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ABSTRACT

Beach user perceptions of various items of commonly found beach debris were assessed with the use of a questionnaire at eight south Wales, UK, beaches during the summer of 1999 (n=850). Photographs of each of 28 debris items were utilised as a visual aid. The perception of particular litter items was virtually universal amongst beach users with the most offensive forms of visual pollution being items that were potentially harmful (e.g. syringe, gas canister) along with items of sewage related debris (e.g. sanitary towels, tampon applicators, condoms). The least offensive debris items were found to be of 'natural' origin (i.e. seaweed, driftwood). One item of sewage related debris, namely cotton bud sticks (Q tips), attained a very low offensiveness rating. The ability to identify certain items was found to be a contributory factor in the level of offensiveness attached to litter. An average of only 2% of interviewees correctly identified cotton bud sticks (Q tips). Sanitary towels were incorrectly identified in 19% of instances, with tampon applicators being incorrectly identified 47% of the time. Items perceived to be of potential threat to health provoked a high level of offensiveness from beach users, whether there was any real danger or not. 'Sewage related debris' was found to be the most offensive 'type' of coastal pollution to beach users, with 'discoloured water' proving to be the least offensive pollution parameter.

KEYWORDS: South Wales, UK, marine debris, beach litter, coastal management, beach users, tourism, offensive forms of pollution.

INTRODUCTION

Health Issues

Numerous studies of beach litter have commented on the potential danger to visitors, mainly from foot lacerations caused by stepping on glass or discarded ring pull tabs (OLIN et al., 1995; PHILIPP et al., 1995, WILLIAMS et al., 2000). Other, more dangerous items have been encountered on beaches that are less expected. Munitions and containers of corrosives have been found washed ashore, along with pyrotechnics, packaged hazardous goods and partly used drugs (Dixon, 1992).

Attention has turned recently to the less obvious health risks that can feature on beaches, these items are medical waste and sewage related debris. Although the risks are considered to be relatively low (REES and POND, 1995), any contact with infected sanitary products or fluids in syringes or other medical equipment, or ingestion of any of these could cause disease. Medical wastes have appeared on holiday beaches (GODLEE and WALKER, 1991), in some places 'sharps' containers are now being issued to lifeguards, who are advised not to go barefoot on these beaches. Forty needlestick accidents on

bathing beaches were reported between 1988 and 1991 to the Public Health Laboratory Service Communicable Disease Surveillance Centre (PHILIPP, 1993).

Debris on beaches is not just a health problem for those visitors who always remain on land, as bathers are also at risk. Debris on beaches provides information on debris in the ocean even though it is uncertain whether beach litter is representative of the ocean litter (JONES, 1995). It is however the only realistic indicator of the amount and type of debris present in the ocean (WALKER et al., 1997). Sewage related debris on a beach would seem to suggest that the adjacent waters are contaminated with sewage, which means a health risk to sea users. Bathers exposed to sewage contaminated water have a higher risk of skin and ear infections (McINTYRE, 1990). In 1990, it was reported to the UK House of Commons that the aesthetic quality of recreational waters is becoming more important as the public becomes increasingly aware of the risks (HOUSE OF COMMONS ENVIRONMENT COMMITTEE, 1990).

Perception

Several researchers have found links between the perception of water quality at a beach and the presence of visual pollution on it. For example, DINIUS (1981) found that laymen considered that visually polluted sites had lower water quality. MORGAN (1996), established that a beach that was perceived to have the greatest amount of

litter within the study area, was also perceived to have the poorest water quality. DINIUS (1981), also stated that if efforts to improve water quality ignored the importance of keeping recreational sites clean, then the public may not appreciate or perceive the benefits from this exertion.

Public attention to problems relating to the coastal zone have been based more upon public perceptions than on any scientific knowledge or evaluation of sources, fates and environmental effects (WINDOM, 1992). Associations have indeed been made between the public perceptions of items affecting the aesthetic appearance of bathing water and bathing beaches and the gastro-intestinal symptoms experienced after bathing in sewage polluted water (UNIVERSITY OF SURREY, 1987). It has been reported that 'overt filth seemed to correlate with microbial filth' (EYKYN, 1988, page 1484). To try and counter any ambiguities, the Government White Paper 'The Health of the Nation' (DOH, 1992) recognised the need for research to pinpoint the association between health consequences and the quality of the environment.

The appearance of clear water does not necessarily mean that the water is uncontaminated, but the presence of certain items on a beach may, however, imply poor micro-biological water quality. Likewise, a beach that is free from any trace of litter does not imply that the sanitary quality of the sand is good. Particular litter

items attain a higher degree of emotional response within the general public than others. Sewage related debris (SRD), medical and hazardous items arouse greater levels of offence, or feelings of unpleasantness, than do more general items of litter such as beverage containers or confectionery wrappers (WILLIAMS et al., 2000). HERRING and HOUSE (1990) established that sewage derived debris had a greater social impact than any other aesthetic pollution environmental parameter, but there are suggestions that the public debate on sewage in bathing water rarely makes any distinction between aesthetic impact and actual health risk (JONES et al., 1991). The UK House of Commons Committee stated that 'while the risk of infection by serious disease is small, the visible presence of faecal and other offensive materials carried by the sewerage system can mean serious loss of amenity and is therefore an unacceptable form of pollution' (HOUSE OF COMMONS ENVIRONMENT COMMITTEE, 1990, page xvii).

Aesthetic Quality and Amenity Loss

The problem of litter in the environment leads not only to potential health risks, but also to economic losses. Stranded debris has direct and indirect social and economic costs to shoreline communities, with the financial strains imposed by such debris not always easy to quantify, or to appreciate.

Aesthetics is usually a subjective and intangible concept. It is a branch of philosophy concerned with the essence and perception of beauty and ugliness. Aesthetics also deals with the question of whether such qualities are objectively present in the things they appear to qualify or whether they exist only in the mind of the individual; hence, whether objects are perceived by a particular mode, the aesthetic mode, or whether instead the objects have, in themselves, special qualities - aesthetic qualities. With regard to marine debris and aesthetics it would seem that perception is almost universal amongst the population, and therefore the consideration of litter is perhaps less subjective (Tudor, 2001).

The aesthetic value of beaches can be reduced by the appearance of plastics, SRD, and other items of litter (JONES, 1995; PRUTER, 1987). People prefer to visit clean beaches, with both land and water free of litter, rather than those containing various assortments of marine debris. The public may avoid certain beaches if they find their appearance unacceptable (WILLIAMS et al., 2000). Studies have found that 'sand and water quality' to be the most important aspect of a beach to visitors (WILLIAMS and MORGAN, 1995). The effect of aesthetic issues on the amenity value of marine and riverine environments has been defined by the World Health Organisation as: Loss of tourist days; resultant damage to leisure/tourism infrastructure; damage to commercial

activities dependent on tourism; damage to fishery activities and fishery-dependent activities; damage to the local, national and international image of a resort (PHILIPP, 1993).

Cause and effect relationships have been established regarding public perception and lost revenue. Beach closures along with public perception of contaminated bathing areas in 1987 and 1988 resulted in approximately US\$2 billion of lost revenue for New Jersey and New York states. The losses were ascribed to debris (REES and POND, 1995). The loss of tourism and recreational potential are very real impacts of marine debris (NOLLKAEMPER, 1994). A coastal community that relies heavily on tourism for its livelihood can have its income severely depleted by marine debris (CORBIN and SINGH, 1993). Indeed, WINDOM (1992), suggested that the greatest impact associated with marine litter is not to organisms, but to the economic loss associated with the reduction of amenities. The money that can be made, or indeed lost, from tourism and related industries is enormous, the UK maritime leisure industry is worth £8 billion a year, with £6 billion relating to seaside holidays (MARITIME TECHNOLOGY FORESIGHT PANEL, 1996).

As well as losses from tourism, there are continual costs of beach clean up efforts that take up time and money. Constant cleaning of beaches due to incessant re-colonisation of debris means that litter is one of the

main issues associated with coastal management (Williams and Tudor, 2001). Cleaning the coast costs local authorities thousands of pounds per year, additional costs are incurred when hazardous containers are found and have to be recovered from beaches (DIXON, 1992). The cities of Santa Monica and Long Beach in California, USA, each spent more than \$1 million in 1988-9 to clean their beaches and costs continue to rise (KAUFFMAN and BROWN, 1991). It has been estimated that the county of Kent, UK, has incurred direct and indirect costs of around £12 million resulting from marine and coastal pollution (GILBERT, 1996).

The Use of Photographs

Many researchers have shown that colour photographs / slides can be used successfully as surrogates for real entities. For example, HERZOG (1985) used photos to investigate aspects of the public's perception of recreational environments; WILLIAMS and LAVALLE (1990), compared 'expert' and the general public's viewpoints of actual and photographic landscape assessments; and NELSON et al., (1999) assessed beach users knowledge of Award flags by photographic means. The techniques may be used to assess differences (or not) between various socio-economic, gender, visitor/local or age groups. Since HOUSE and HERRING (1995) looked at public perception of litter, utilisation of photographs as a means of

assessing the public's views on litter pollution has not generally been investigated.

BEACHES STUDIED

The beaches were chosen to represent a geographical spread across the length of the south Wales coast, UK, with the aim of including both resort and semi-resort beaches. Rural undeveloped beaches were omitted from the study as it was important that the investigated beaches had a significant amount of visitors to enable a large number of questionnaires to be completed. The criteria for the two categories of beach used was: Resort Beach: a beach with significant urban development and facilities e.g. fun fair, hotels. Semi-Resort Beach: a beach with limited facilities and only a small amount of development e.g. a café, toilets.

a) Resort Beaches

North Beach, Tenby, Pembrokeshire (SN 135 008)

Tenby is Pembrokeshire's main holiday resort, and its beaches reflect this - plenty of facilities and often crowded. North Beach consists of a sweep of golden sand, with occasional rocks, including the prominent Goskar Rock, dotting the beach. It extends to >400m in length and a width of >50m. It is backed by the harbour and castle at the southern end. There is a promenade above

the beach all the way from the harbour to the cliffs at the north end. The beach is also backed by food and other retail premises. The southern end of the beach is well sheltered from Pembrokeshire's predominantly south westerly winds (ALDERSON, 1993). Holder of a Tidy Britain Group Resort Beach Seaside Award and an EU Blue Flag in 1999.

Saundersfoot, Pembrokeshire (SN 137 048)

This large, south east facing beach is one of the most popular stretches of coastline in Pembrokeshire. The beach is sandy and is approximately 3.75 km in length at low tide (YOUNG et al., 1995). Although now a major holiday resort, Saundersfoot developed initially as a harbour for the export of locally mined coal in the 19th and early 20th centuries. The coal industry no longer exists, but the harbour at the south end of the beach, is still busy, especially in summer when numerous pleasure craft dock there (ALDERSON, 1993). Many shops, restaurants, and other outlets relating to the tourist industry are based directly above the beach. Holder of a Tidy Britain Group Resort Beach Seaside Award and an EU Blue Flag in 1999.

Whitmore Bay, Barry Island, Vale of Glamorgan (ST 115 663)

The beach is predominantly composed of fine grained sand, faces south to the Bristol Channel and has a

surface area of 200,000m². It is 800m long and 250m wide to low water. The resort has a highly developed commercial and tourist hinterland, including a residential holiday camp, funfair, amusements, shops, public houses and night-clubs. Barry Island is a popular destination for holiday makers, day trippers and locals. Tourism is very important to the area with the beach attracting 850,000 people during 1994, providing 13.4% of the employment sector (VOG, 1996; Nelson, 1998).

b) Semi-Resort Beaches

Whitesands, St. Davids, Pembrokeshire (SM 732 268)

One of the most popular beaches in Pembrokeshire, Whitesands is a large, circa 1km in length, sandy beach enclosed by prominent headlands, which can become very busy in the summer. The beach is also popular with recreational water users, especially surfers and sail boarders as well as sea anglers on the headlands. This area of coastline is rich in wildlife, with a large variety of sea birds as well as the occasional sighting of seals out to sea (ALDERSON, 1993). Holder of a Tidy Britain Group Resort Beach Seaside Award and an EU Blue Flag in 1999.

Langland Bay, Gower, Swansea (SS 607 872)

Langland Bay is a pocket beach (circa 100m in length) flanked by Carboniferous Limestone headlands,

situated in an intensively used stretch of Gower coastline. The beach is backed by chalets, tennis courts and a car park, with the western headland housing a golf course. The bay also supports a café and other small retail premises. Langland is well known for its excellent surf and ideal conditions for water sports. Water based activities which take place include surfing, bathing, canoeing, wind-surfing and recreational fishing (NELSON, 1998).

Oxwich Bay, Gower, Swansea (SS 510 872)

The 300ha. Oxwich National Nature Reserve established in 1963, is part of this bay which extends for > 3 km. Post Pleistocene sea level rise reworked sand deposits which were moved shoreward to form a beach/dune system which developed as a series of parallel sand waves increasing in height landward. It is a pocket beach flanked by stabilised dunes. Military exercises during World War II seriously damaged the dune vegetation, which did not recover until the mid sixties. Management objectives have been dune stability and diversity, and allowing access for recreation.

Rest Bay, Porthcawl, Bridgend (SS 803 775)

This is sited to the west of Porthcawl, a small coastal resort town located on the south Wales coastline. It is a large sandy (3-400m) beach which has been granted Blue Flag status. Low reefs of Carboniferous limestone

flank the beach and it is one of the main recreational beaches in the area. Holder of a Tidy Britain Group Resort Beach Seaside Award and an EU Blue Flag in 1999.

Dunraven Bay, Southerndown, Bridgend (SS 885 730)

This is the main recreational beach of the Glamorgan Heritage Coast and is a large (300m) wide sand beach backed by a large pebble storm beach. The enclosing cliffs are composed of Lias limestone on the west and central areas together with a large headland of Carboniferous limestone blocking eastward longshore movement. It houses the headquarters of the Glamorgan Heritage Coast ranger service.

METHODOLOGY

The eight beaches were covered in the summer of 1999, with 850 questionnaires being completed by beach users. Numbers investigated were a function of logistics, as time allowed for one beach to be surveyed per day per interviewer. Weather played a part in the final number of people interviewed and beaches covered. The weather was predominantly sunny during these surveys but the unpredictable nature of the British climate meant that many of the less developed beaches, e.g. Dunraven Bay, did not have significant numbers of people on them if the weather was not hot and dry, and was likely to remain so. Interviewees were courteously asked to complete the

survey form, and an interviewer was on hand to assist in any queries. The questionnaire was made up of two parts: The first section involved the use of a selection of photographs in order to assess the perception of certain litter items by the public. Photographs were chosen to reflect litter items routinely encountered on beaches fringing the Bristol Channel. Items such as disposal diapers were not included as they were not found consistently on beach visits. Participants were asked to score, on a scale of 1 to 9, how offensive they considered each litter item shown in the photographs. A score of 1 signified that the item was 'not offensive', while a score of 9 indicated a 'very offensive' item. The items shown in each photograph are named in Table 1, and a sub-set of photographs used are illustrated in Plates 1 to 8. As part of the photographic portion of the study, respondents were asked if they were able to identify and name three separate items of SRD shown to them. The second part of the questionnaire was created to ascertain which 'forms', or 'types', of pollution found within the coastal zone were most offensive to the public.

RESULTS AND DISCUSSION

Public Perception of Specific Litter Items

Table 2 lists the beaches along with the respective rank of each photograph, and the average score given for each photograph at a certain beach is shown in

parentheses. Table 2 reveals a level of consistency in results across the eight beaches. The syringe (photo 7; Plate 2) was ranked as being the most offensive item at each beach, with the condom (photo 25; Plate 6) and medical/pill container (photo 28; Plate 8) consistently appearing in the second or third most offensive positions. The same level of consistency is seen at the other end of the offensiveness spectrum, with photos number 3 (driftwood) and 26 (seaweed) occupying the bottom two positions across all beaches.

Table 3 shows the ranking of the litter items along with their respective average score from all eight beaches studied. Table 3 illustrates the relative offensiveness of the litter items after averaging out the results from each beach. The final column gives the UK Environment Agency (EA) / National Aquatic Litter Group (NALG) protocol category for each litter item (EA/NALG, 2000). This 'Monitoring Protocol and Classification Scheme' has been developed by the EA and NALG over a number of years in an attempt to standardise the recording and grading of UK beaches with reference to their aesthetic quality (EARLL et al., 2000). Seven categories are used to describe the visible pollution found on a beach, with grades assigned to each parameter depending on the abundance of debris (Table 4). Some of the categories are defined as follows: Sewage Related Debris, e.g. feminine hygiene products, contraceptives, human faeces- these items are termed as General Sewage

Related Debris. Cotton Bud Sticks (CBS), also known as Q tips, are counted as a separate item. Potentially Harmful Litter, this category includes items which are considered dangerous to either humans or animals using the beach. Gross Litter comprises items that have at least one dimension greater than 50 cm, e.g. shopping trolleys, tyres, traffic/road cones; driftwood should not be included. General Litter includes all other items less than 50 cm in dimension, e.g. drink cans, food packaging etc. Items with a maximum diameter of less than 1 cm in all dimensions are not counted.

Ten of the top eleven most offensive items from the list of 28 photos, were either from the SRD, gross, or potentially harmful litter categories, there was no 'general litter' item until position 14 (Table 3). This confirmed the weighting given to these items within the EA/NALG protocol. It is pertinent to note that the medical/pill container (photo 28; Plate 8) does not have any labelling or markings, and is perhaps a classic example of an item appearing to be of danger or a hazard to health. The lack of labelling does not dispel the perceived danger; it may even exaggerate it, which is as relevant to the beach user as any real danger. This example shows that markings are not needed for there to be a perceived risk.

Animal faeces are ranked high on the list, even though the picture was of horse faeces. The EA/NALG

protocol stipulates that only dog faeces should be included in its non-human faeces category, as 'faeces from animals such as sheep or horses should not be counted. These are not considered to be a general nuisance or hazard' (EA/NALG, 2000, page 8). Whether the public distinguishes between different forms of faeces when considering offensiveness is unclear at present.

The traffic/road cone receives a low score considering it is an item of gross litter - the other gross litter items appear in the top half of the table (Table 3). A number of such large items on a beach may produce a different response; an individual large item would appear to be not very offensive. This highlights the problems in the use of photographs where scale and perspective is lost.

CBS's (Q tips; Plate 4) are extremely low on the list (position 26 of 28), indeed the average score was only just above the median value. This position and average score is in direct contrast to the other sewage related items; it even ranks below the innocuous crisp packet. This low ranking is possibly due to CBS's not being generally associated with SRD by the public.

A further part of the questionnaire was to ascertain whether interviewee's were able to identify certain items of debris. This was not a test of the effectiveness of the photos, but an inquiry into whether people were

actually aware of what items were potentially around them on the beach. The beach users were asked if they could identify the items in the photographs that were actually of the CBS (Plate 4), the tampon applicator (Plate 7) and the sanitary towel (Plate 1). It is clear from Table 5 that there was a very low level of recognition of the cotton bud stick photograph. The average figure for the percentage of people that correctly identified the item was just 2%. The figures for each beach vary from 0% at Whitmore Bay, to 8% at Rest Bay. This very low level of recognition could possibly be part of the reason for the low position this item attains on the offensiveness ranking scale (Table 3).

A much higher level of recognition was experienced with both the tampon applicator and the sanitary towel. Table 6 shows the level of recognition of the tampon applicator across the eight beaches. The lowest level of recognition was around 50% at Whitmore Bay, with Oxwich Bay having a figure of 56%. The average figure for all beaches was 53%. The sanitary towel item was even more widely recognised than the tampon applicator. Table 7 illustrates the results of this portion of the study. Figures of recognition ranged from 85% at Oxwich bay, to 78% at Rest Bay, with an average of 81% for all beaches.

The level of recognition of these items is important in that results can be linked back to the offensiveness scores given by the public. The high levels of

recognition for the two sanitary products helped result in a high position in the offensiveness table (Table 3). CBS's on the other hand have a very low level of recognition, which was reflected in the very low level of offensiveness attributed to this item. Over the eight beaches the cotton bud stick was identified as a straw in 56% of instances (Table 8). With this level of mis-identification it was likely that a low offensiveness rating would result. If the public were aware of the identity of this item, where it came from, and what that link meant, a much higher result could be expected. There appears to be a significant lack of appreciation amongst the public that many items of litter, particularly CBS's and feminine hygiene products, travel to the beach from their own homes via outfalls at the coast or on rivers. Whereas SRD is universally considered to be one of the most offensive items on a beach, for some items it was perhaps one of the least recognised categories of visual pollution. If people are not aware or cannot identify the debris they see around them on a beach, they will be unable to make the link back to its source. The very low levels of recognition of the CBS does not help beach users realise that this item exists ubiquitously on beaches and that it comes from their own homes, and is an easily preventable form of pollution.

Potentially harmful litter reaches high levels of offensiveness, with 5 of the top 10 most offensive items being from this category (Table 3). There is little

ambiguity as to the identification of these items, the only doubt lies in the judgement of whether they are potentially harmful or not. It is the potential to harm which gives these items their high position within Table 3, whether they are of any real danger to the public or the environment is another matter. This is essentially the crux of the perception issue; how a beach is perceived with regard to pollution is as important to the community and businesses surrounding it as the actual state of cleanliness and any real threat posed.

The greatest differences in average photo score results between the eight beaches have been illustrated in Table 9. In these instances with a high maximum / minimum difference, all have respondents at Whitmore Bay giving either the largest or smallest score. The reason for this needs further investigation. These same litter items are all grouped in the EA/NALG 'general litter' category, and are in the bottom half of the table of offensiveness (Table 3), whereas the five litter items with the smallest max. / min. difference are also the top five most offensive items (Table 3; Table 9). This reaffirms the view that the perception of what constitutes the most offensive items is consistent across all beaches studied and all interviewees. The perception of items of general litter that have the greatest maximum / minimum differences between beaches (e.g. driftwood, crisp packet) would seem to be open to more subjectivity than items of SRD or potentially harmful litter.

The item with the highest maximum / minimum difference was the '4 pack ring/yoke' (photo 22) with a value of 1.8. This large disparity could be attributed to certain interviewees viewing the item as potentially harmful (e.g. to animals), while others perhaps viewed it as a relatively inoffensive form of litter pollution. There is evidence that these items can be a hazard to wildlife (e.g. LUCAS, 1992).

Public Perception of 'Types' of Coastal Pollution

An additional section of the questionnaire was designed to determine what forms of pollution beach users found most offensive. The interviewees were asked to rank in order what they considered to be the most offensive forms of beach / sea pollution from a choice of eight. The categories used (Table 10) are wider and less specific than the photographs used earlier in the questionnaire, but help to give an insight into what are considered by beach users to be the offensive types of pollution without concentrating on specific items of debris. Much research in this area has tended to consider just one aspect of environmental quality. However, the present study attempted to combine both terrestrial and marine pollution types in order to ascertain a broader more holistic view of the beach / coastal environment. Whether the two should be kept separate will be dependant

on the aims of a study, in this case it was felt that the two could not realistically be separated.

The top three most offensive pollution types are broadly consistent across the eight beaches studied (Table 10). SRD is considered as the most offensive pollution type, this result is perhaps not surprising when one considers the stigma and association of the word 'sewage'. The ranking of this type of pollution is in line with other studies of a similar vein (e.g. House, 1996). A consistent view was experienced with the second ranked parameter, 'oil on the beach', which was placed second by respondents at all beaches. The Sea Empress oil spill occurred in 1996, only three years previous to the questionnaire survey, and had affected many of the westerly beaches covered in the present study (i.e. beaches of Pembrokeshire). Whether this was a factor in influencing respondents is unclear. In light of this, the need to replicate this question over a number of years was considered to be important. It is necessary to establish that responses to pollution are not just of temporary concern, and not the reaction to an event preceding the interview (David, 1971). 'Oil in the sea' was ranked third in seven out of eight beaches, only Rest Bay respondents placing 'floating debris' above this factor (Table 10).

'Foam/scum' and 'floating debris' parameters were generally ranked fourth and fifth (Table 10). These two

pollution forms were intentionally left vague in their descriptions, the public being left to make their own assumptions. Foam / scum is very often of a natural composition; marine algae can easily be mistaken for sewage. A common non-toxic alga called Phaeocystis, found in British coastal waters, forms clouds of 'frog spawn' like colonies, sometimes mistaken for oil drops in the water. It can grow rapidly, or 'bloom', in early summer. When this bloom subsequently breaks down as the algae die, creamy-brown coloured foam can be formed. This foam may appear as a thin layer or, under rougher conditions, form slicks 1 to 2 metres deep. Although non-toxic, this can look, and occasionally smell, very unpleasant, and can be mistaken for sewage(EA/SAS, 1999). David (1971), found that foam and algae were often cited as indicators of water pollution by the public. Kruskal-Wallis One Way Analysis of Variance on Ranks was utilised to determine if any statistical differences were apparent in responses given between the beaches studied. This test showed differences in the median values among the beaches were not statistically different for all categories at $P = 0.05$ level, except for 'floating debris'. The 'floating debris' parameter varied in rank position between 3rd at Rest Bay, and 6th at Dunraven Bay. Reasons for this difference are unclear.

'Unusual smell' was ranked relatively low on the list by respondents (Table 10), perhaps due to the lack of any industry surrounding the beaches chosen for study.

This is in contrast to studies by Ditton and Goodale (1974), where smell was an important parameter. However, their research was conducted in an industrialised area. Personal sensitivities to smell differ greatly, for this reason evaluating offensiveness of odours is difficult (Nicolson and Mace, 1975).

Beach litter is the most immediate and common form of visual pollution experienced on beaches, this parameter (along with SRD) is experienced by all beach users, whereas some of the others would only be noticed if they entered, or at least closely inspected, the sea. It is perhaps the perceived lower health risk posed by this pollutant in comparison to well known risks from SRD and oil that results in its low ranking. Items of SRD are considered in most research to be an integral part of marine or beach litter, and the term 'beach litter' encompasses SRD as well as domestic and industrial physical wastes. However, for this study 'beach litter' and SRD were disassociated to enable more detail to be gained from the interviewees. Table 10 shows that Whitmore Bay is unusual in that 'beach litter' was ranked higher than at any other beach (fourth), and 'foam/scum' and 'unusual smell' were ranked lower than at any of the other beaches. Perhaps the relatively high position of 'beach litter' is due to the sheer number of people visiting Whitmore Bay who generate huge amounts of litter, which was clearly visible in the afternoon when this survey took place.

'Discoloured water' was ranked as the least offensive form of pollution by beach users at the majority of sites, which is perhaps unexpected as water in the Bristol Channel, especially at its eastern end near the Severn Estuary, is particularly turbid in appearance (Table 10). Beach users at the most easterly beaches (Whitmore Bay, Dunraven Bay, Rest Bay) were those that ranked this parameter higher than those frequenting the beaches of the Gower and Pembrokeshire to the west.

Table 11 averages the ranks of the different types of pollution in order of offensiveness for all beaches studied. It can be seen in Table 11 that the average position for all pollution forms, bar the first three, are closely grouped around the 5th position. This indicates therefore very little difference in the level of offensiveness attached to these forms of pollution by the public.

CONCLUSION

This study has established that the general public view of debris items on beaches is consistent. Potentially hazardous items, such as a syringe, along with items of SRD were found to be the most offensive forms of litter, with the least offensive items being those of a 'natural' character, i.e. driftwood and seaweed. This was the case for all eight beaches studied

along the south Wales coast, UK. The high level of offensiveness attributed to SRD and potentially hazardous items cements the weighting given to these items within the EA/NALG protocol.

It is important to realise that items are often considered offensive because of a perceived health hazard, rather than there actually being any real danger. Moreover, this perception is very relevant to beach users and its importance cannot be ignored. If there is the perception that a beach is heavily polluted, or contains items that are perceived to pose a threat to health or induce a feeling of discomfort, then this can lead to a loss of tourists and subsequent financial implications.

Responses regarding beach users' views of the most offensive pollution 'types' were obtained. Results indicated that sewage related debris was the most offensive pollution parameter. Oil, both on the beach and within the sea, ranked as second and third most offensive forms of pollution respectively. Discoloured water was found to be the least offensive 'type' of coastal pollution.

The lack of recognition of certain items of SRD, i.e. CBS, tampon applicators, and sanitary towels, is of concern with respect to peoples' viewpoints as to what litter is present on a beach. Greater levels of education are needed amongst the public to alert them as to what

litter is present on beaches. Only with this knowledge can larger strides be made in the effort to prevent the public using their toilet as a 'wet bin'. This will consequently lead to reductions in such items reaching beaches, by cutting off this aspect of litter at source. This is the ultimate aim of all litter prevention scenarios.

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Table 1 Litter Items Shown In Each Photograph

Photograph Number	Item shown in Photograph
1	Glass Bottle
2	Plastic Packing Strap
3	Driftwood
4	Glass Sharps
5 (Plate 1)	Sanitary Towel
6	Crisp Packet
7 (Plate 2)	Medical Syringe
8	Oil
9	Aluminium Drinks Can
10	Fishing Gear
11	Traffic/Road Cone
12	Disinfectant Container
13	Toiletry Container
14	Animal Faeces
15	Cigarette Butt
16	Polystyrene Food Carton
17	Spent Gun Cartridge
18	Plastic Drinks Bottle
19 (Plate 3)	Toilet Detergent/Cleanser
20 (Plate 4)	Cotton Bud Stick (Q tip)
21	Large Barrel
22	'4 pack' Ring/Yoke
23 (Plate 5)	Propane Gas Cylinder
24	Tyre
25 (Plate 6)	Condom
26	Seaweed
27 (Plate 7)	Tampon Applicator
28 (Plate 8)	Medical/Pill Container

Table 2 Photo rankings with score averages. Figures in parenthesis relate to average score attained by each item shown in the photograph. Rank 1 is most offensive, 28 least offensive.

Beach	Whitmore Bay N=111	Langland Bay N=95	Oxwich Bay N=172	Rest Bay N=125	Saundersfoot N=97	Dunraven Bay N=15	North Beach N=140	Whitesands N=95
Rank	Photo number (average score in parenthesis)							
1	7 (8.9)	7 (9.0)	7 (8.8)	7 (8.8)	7 (8.8)	7 (9.0)	7 (8.8)	7 (8.8)
2	28 (8.7)	25 (8.9)	25 (8.6)	25 (8.7)	25 (8.6)	25 (8.9)	28 (8.6)	25 (8.7)
3	25 (8.6)	28 (8.8)	28 (8.6)	28 (8.4)	28 (8.6)	5 (8.7)	25 (8.6)	28 (8.6)
4	5 (8.4)	4 (8.5)	23 (8.2)	23 (8.3)	23 (8.3)	28 (8.4)	14 (8.3)	23 (8.3)
5	23 (8.4)	14 (8.4)	5 (8.2)	5 (8.1)	14 (8.2)	4 (8.3)	4 (8.3)	5 (8.2)
6	4 (8.2)	5 (8.4)	4 (8.2)	4 (8.1)	5 (8.1)	12 (8.3)	23 (8.2)	12 (8.2)
7	21 (8.0)	23 (8.4)	21 (7.8)	21 (7.9)	21 (8.0)	14 (8.3)	5 (8.1)	14 (8.1)
8	14 (8.0)	21 (8.2)	12 (7.7)	27 (7.7)	4 (7.9)	23 (8.1)	12 (7.9)	4 (8.0)
9	12 (7.9)	27 (8.1)	27 (7.7)	12 (7.6)	12 (7.8)	21 (8.0)	21 (7.8)	27 (7.9)
10	27 (7.6)	12 (8.0)	19 (7.4)	19 (7.6)	27 (7.5)	27 (7.8)	27 (7.6)	21 (7.8)
11	24 (7.4)	24 (8.0)	14 (7.4)	24 (7.5)	24 (7.3)	8 (7.6)	24 (7.6)	8 (7.7)
12	8 (7.4)	19 (7.8)	24 (7.4)	14 (7.3)	19 (7.2)	22 (7.4)	19 (7.5)	19 (7.7)
13	19 (7.1)	8 (7.7)	8 (7.3)	8 (6.8)	8 (7.1)	19 (7.0)	8 (7.1)	24 (7.4)
14	1 (6.5)	17 (7.0)	1 (6.5)	1 (6.8)	1 (6.3)	24 (7.0)	1 (6.5)	22 (7.0)
15	17 (6.3)	22 (6.9)	22 (6.4)	17 (6.6)	22 (6.2)	1 (6.8)	22 (6.4)	9 (6.7)
16	9 (6.0)	15 (6.7)	9 (6.4)	22 (6.4)	9 (6.1)	13 (6.8)	15 (6.3)	1 (6.6)
17	10 (5.9)	1 (6.7)	13 (6.3)	9 (6.3)	13 (5.8)	9 (6.7)	17 (6.3)	13 (6.5)
18	15 (5.8)	16 (6.6)	15 (6.2)	10 (6.2)	15 (5.8)	16 (6.7)	9 (6.3)	17 (6.5)
19	2 (5.6)	9 (6.6)	16 (6.2)	13 (6.2)	17 (5.7)	18 (6.5)	16 (6.2)	6 (6.3)
20	22 (5.6)	13 (6.4)	18 (6.1)	15 (6.1)	16 (5.6)	17 (6.3)	13 (6.0)	15 (6.3)
21	18 (5.4)	18 (6.3)	17 (6.1)	16 (6.0)	18 (5.6)	11 (6.2)	18 (5.9)	16 (6.2)
22	13 (5.3)	10 (6.2)	6 (6.0)	18 (5.9)	10 (5.5)	2 (6.1)	10 (5.6)	18 (6.2)
23	20 (5.3)	2 (6.1)	11 (5.7)	20 (5.7)	2 (5.2)	6 (6.1)	11 (5.6)	11 (5.9)
24	16 (5.2)	6 (5.9)	10 (5.5)	11 (5.6)	11 (5.1)	15 (5.8)	6 (5.5)	10 (5.8)
25	11 (5.1)	11 (5.8)	20 (5.5)	2 (5.5)	20 (4.9)	10 (5.7)	2 (5.4)	2 (5.7)
26	6 (4.7)	20 (5.6)	2 (5.4)	6 (5.4)	6 (4.9)	20 (5.6)	20 (5.3)	20 (5.5)
27	3 (4.1)	26 (3.0)	26 (2.8)	26 (3.3)	3 (3.0)	26 (2.8)	3 (3.4)	3 (2.5)
28	26 (3.8)	3 (2.6)	3 (2.8)	3 (3.2)	26 (2.8)	3 (2.7)	26 (3.2)	26 (2.4)

Table 3. All Beaches - Photo Rankings with Score Averages (5 is the median score, on a rating 1-9. N = 850. Highlighted rows are discussed in text.)

Offensiveness rank	Photo Number - Litter Item	Average Score	EA/NALG Protocol Category
1	7- Medical Syringe	8.8	Potentially Harmful Litter
2	25- Condom	8.6	Sewage Related Debris
3	28- Medical/Pill Container	8.6	Potentially Harmful Litter
4	23- Gas Cylinder	8.3	Potentially Harmful Litter
5	5- Sanitary Towel	8.2	Sewage Related Debris
6	4- Glass Sharps	8.2	Potentially Harmful Litter
7	21 - Large Barrel	7.9	Gross Litter
8	14- Animal Faeces	7.9	Non Human Faeces
9	12- Disinfectant Container	7.8	Potentially Harmful Litter
10	27- Tampon Applicator	7.7	Sewage Related Debris
11	24- Tyre	7.5	Gross Litter
12	19- Toilet Detergent/Cleanser	7.4	Sewage Related Debris
13	8- Oil	7.2	Oil
14	1- Glass Bottle	6.6	General Litter
15	22- '4 pack' Ring/Yoke	6.4	General Litter
16	9- Aluminium Drinks Can	6.3	General Litter
17	17- Spent Gun Cartridge	6.3	General Litter
18	15- Cigarette Butt	6.1	General Litter
19	13- Toiletry Container	6.1	General Litter
20	16- Polystyrene Food Carton	6.0	General Litter
21	18- Plastic Drinks Bottle	5.9	General Litter
22	10- Fishing Gear	5.8	General Litter
23	11- Traffic/Road Cone	5.6	Gross Litter
24	6- Crisp Packet	5.5	General Litter
25	2- Plastic Packing Strap	5.5	General Litter
26	20- Cotton Bud Stick	5.4	Sewage Related Debris
27	3- Driftwood	3.1	-----
28	26- Seaweed	3.1	-----

Table 4 - Environment Agency / National Aquatic Litter Group Grading and Classification Scheme (EA/NALG, 2000). (Numbers refer to abundance of items).

			Grade			
	Category	Sub-category (where applicable)	A	B	C	D
1	Sewage Related Debris	General	0	1-5	6-14	15+
		Cotton Buds (Q tip)	0-9	10-49	50-99	100+
2	Gross Litter		0	1-5	6-14	15+
3	General Litter		0-49	50-499	500-999	1000+
4	Potentially Harmful Litter	Broken Glass	0	1-5	6-24	25+
		Other	0	1-4	5-9	10+
5	Accumulations	Number	0	1-4	5-9	10+
		Continuous Strip	-	-	-	Grade D
6	Oil		Absent	Trace	Nuisance	Objectionable
7	Non Human Faeces		0	1-5	6-24	25+

Table 5. Recognition of cotton bud stick (Q tip) by respondents (% rounded up)

	Whitmore Bay	Langland Bay	Oxwich Bay	Rest Bay	Saundersfoot	North Beach	Dunraven Bay	Whitesands
Number correctly identifying item	0	1	2	10	1	2	0	2
n=	111	95	172	125	97	140	15	95
% correct	0	1	1	8	1	1	0	2
Average % correct across all beaches	2							

Table 6. Recognition of tampon applicator by respondents (% rounded up)

	Whitmore Bay	Langland Bay	Oxwich Bay	Rest Bay	Saundersfoot	North Beach	Dunraven Bay	Whitesands
Number correctly identifying item	55	52	96	67	48	70	8	51
n=	111	95	172	125	97	140	15	95
% correct	50	55	56	54	51	50	53	54
Average % correct across all beaches	53							

Table 7 Recognition of sanitary towel by respondents (% rounded up)

	Whitmore Bay	Langland Bay	Oxwich Bay	Rest Bay	Saundersfoot	North Beach	Dunraven Bay	Whitesands
Number correctly identifying item	90	78	146	98	78	113	12	80
n=	111	95	172	125	97	140	15	95
% correct	81	82	85	78	80	81	80	84
Average % correct across all beaches	81							

Table 8. Level of Mis-identification of cotton bud stick (Q tip). Responses given by interviewees when asked to identify item shown to them.

	Response to photograph			
	Cotton bud stick	Drinking Straw	Don't know/no response	Row Total
n	16	478	356	850
%	2	56	42	100

Table 9. Average photo scores for each beach with maximum - minimum differences. (Highlighted rows are discussed in text).

Beach	Whitmore Bay	Langland Bay	Oxwich Bay	Rest Bay	Saundersfoot	Dunraven Bay	North Beach	Whitesands	Maximum / Minimum Score Difference
	N=111	N=95	N=172	N=125	N=97	N=15	N=140	N=95	
Photo number	Average photo score given by respondents								
1	6.5	6.7	6.5	6.8	6.3	6.8	6.5	6.6	0.5
2	5.6	6.1	5.4	5.5	5.2	6.1	5.4	5.7	0.9
3	4.1	2.6	2.8	3.2	3.0	2.7	3.4	2.5	1.6
4	8.2	8.5	8.2	8.1	7.9	8.3	8.3	8.0	0.6
5	8.4	8.4	8.2	8.1	8.1	8.7	8.1	8.2	0.3
6	4.7	5.9	6	5.4	4.9	6.1	5.5	6.3	1.6
7	8.9	9.0	8.8	8.8	8.8	9.0	8.8	8.8	0.2
8	7.4	7.7	7.3	6.8	7.1	7.6	7.1	7.7	0.9
9	6.0	6.6	6.4	6.3	6.1	6.7	6.3	6.7	0.7
10	5.9	6.2	5.5	6.2	5.5	5.7	5.6	5.8	0.7
11	5.1	5.8	5.7	5.6	5.1	6.2	5.6	5.9	1.1
12	7.9	8.0	7.7	7.6	7.8	8.3	7.9	8.2	0.7
13	5.3	6.4	6.3	6.2	5.8	6.8	6.0	6.5	1.5
14	8.0	8.4	7.4	7.3	8.2	8.3	8.3	8.1	1.1
15	5.8	6.7	6.2	6.1	5.8	5.8	6.3	6.3	0.9
16	5.2	6.6	6.2	6.0	5.6	6.7	6.2	6.2	1.5
17	6.3	7.0	6.1	6.6	5.7	6.3	6.3	6.5	1.3
18	5.4	6.3	6.1	5.9	5.6	6.5	5.9	6.2	0.9
19	7.1	7.8	7.4	7.6	7.2	7.0	7.5	7.7	0.8
20	5.3	5.6	5.5	5.7	4.9	5.6	5.3	5.5	0.8
21	8.0	8.2	7.8	7.9	8.0	8.0	7.8	7.7	0.5
22	5.6	6.9	6.4	6.4	6.2	7.4	6.4	7.0	1.8
23	8.4	8.4	8.2	8.3	8.3	8.1	8.2	8.3	0.3
24	7.4	8.0	7.4	7.5	7.3	7.0	7.6	7.4	0.7
25	8.6	8.9	8.6	8.7	8.6	8.9	8.6	8.7	0.3
26	3.8	3.0	2.8	3.3	2.8	2.8	3.2	2.4	1.4
27	7.6	8.1	7.7	7.7	7.5	7.8	7.6	7.9	0.6
28	8.7	8.8	8.6	8.4	8.6	8.4	8.6	8.6	0.4

Table 10. Offensive forms of pollution. Rank 1 is most offensive, rank 8 least offensive. n=827

Rank	Beach Studied							
	Whitmore Bay	Langland Bay	Oxwich Bay	Rest Bay	Saundersfoot	North Beach	Dunraven Bay	Whitesands
1	Sewage Related Debris	Sewage Related Debris	Sewage Related Debris	Sewage Related Debris	Sewage Related Debris	Sewage Related Debris	Sewage Related Debris	Sewage Related Debris
2	Oil (on beach)	Oil (on beach)	Oil (on beach)	Oil (on beach)	Oil (on beach)	Oil (on beach)	Oil (on beach)	Oil (on beach)
3	Oil (in the sea)	Oil (in the sea)	Oil (in the sea)	Floating Debris	Oil (in the sea)	Oil (in the sea)	Oil (in the sea)	Oil (in the sea)
4	Beach Litter	Floating Debris	Foam/Scum	Oil (in the sea)	Foam/Scum	Foam/Scum	Foam/Scum	Floating Debris
5	Floating Debris	Foam/Scum	Floating Debris	Foam/Scum	Floating Debris	Floating Debris	Unusual Smell	Foam/Scum
6	Discoloured Water	Beach Litter	Unusual Smell	Unusual Smell	Unusual Smell	Unusual Smell	Floating Debris	Unusual Smell
7	Foam/Scum	Unusual Smell	Beach Litter	Discoloured Water	Beach Litter	Beach Litter	Discoloured Water	Beach Litter
8	Unusual Smell	Discoloured Water	Discoloured Water	Beach Litter	Discoloured Water	Discoloured Water	Beach Litter	Discoloured Water

Table 11. Average rank position achieved by each pollution category for all beaches. n=827. Rank 1 is most offensive, rank 8 least offensive

Pollution Form	Average Rank Position
SRD	1.7
Oil (on beach)	3.5
Oil (in the sea)	4.0
Floating Debris	4.9
Foam/Scum	5.0
Unusual Smell	5.3
Beach Litter	5.4
Discoloured Water	5.8

FIGURE CAPTIONS

Plate 1	Photograph of Sanitary Towel
Plate 2	Photograph of Medical Syringe
Plate 3	Photograph of Toilet Detergent/Cleanser
Plate 4	Photograph of Cotton Bud Stick (Q tip)
Plate 5	Photograph of Propane Gas Cylinder
Plate 6	Photograph of Condom
Plate 7	Photograph of Tampon Applicator
Plate 8	Photograph of Medical/Pill Container