

*Article***Attitudes and Perceptions of Recreational Boat Owners on Waste Management Processes: A Case Study of Chichester Harbour, United Kingdom**

Paul Oluwatimileyin Olatunji^{1,2,*}, Jonathan Potts¹, Pierre Failler^{3,*},
Richard Austin⁴

¹ School of the Environment, Geography and Geosciences, University of Portsmouth, Portsmouth, PO1 3HE, UK

² Plentzia Marine Station, PiE-UPV/EHU, University of the Basque Country, Areatza Hiribidea, 47, Plentzia, 48620, Spain

³ Department of Economics and Finance, Portsmouth Business School, University of Portsmouth, Portsmouth, PO1 3DE, UK

⁴ Chichester Harbour Conservancy, the Harbour Office, Itchenor, West Sussex, PO20 7AW, UK

* Correspondence: Paul Oluwatimileyin Olatunji,
Email: olatunji.o.paul@gmail.com; Pierre Failler,
Email: pierre.failler@port.ac.uk.

ABSTRACT

The paper analyses the current Port Waste Management Plan (PWMP) of Chichester Harbour, United Kingdom. The perceptions and attitudes of recreational boat owners on the waste management process in the Harbour were examined using a web-based survey and a selected semi-structured interview by examining their demographics, vessel choice, and perception of the effectiveness of the PWMP in managing Harbour waste. Our findings revealed that boat owners had little or no awareness of what the PWMP is all about. In addition, they have limited use of the waste reception facilities made accessible by the Harbour despite knowing most of the Harbour's Environmental Designated Areas (EDAs). Education on the purpose of the PWMP increased publicity and the availability of more affordable pump-out facilities are critical for improving waste management and developing best practices in the Harbour. The research bridged a knowledge gap regarding the perception of the waste management process in Chichester Harbour.

KEYWORDS: port waste management plan; Chichester Harbour; perception; environmental designated areas; pollution

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INTRODUCTION

According to Marin et al. [1], pollution in harbours can impact the port, its users, and the surrounding environment. The pollution results from waste generated by vessels, boat users and owners, harbours, and marinas. However, the harbour wastes can be classified differently to

understand better the sources [2]. Chichester Harbour is a 57-square-kilometre estuary with over 80 kilometres of shoreline, 5200 moorings and marina berths, 14 sailing clubs, and over 10,500 vessels [3]. The waste generated by recreational vessels at Chichester Harbour, United Kingdom is similar to mixed household wastes [4]. MGN 563 [5] Port Waste Management advocates for recycling ship-landed waste. This necessitates different waste reception facilities for oil waste, batteries, and effluent from holding tanks, which Chichester Harbour Conservancy has made available at various moorings [4].

Human activities like dredging, container handling, ship discharge, disposal of untreated ship waste, residential and industrial waste generate a lot of environmental pollutants that end up in harbours [1]. The coastal area is affected by the port's operation [6] since ports and harbours produce, receive, and manage enormous amounts of waste of all kinds (Table 1) [7]. It may appear that a single boat or marina has little to no effect on the water quality in a given area. However, these effects become apparent and significant when compounded by the number of ships and marinas in use [8]. Therefore, marinas may put the preservation of coastal ecosystem services and water quality at risk [9].

According to Zhang et al. [10], ship waste has been proven to have a significant negative impact on the aquatic environment by containing toxic substances that can make it difficult for aquatic organisms to survive as well as negatively impact water quality and interfere with the water's natural ability to purify itself. Furthermore, people, coastal towns, and businesses that use marine waters could be put in danger by the waste generated by the poorly managed ships [11]. Dolgen et al. [2] further stated that if wastes are not properly handled, the harbours and marinas risk having significant hygienic and aesthetic problems on their property.

The International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), administered by the International Maritime Organization (IMO), and ratified by the vast majority of maritime nations, establishes the types of waste that may be disposed of at sea and the types that are prohibited [2,6,12]. The fundamental provisions of MARPOL are rules outlined in six annexes (Table 2), which address various forms of port wastes [13,14]. In accordance with the MARPOL 73/78 standards, the European Union (EU) has also approved legislation (EU Directive 2000/59) requiring ports to provide reception facilities for various ship-generated garbage kinds [6,7,15,16]. Furthermore, whether port waste receiving facilities are utilised or not, vessels using EU ports are obligated to pay a tax based on the ship size and goes toward port expenses [17].

To fulfil their waste management obligations under MARPOL 73/78, the majority of ports in the United Kingdom (UK) have chosen to ensure that authorised waste disposal providers offer a service to the marine community. The UK government mandated port, harbour, marina, and

other docking facility operators to develop a waste management policy and appropriate waste reception facilities for marine waste. This requirement for port and harbour authorities is part of a more significant effort to prevent pollution from all types of commercial and recreational vessels that use UK ports [13]. The Port Waste Management Plan (PWMP) created by Chichester Harbour Conservancy (CHC) and Marine & Coastguard Agency (MCA) for Chichester Harbour includes a concise overview of waste disposal procedures and costs [4]. The Conservancy claims that waste reception should be complimentary at the point of disposal, with the costs embedded in other harbour dues and berthing charges [4]. Whilst the PWMP identifies local sites where there are pump-out facilities, it is mostly focussed on non-sewage marine waste.

Waste management in ports and harbours has been considered in some studies [2,12,18–21]. However, except for Ibabe et al. [22], there is little research into the public perception of port pollution and waste management. Hence, the paper aims to evaluate recreational boat owners' perspectives on waste management processes in Chichester Harbour as they use their boats in the harbour. The aim also includes knowing how efficient the PWMP and waste reception facilities made available at the harbour have been. This was accomplished by collecting data from boat owners in Chichester Harbour through a web-based questionnaire distributed to them via the weekly harbour bulletin. The view of Chichester Harbour stakeholders on the waste management in the harbour was also captured in a semi-structured interview. The data gathered and analysed was used to assess the state of waste pollution and management in Chichester Harbour. This paper is significant as it adds to the knowledge of perception research on waste management in harbours. The work also includes an evaluation of the effectiveness of waste reception facilities and the PWMP made available by Chichester Harbour Conservancy. This paper also explores a better way to address waste management processes in Chichester Harbour without negatively impacting the harbour and the boat owners that use the harbour.

The paper is structured into three main sections, which include: (a) a detailed overview of the data collection process and analysis; (b) interpretation of the analysed data and graphical representation of the results; and (c) discussion of the results concerning previous works and recommendations for future management processes in Chichester Harbour.

Table 1. Sources and types of harbour waste (Adapted from Sciortino & Ravikumar) [23].

| Source of waste | Waste generated |
|---------------------------|----------------------------|
| Vessels (Ships and boats) | Bilge water |
| | Lube oil |
| | Kitchen waste |
| | Deck washing |
| | Floating garbage |
| Toilet waste | Sewage |
| | Waste from the wash area |
| Boat and ship repair | Oil and grease |
| | Paint cans, paint |
| | Anti-fouling paint cans |
| | Used batteries |
| | Wood shavings, steel scrap |

Table 2. MARPOL Annexes (Adapted from Di Vaio et al.) [14].

| ANNEXES | REGULATIONS |
|---------|---|
| ANNEX 1 | Regulations for the Prevention of Pollution by Oil |
| ANNEX 2 | Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk |
| ANNEX 3 | Regulations for the Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Forms, or in Freight Containers, Portable Tankers or Road and Rail Tank Wagons |
| ANNEX 4 | Regulations for the Prevention of Pollution by Sewage from Ships |
| ANNEX 5 | Regulations for the Prevention of Pollution by Garbage from Ships |
| ANNEX 6 | Regulations for the prevention of air pollution from ships |

METHODOLOGY

A web-based survey was designed on survey monkey and distributed to the boat owners in Chichester Harbour, UK (50.7907° N, 0.9489° W) (Figure 1) through the weekly Chichester Harbour Navigation Bulletin. The questionnaire was designed using a mixed approach (open-ended and closed-ended questions) [24], with approximately 95% of the questions being closed-ended. This is to understand recreation boat owners' attitudes and perceptions of waste management processes at Chichester Harbour.

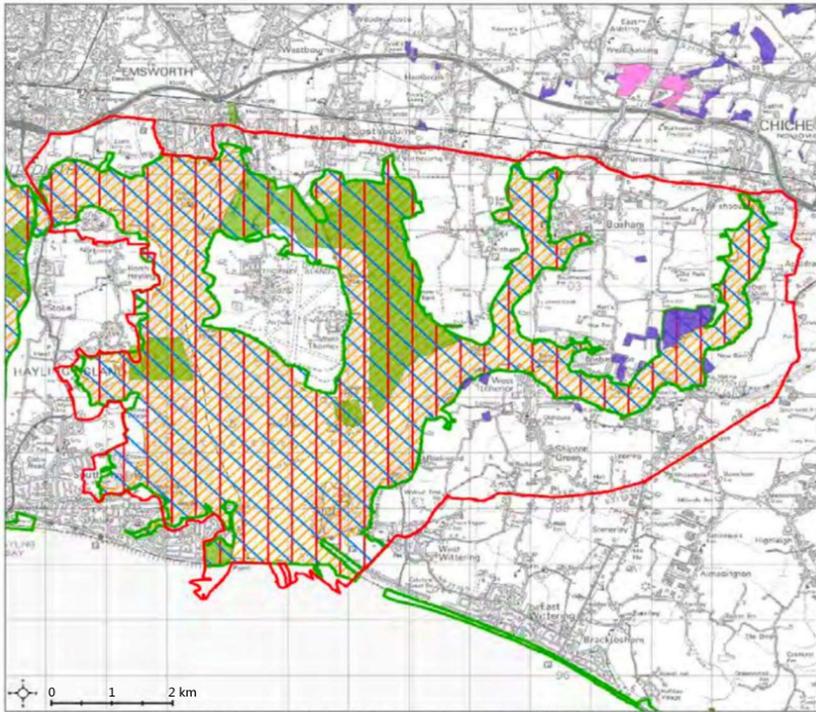


Figure 1. Map of Chichester Harbour AONB area (Parker & Manson) [25].

As suggested by Brace [26], a funnel approach was used by asking general questions first to understand respondents' characteristics before delving into more technical questions like water quality, environment designated areas and Port Waste Management Plan. A total of 132 respondents were classified by sex, age, education level, vessel types, number of vessels owned, and waste disposal methods. The questionnaire was validated through a pilot study by volunteers from the boat owners, stakeholders in Chichester Harbour and the researchers at the School of the Environment, Geography and Geosciences, University of Portsmouth. To know the boat owner's attitudes and perceptions towards the waste management process in the harbour, the questionnaire was divided into three sections: Chichester Harbour water quality, designation, and Port Waste Management Plan.

Semi-structured interviews were conducted following the steps to understand better the issues raised by respondents in the questionnaire. Six different stakeholders in Chichester Harbour volunteered to be interviewed. They were interviewed to better understand Chichester Harbour and its waste management practice by posing the structured questions piloted through a peer review and by some of the interviewees. The interview was divided into three sections: Chichester Harbour water quality, Port Waste Management Planning—Chichester Harbour, and Recommendations, each of which has multiple questions. The transcribed interview replies were sent to the interviewees to ensure that their perspectives were properly documented before being used in this study.

The data was largely utilized for descriptive statistical analysis, with tables, maps, and graphs used to describe the data set's essential properties and summarise variables. In addition, univariate analyses were used to compare one variable. In contrast, bivariate analyses were used to investigate the relationships between two data sets [27].

RESULTS

Out of the 132 responses received, the male gender represents 87%, followed by the female (11%) and 2% with preferred not to mention their gender. 36% of the respondents are 71 years or above and, followed by those aged 61–70 (33%) and then others (Figure 2). The respondents are majorly postgraduate degree holders (35%), followed by undergraduate degrees (29%), then Trade/Technical/Vocational training (14%) and others.

81% of the respondents have 21 years and above experience as recreational boat owners. This was followed by 11–15 years (6%) (Figure 3). Hence, most of the respondents considered themselves experts (49%). However, many with higher studies and postgraduate and undergraduate degrees have a negative view of the quality of the harbour's water. They represent 67% of the respondents that said the water quality is very low and 66% low quality, and 64% neither high nor low, but this does not correlate with the age of the respondents.

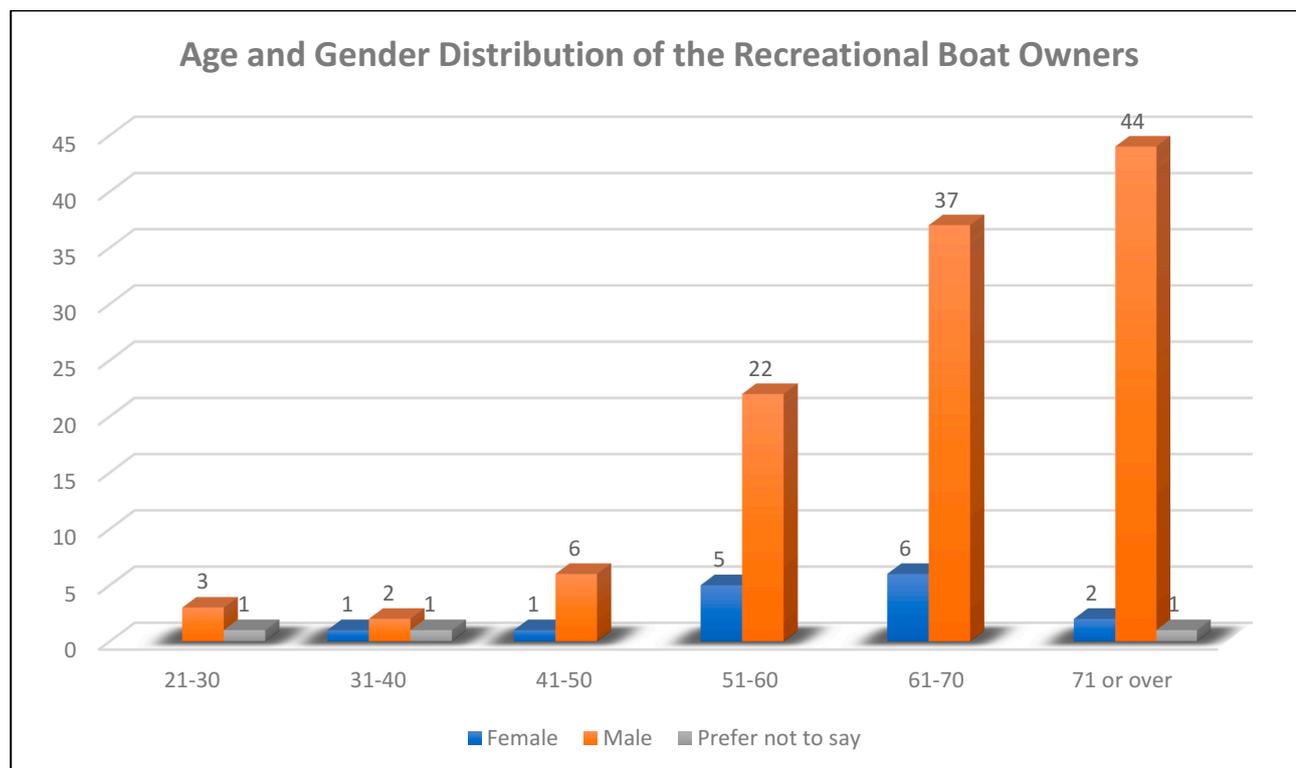


Figure 2. Age and gender distribution of the respondents.

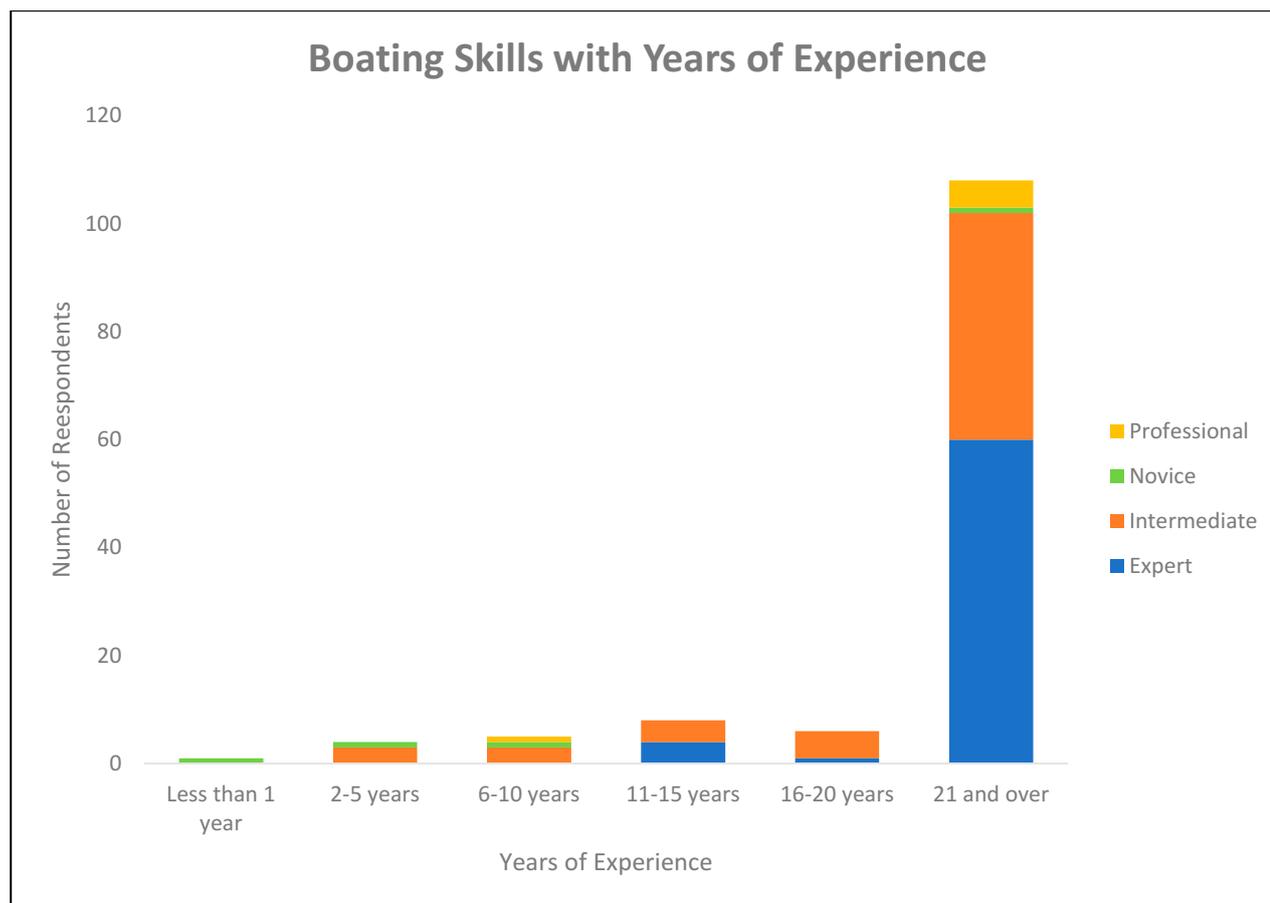


Figure 3. Boating Skills with Years of Experience.

According to Sennitt [28] and Byrnes et al. [29], the knowledge of the types of vessels in the harbour is essential to know their impacts on the environment 75% of the respondents have Sailboats powered by wind (with 64% being Yacht and dinghy being 11%), followed by Motorboat with cabin (16%) and without cabin (1%), kayak/canoe (4%), paddleboard (2%), and RIB inflatable represents 2%. However, most respondents own their vessels (87%), and 72% have only one vessel. Most responders (73%) do not have the necessary deck fittings on board their vessel to discharge sewage at an onshore pump-out station. Toilets/holding tanks are on board 19% of boats without deck fittings. However, 100% of respondents with deck fittings have toilets (Figure 4). To obtain a comprehensive picture of the type of waste generated, boat owners were asked what type of waste they discharged. Sewage is the most generated waste (42%), followed by petroleum/fuel waste (19%), hazardous items (13%), and solid wastes (11%) (Figure 5). However, 15% of respondents reported that their vessels generate no waste, and 23% maintained that they discharged their wastes at sea according to the discharge law. In comparison, 14% of respondents discharge their wastes directly into Chichester Harbour.

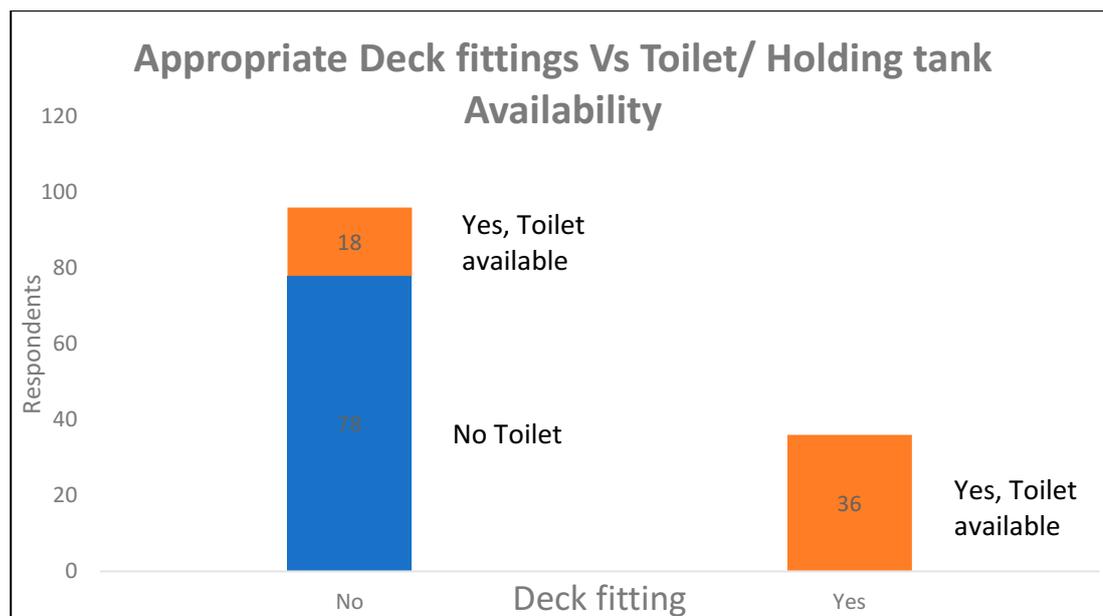


Figure 4. Deck fitting and toile/ holding tank availability.

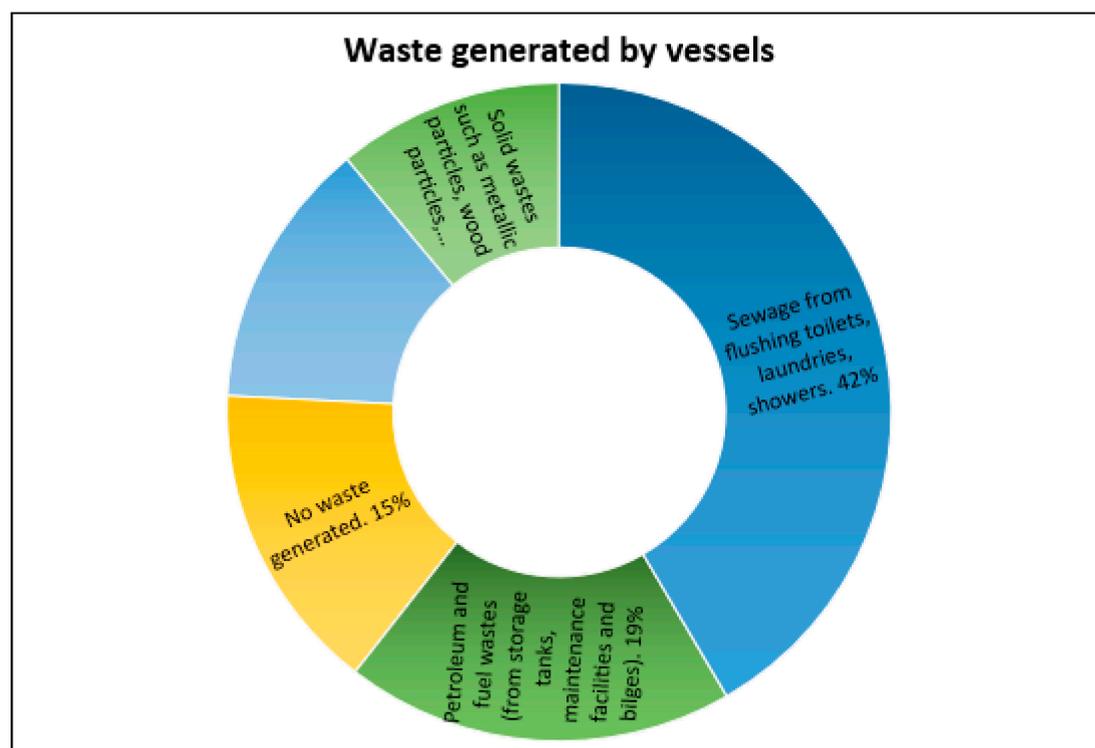


Figure 5. Wastes generated by Recreational boat users.

The Environmental Designation Areas (EDAs) provide a long-term means of supporting habitats, plants, and animals that find it more challenging to survive in the broader environment. Chichester Harbour has different environmental designations, including an Area of Outstanding Natural Beauty (AONB), a Ramsar site, a Site of Special Scientific Interest (SSSI), a Special Protection Area (SPA), a Special Area of Conservation (SAC), Sites of Nature Conservation Importance (SNCI), Local

Nature Reserves (LNR), Historic Environment Record sites (HER), and a Geological Conservation Review site (GCR). However, the respondents' understanding of the different EDAs in Chichester Harbour differs, as depicted in Figure 6. The response of the interviewees later confirmed this.

After gathering information about the type of waste and waste disposal method of the boat owners, their knowledge and perception about the effectiveness of the PWMP made available by the Chichester Harbour Conservancy and the Marine & Coastal Agency (MCA) were asked. 87% of the respondents did not know about the PWMP, which was not surprising as it is not a public facing document, 80% of the respondents did not use the PWMP facilities as only 11% knew of the facilities' location. However, a more significant percentage of the respondents (59%) know that there are different waste reception facilities for different kinds of waste.

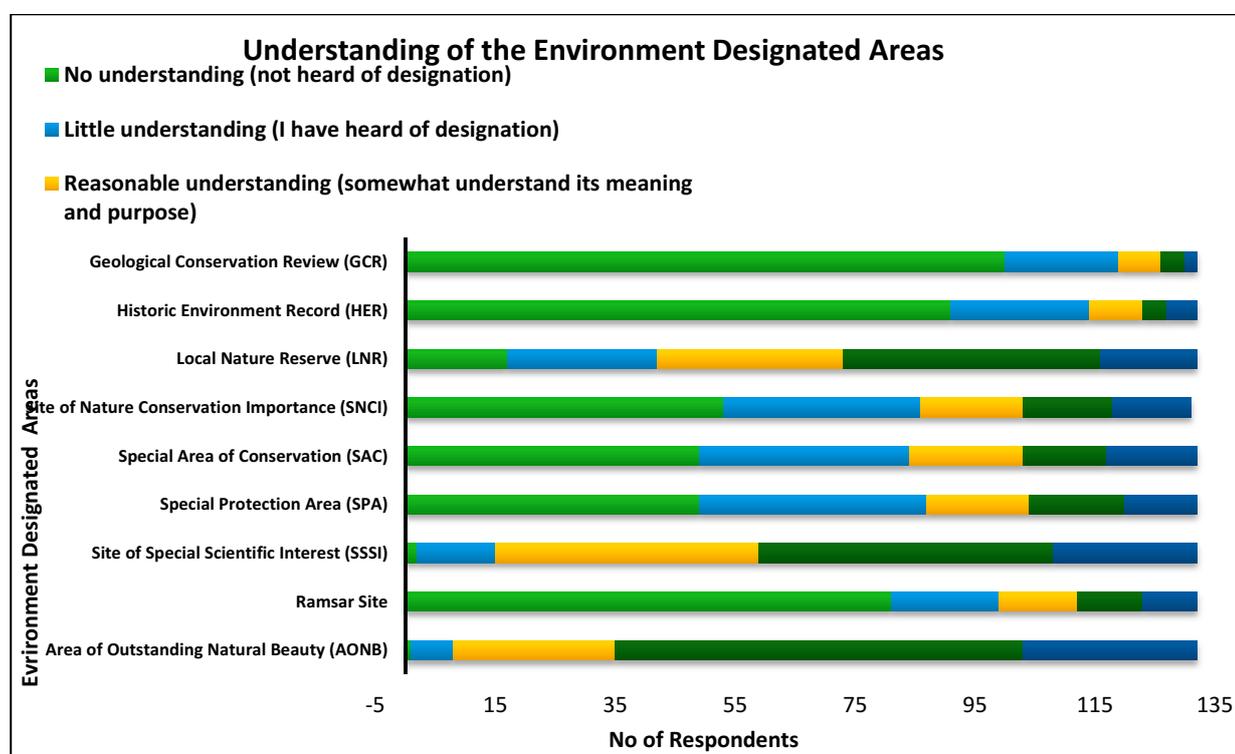


Figure 6. Respondents' EDAs understanding in Chichester Harbour.

39% of respondents find access to waste facilities neither easy nor difficult, while 19% find it not applicable, and 15% find it difficult. This could be due to respondents' lack of understanding of the PWMP, as described above. As a result, a larger majority (63%) could not comment on the facilities' utility. In comparison, 22% of respondents said the facilities were helpful, 5% said the facilities were irrelevant, and 11% said the facilities were not helpful (Figure 7). However, 33% of the respondents agreed that the PWMP had been successful, 39% could not comment, and 60% stated that it had not successfully handled waste management at the harbour.

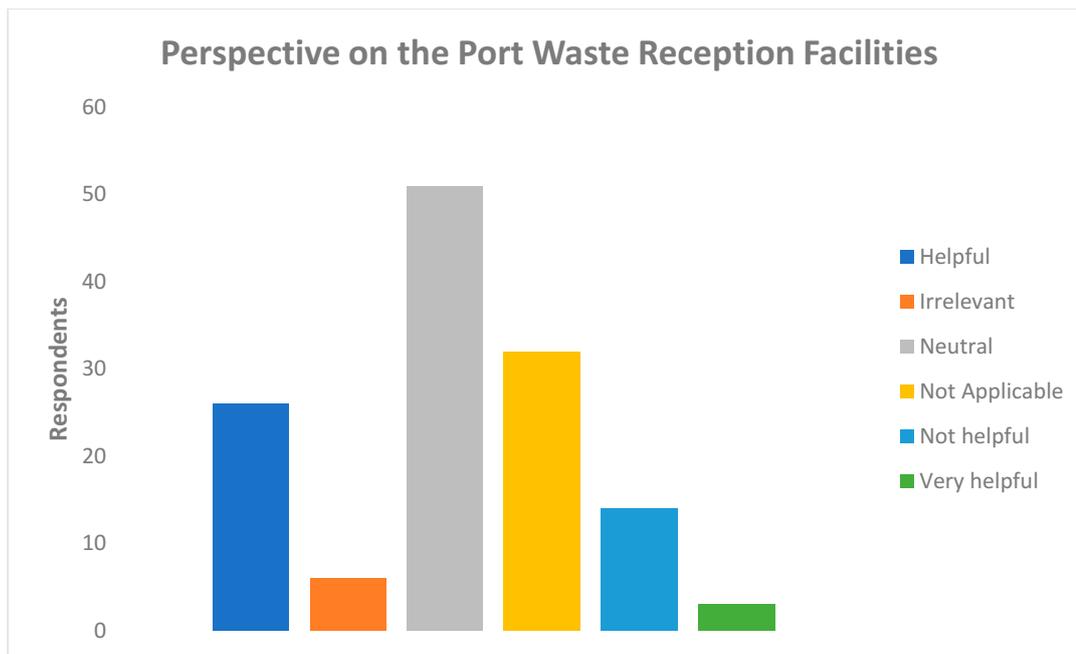


Figure 7. Perspective on port waste reception facilities.

Both questionnaire responders and interviewees were found to have a reasonable understanding of the environmental designations in Chichester Harbour. However, there were various perspectives on the harbour's water quality, with a few percentages of the respondents stating it was good and others claiming it was not. This was supported by the interviewees' differing perspectives on the state of the harbour's water quality, with the majority concluding that the water quality is good when compared with the EU bathing water directive. Also, the microbiological load is now better than it was 10–15 years ago due to certain efforts, including that of Southern Water investment, mainly at the Chichester wastewater treatment in installing UV disinfection on storm discharges from Apuldram works.

However, as indicated in the questionnaire, some interviewees were uninformed of the PWMP, which prohibited them from commenting on its use and purpose. In contrast, other interviewees expressed their opinions that the PWMP has been effective as there is no case of marine waste pollution in the harbour except the nitrate pollution from agricultural runoff and storm discharge from the adjacent water company. Increasing public awareness of the PWMP and ensuring that all boats have a holding tank are among the recommendations consistent with those stated by questionnaire respondents. Other ideas include limiting the number of boats in the harbour, enhancing education, and incorporating the PWMP into the mooring permit.

DISCUSSION

The result provides a detailed overview of recreational boat owners' perception of the waste management process in Chichester Harbour and

the level of their usage of the Port Waste Management Plan made available by the Conservancy. A notable percentage of the surveyed people have a negative perspective of the harbour's water quality. This is mainly due to untreated waste discharge from the area's public wastewater collection and treatment company, which corresponds with the report by Beer [30]. However, it was noted by the interviewees that the water quality of the harbour is good while considering the bacterial loads and other pollution save the nitrate pollution [31,32]. Nevertheless, the result shows that the recreational boaters are concerned about the harbour's water quality, which may be due to more than 50% of the respondents having at least a university degree.

The gender distribution is the same as Sennitt's [28] discovery in his research. However, the results of the respondents contradict what Ibabe et al. [22] and Lau [33] discovered in their perception studies on pollution and waste management at recreational ports. The majority of respondents in both studies are under 30 years old, and according to the survey by Ibabe et al. [22], the majority were female. In addition, the questionnaire in the prior two studies was delivered individually. In contrast, the questionnaire used in this study was web-based, which could cause the discrepancy. However, McAuliffe et al. [34] and Sennitt [28] used web-based surveys and still obtained different age distributions from those found in this research.

The understanding of EDA by the respondents (Figure 6) is the same as that observed elsewhere [28,34]. Besides the Ramsar site, which had a low response rate, their research showed that many respondents understood the EDAs. However, these EDAs may not be well understood because they are tiny and could be confused for completely different EDAs [34]. However, GCR and HER were not taken into account in their studies.

A variety of wastes are produced by recreational boats, including solid waste, hazardous waste, and ballast water [6]. Due to the variety of vessels owned by the respondents, they produce a variety of wastes, with sewage waste (Figure 5) being the main waste produced by recreational boat owners. In their study, Sliško^{vi}c et al. [35] found a comparable pattern, with sewage waste making up 62% of all waste produced by vessels and then followed by other types of waste. Many used vessels in the harbour lack deck fittings and onboard holding tanks, necessitating the direct dumping of wastes into the water. Due to this, the PWMP was not entirely functional in the harbour. Similar findings were found in a study by Di Vaio et al. [36]. They found that most tourists in a port on the Mediterranean Sea do not sustainably dispose of their other wastes except for plastics. Hence, most interviewees suggested that all boats should have holding tanks to improve waste management and the utilization of waste reception facilities provided by the CHC.

It is not surprising that most respondents do not use the PWMP as most have difficulty accessing the PWMP reception facilities, which is related to the factors mentioned by Ball [13]. He mentioned the lack of or

unsuitability of port reception facilities for various waste types, i.e., facilities that are challenging to use, challenging to locate, or inconveniently situated as part of the factors. This is consistent with Lau's [33] research, which found that attitudes toward waste management can be improved by perceived ease of recycling and disposal. However, inconvenience is viewed as a barrier to general waste and recycling [37,38]. This is further supported by the respondents, who expressed dissatisfaction about the lack of port reception facilities near where they moor their boats. In light of this, Kumar and Goel [39] suggested that the best location for waste and recycling bins be determined physically and selected after thorough consideration. However, only a small fraction of respondents knows the exact location of the waste reception facilities since only a small proportion has heard about the PWMP, and the location of the PWMP is adequately documented in the PWMP document [4].

As a result, the respondents recommended more publicity and education to raise awareness of the PWMP among recreational boat owners which is consistent with the result of the review conducted by Di Vaio et al. [40] where it was noted that in order to achieve proper waste management on board, cruisers and crew members must be included in the waste digital process. The respondents further stated that education about the PWMP's usefulness and how to utilize it would improve the use of waste reception facilities. The recommendation supports Lau [33] that encouraging recycling initiatives and waste management guidelines, as well as making each sort of garbage available with specific information, will improve boat owners' and users' proper disposal practices [41].

CONCLUSION

This study is significant because it adds to the body of knowledge on the public perception of waste management in harbours and ports. The attitudes and perceptions of recreational boat owners concerning Chichester Harbour's waste management process were researched and discussed, as well as how successfully the PWMP has reduced improper disposal of waste in the harbour and whether the waste reception facilities are being used properly. We observed that the majority of recreational boat owners do not use the waste reception facilities that are provided at the harbour because some of them have no holding tanks on their vessels, and some do not have easy access to the waste reception facilities. Additionally, it was found that most recreational boaters do not even know what the PWMP is all about and are unaware of the information needed for efficient waste management in Chichester Harbour.

The study is relevant for Chichester Harbour because of its multiple EDAs. Therefore, it has been advised that education regarding the PWMP's purposes is essential to properly understand its objectives and how best to use it to enhance the waste management process in Chichester Harbour.

An extensive study on the effects of water company on the state of Chichester Harbour's water quality would be useful, as the majority of

respondents claimed that the water company is the most significant contaminant of the harbour due to their untreated discharge. Whilst contemporary wisdom suggests that the contribution of the water company to deteriorating water quality is comparatively low (with agricultural run-offs and water washing-in from the Solent being greater sources), it is nevertheless interesting that the respondents focussed on the water company, perhaps due to a combination of public pressures currently experienced at Chichester Harbour (the competing Government priorities of development and conservation) and heightened public awareness. In addition, the perception and attitudes of visitors, marinas, sailing clubs, and locals in Chichester Harbour regarding the waste management process in the harbour should also be further examined to understand the process comprehensively.

DATA AVAILABILITY

The dataset of the study is available from the authors upon reasonable request.

AUTHOR CONTRIBUTIONS

Paul O. Olatunji contributed to the design of the work, data collection, data analysis and interpretation, drafting of the article and critical revision, and the final approval of the article before it was published.

Jonathan Potts contributed to the design of the work, the article's critical review, and the final approval of the article before it was published.

Pierre Failler contributed to the drafting of the article, critical review, and the final approval of the article before it was published.

Richard Austin made contributions to the design of the work, data collection, critical review of the article, and the final approval of the article before it was published.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

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