuiderzee or the Atlantic Holland Tidal Basin. For delta-areas, however, it probably compensates for the confinement of shipping to deeper channels. It has the added advantage of being a practical unit in dredging.

[2] Despite around 2 500 entries of wreck that constitute shipping hazards in the records of the Hydrographic Office and despite the huge amount of data collected from all sorts of historical records and sea users by the private enterprise WRAKSYS, in all now 60 000 wreck entries for this area.