RESEARCH ARTICLE

Public perception of coastal habitat loss and habitat creation using artificial floating islands in the UK

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Abstract

Eco-engineering and the installation of green infrastructure such as artificial floating islands (AFIs), are novel techniques used to support biodiversity. The European Convention on Biological Diversity highlighted the development of green infrastructure as a key method of enhancement in degraded habitats. Research specifically on AFIs in marine environments has largely focused on their ecological functioning role and engineering outcomes, with little consideration for the social benefits or concerns. The aim of this study was to gain an understanding of public perception of coastal habitat loss in the UK and AFIs as a method of habitat creation in coastal environments. This was achieved via a survey, consisting of six closed and two open questions. Of the 200 respondents, 94.5% were concerned about the loss of coastal habitats in the UK, but less than a third were aware of habitat restoration or creation projects in their area of residence. There was a positive correlation between proximity of residency to the coast and knowledge of habitat restoration or creation projects. The majority of the respondents understood the ecological functioning role of AFIs and 62% would preferably want successful plant growth and avian species utilising the AFI. Nearly a third of the respondents had concerns about AFI installations, such as the degradation of the plastic matrix, long term maintenance and disturbance of native species. Despite 90.9% of the respondents supporting the installation of AFIs, the concerns of the public must be addressed during the planning stages of any habitat creation project.

Introduction

By 2025, more than 75% of the human population is estimated to live within 100km of the coast [1–6]. Currently, 14 of the World's largest cities occupy coastal regions [4], associated with extensive infrastructure to support commercial, residential and recreational developments [1,7–12]. Due to the risk of flooding and erosion caused by rising sea levels and severe storms, densely populated areas require protection via coastal defences such as sea walls, groynes and revetments [1,7,13–17]. The combined impact of coastal 'armouring' and marine urban sprawl has caused increasing spatial disconnection of coastal habitats, habitat degradation and alterations to natural community assemblages [1,18–22]. Coastal wetlands for example, are considered one of the most threatened ecosystems, with up to 50% of global saltmarsh recorded as either lost or degraded [23–26]. Avian species are reliant on coastal habitats for nesting, foraging and roosting and are increasingly under threat, due to rising sea levels and proposed coastal infrastructure [27]. Fish larvae dispersal and recruitment can also be disrupted by coastal infrastructure, which causes fluctuations in current patterns and sediment loading [28,29]. The European Convention on Biological Diversity aims to prevent any further loss of biodiversity and ecosystem services in Europe by 2020, with the support of novel techniques such as eco-engineering and green infrastructure [30–32]. The United Kingdom (UK) Post–2010 Biodiversity Framework intends to meet these international obligations, utilising biodiversity enhancement methods where appropriate [33].

Eco-engineering refers to the modification of planned or existing structures to become multifunctional [8,34–36]. The process integrates ecological theory with the design of a proposed structure, either during the construction or post construction phase [37]. For example texture can be added to a sea wall via small indents, larger pits or water holding features, such as flower pots [32,38–40]. In highly modified marine ecosystems such as marinas and docks, eco-engineering offers a means of enhancing existing or planned structures to benefit local biodiversity, while maintaining the integral anthropogenic function of the structure [41–43].

AFIs, also referred to as floating treatment wetlands, biohavens and floating ecosystem modules, offer an alternative eco-engineering method [44,45]. These small-scale floating structures should not be confused with the larger land reclamation activities occurring around the world and proposals for floating cities to support population growth and climate migration [46,47]. In the UK, they are commercially sold by companies that provide eco-engineering solutions for silt management, plastic pollution, wastewater treatment and habitat creation. They broadly consist of a buoyant mat, planting media and emergent vegetation [48–51]. The design referred to in this study (Fig 1, *top left*), consists of a non-woven recycled plastic matrix, an integrated connection grid providing structure and closed cell polyurethane foam for buoyancy [52,53]. With established plants grown on coir matting, AFIs support a localized ecological community within the submerged roots and on the surface of the structure itself; these include algal communities, macroinvertebrates and epibiotic species [49,54]. They have largely been installed in deteriorated and over-modified freshwater habitats to improve water quality, via the removal of suspended solids and organic matter, and biosynthesis of nutrients, effectively purifying the surrounding water body [48,49,55–58]. However, interest in the use of AFIs in coastal environments has increased and is the key focus of this study [59].

Over 300 AFIs have been utilised by the Royal Society for the Protection of Birds (RSPB) to provide breeding grounds and roosting sites for divers, gulls, terns, waders and wildfowl species, within coastal wetlands in the UK [61]. Their use extends to conservation projects in San Leandro Bay Oakland, California, to provide tidal refuge habitat for the California Ridgeway's rail (*Rallus obsoletus obsoletus*) during inundation periods of the natural wetland habitat [57]. Floating structures also promote the formation of biofouling communities [44,62,63], increasing productivity and nutrient availability via deposition of organic matter within the local environment. This can attract higher trophic species such as fish, elevating the local species diversity [63–65]. For example juvenile common two-banded sea bream (*Diplodus vulgaris*) have been associated with artificial structures in high abundances, utilising installed 'biohuts' that add complexity to the localised habitat [29]. In Swansea, three AFIs have been installed in inshore marine habitats to assess the successful establishment of vegetation and their utilisation by birds, fish and invertebrates (Fig 1, *bottom left*). However, there currently is a lack of understanding of the public perception of AFIs, which could impact on the success of future installation projects [35,66–68].

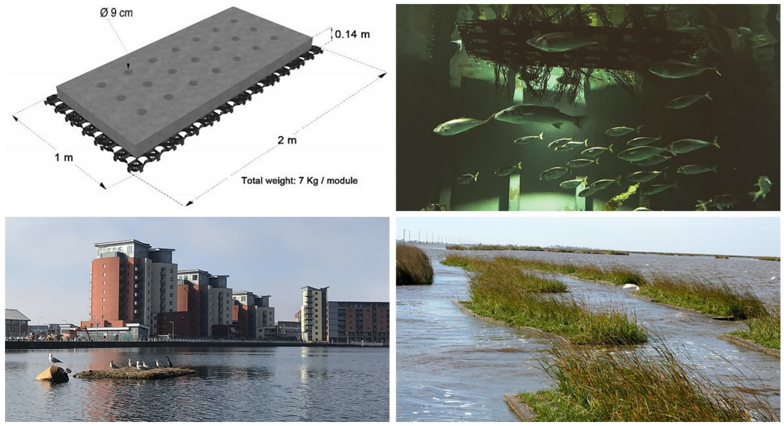

Fig 1. Artificial floating island (AFI) unit and existing installations and research. *Top left*–Schematic diagram of a $2m^2$ matrix unit, commercially sold as 'biohavens'. These AFIs consist of a non-woven plastic matrix, integrated connection grid and polyurethane foam [53]; *top right*–AFI installed in a controlled experiment at Bristol Aquarium, with 13 native, marine vertebrates; *bottom left*–AFI installed in a saline dock in Swansea known as Prince of Wales Dock; and *bottom right*–Linear arrangement of AFIs used on the coast of Louisiana, USA, for wave absorption and to reduce coastal erosion [60].

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Public awareness and perception of both national and international scale environmental concerns is important, as it influences acceptance of environmental policies and positive behavioural change within society [69,70]. Understanding the relationship the public currently have with marine ecosystems will enable the identification of any misconceptions of environmental issues and highlight the issues of concern [71]. With a better understanding of successful and failed processes of scientific communication, future environmental management and policy strategies can be improved, encouraging public support. Incorporating public awareness and citizen science campaigns into environmental conservation can positively contribute to the success of achieving new, conservation objectives [72–74]. Previously, the importance of stakeholder engagement has been highlighted during the installation of artificial reefs off the west coast of Scotland and southern Portugal [75,76]. In a number of studies worldwide, the majority of the respondents supported eco-engineering initiatives that enhanced the conservation of biodiversity [35,67,68]. However, awareness and knowledge of eco-engineering initiatives tends to be lower in Europe compared to America and Australia [67].

In the UK, public perception research has focused on the general marine environment and its protection from global concerns such as climate change [72,77–79], managed realignment [80,81], beach aesthetic and selection [82] and offshore wind farms [83]. It is important that similar information is gained on the public perception of eco-engineering methods, such as AFIs.

This study aimed to gain an understanding of the perceived importance of coastal habitat loss in the UK, in comparison to other environmental issues. Further, the study aimed to obtain information on the public's understanding of AFIs and any concerns related to AFI installations. The objectives of the survey were to assess whether the public were: (1) concerned about the loss of coastal habitats in the UK; (2) aware of local habitat restoration or creation projects; (3) aware of the ecological functioning role of AFIs; and (4) supportive of AFI initiatives as a method of habitat creation within coastal environments. Further, the study aimed to assess whether public awareness correlated with proximity of residency from the coast. The results of this study will help inform stakeholders planning on installing AFIs in UK coastal environments on public opinion and best practice before and during the AFI installation.

Methods

Survey design

The survey consisted of eight questions, subdivided into two themes: coastal habitats and AFIs (Table 1). The survey included questions with 5-point Likert scale answers, binary and multiple choice. It was restricted to six closed questions and two open questions, with an average completion time of 3 minutes, thus maximising participation. No background information was provided prior to the respondent completing the survey. Question 1 was limited to five

Table 1. The complete survey consisting of 8 questions.

Section 1: Coastal habitats	
Questions	**Possible answers**
1. Which of the following factors do you think are negatively impacting on the health of coasts in the UK? Rank each factor by importance. Urbanisation/ Coastal Developments, Flooding, Invasive species, Plastic pollution and Habitat loss.	Very important, Fairly important, Important, Slightly important or Not at all important.
2. Are you concerned about the loss of coastal habitats in the UK, such as beaches, coastal wetlands and saltmarsh?	Yes, No or Not sure.
3. Are you aware of any habitat restoration or creation projects in your area like artificial floating islands or wildflower planting? If yes, any further details of the type of project and in what location can be added here.	Yes or No.
Section 2: Artificial floating islands	
Questions	**Possible answers**
4. Artificial floating islands consist of a recycled plastic matrix and growing medium, that plants are able to grow roots through. They are often installed in lakes and rivers. What do you think artificial floating islands are installed for? Tick any answers that you think are correct.	Aesthetic, To create habitat and support biodiversity, To support boating activity, To improve water quality, To collect litter or Other.
5. On some occasions it is difficult to maintain both plant growth and bird use. Which of the following scenarios would you prefer if an island were installed in your local area?	Bird activity and no plants, Plants and fencing with roots growing through the island for fish, Plant growth but not fully covering the island and bird activity or Not sure.
6. Would you have any concerns about the installation of an artificial floating island?	Open question.
7. Would you support future installations of artificial floating islands or other habitat creation projects along the coast?	Yes, No or Not sure.
8. How far from the coast to do live?	1 mile, 5 miles, 10 miles or 20 miles +.

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factors for simplicity and the factors selected were all environmental concerns prevalent in the UK. In terms of personal information, only distance that the respondent lived from the coast was determined. Other demographic information was not collected in this survey, such as age and occupation, as these details were not required to meet the study objectives. However, more detail about the location of residency was inferred from Question 3, addressing awareness of habitat restoration initiatives and assuming that participants had greater knowledge of projects in their local area. Question 5 addressed a common issue associated with high numbers of wildfowl and maintaining plant growth on AFIs. Additionally, AFIs can be specifically installed without vegetation to attract certain avian species that require only substrate for breeding [61,84].

Survey collections

The target demographic was members of the public living in the UK, aged 18 or above. One respondent living in the Netherlands completed the survey and was included in the analysis. The survey was self-administrated using the survey tool 'Survey Monkey' (https://www.surveymonkey.com) and went live on 27th January 2019. The survey was live for 68 days, until 5th April 2019. The survey was circulated on social media platforms such as Facebook and Twitter and members of the public were approached in Bristol Aquarium and Swansea. The survey was also circulated via community forums such as such as 'Maritime Quarter Residents Association' and 'Uplands and Brynmill community forum', to gain information on the opinion of local residents, who may have observed the AFIs in Swansea. A total of 200 surveys were collected during the 68 days that the survey was live (online, n = 170; in person, n = 30). The information provided during the online surveys and in person was the same, minimising any bias results. Swansea University ethics committee approved research conducted in this study (SU-Ethics-Student-030719/1106).

Data analysis

Descriptive statistics were used to summarise results from each question of the survey. Chi squared tests were used to assess whether there was a relationship between the distance the respondent lived from the coast and their (1) concern of coastal habitat loss; (2) awareness of habitat restoration and creation projects; (3) awareness of AFIs and their ecological functioning role; and (4) concerns related to AFIs being installed. Comments that addressed concerns about AFI installations (Question 6; Table 1) were organised into categories appropriately. Statistical tests were completed using R 3.6.0 statistics software.

Results

Of the 200 respondents, 29.5% (n = 59) lived within 1 mile of the coast, 23% (n = 46) within 5 miles, 17.5% (n = 35) within 10 miles and 30% (n = 60) greater than 20 miles.

Coastal habitats

The majority of respondents considered plastic pollution (77.8%, n = 154) and habitat loss (70.9%, n = 139) to be very important factors affecting the health of coasts in the UK (Fig 2). Urbanisation was also considered to be a very important factor by 43.2% of the respondents (n = 86). There was no significant relationship between perceived importance of coastal habitat loss and proximity of residence to the coast ($\chi^2 = 2.86$, d.f. = 3, $p = 0.41$, n = 200). Less than a third of the respondents considered flooding (28.4%, n = 55) and invasive species (24.2%, n = 47) to be very important factors affecting the health of coasts in the UK. Three of the

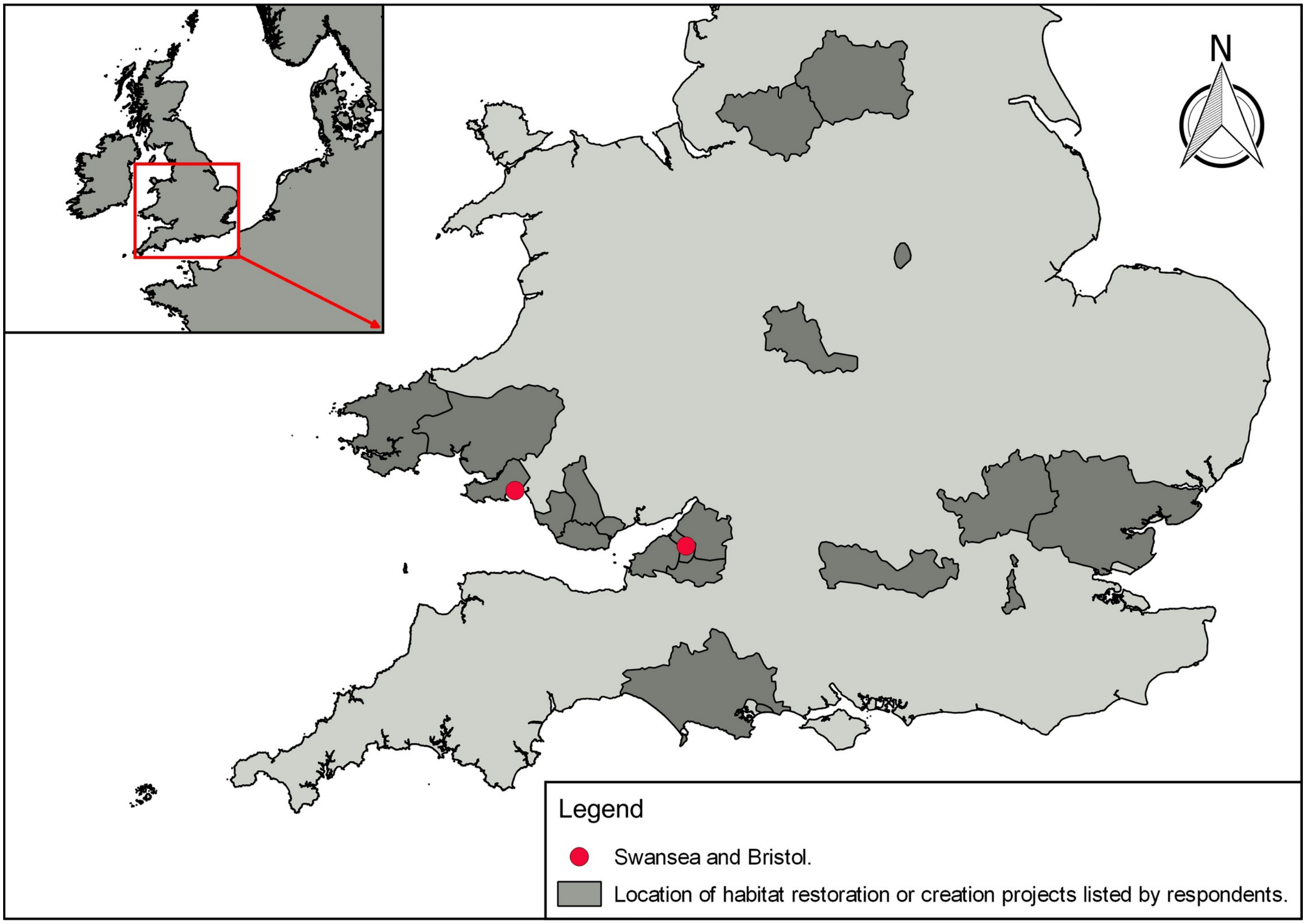

Fig 2. The perceived importance of factors negatively impacting on the health of UK coasts.

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factors were perceived as not important at all. These were invasive species (5%, n = 9), flooding (4%, n = 7) and urbanisation/coastal developments (1%, n = 2).

The majority of respondents were concerned about the loss of coastal habitats in the UK (94.5% n = 189). Under a third of the respondents (28.5%, n = 57) were aware of habitat restoration or creation projects in their area of residence and this was dominated by respondents living within 1–5 miles of the coast (70%). There was a significant relationship between the respondents' awareness of habitat restoration and creation projects and the proximity of residence from the coast (χ^2 = 8.95, d.f. = 3, p = 0.02, n = 200). The respondents that provided further detail to Question 3 (n = 34) mentioned projects located in South Wales and England (Fig 3) and 52% of the schemes were related to marine environments, rather than terrestrial or freshwater habitats.

Artificial floating islands

As the respondents could give multiple answers on the perceived purpose of installing an AFI (Table 1, Question 4), there were 385 responses; 306 understood the ecological functioning role of AFIs ('to create habitat and support biodiversity' n = 196; 'to improve water quality'

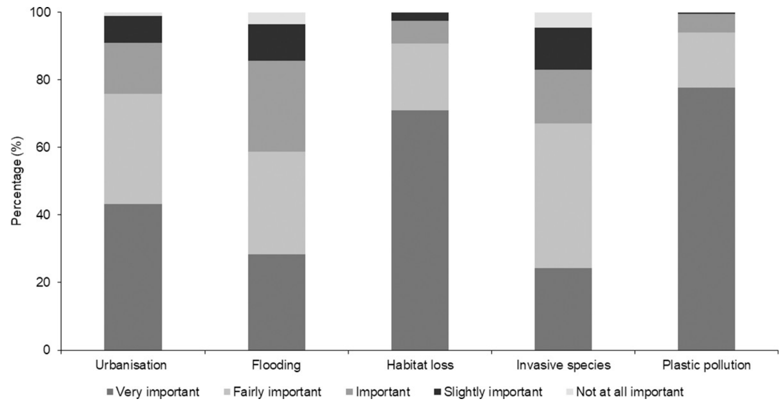

Fig 3. The location of habitat restoration or creation projects listed by the respondents of the survey (n = 34). The projects mentioned by respondents were located in 23 counties in England and Wales. Each project is represented by county it is located in [85,86].

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n = 110). There was no significant relationship in public awareness of the ecological functioning role of AFIs between the four proximity categories ($\chi^2 = 3.64$, d.f. = 3, p = 0.30, n = 200).

The majority of the public surveyed preferred to have both successful plant growth and birds utilising an AFI (62%, n = 125, Fig 4). One third of the respondents preferred the installation of an island with successful plant growth, maintained by the inclusion of fencing (33%, n = 67). High levels of bird activity with no plants growing was the least popular response (4%, n = 9).

Question 6 of the survey allowed the respondents to voice any concerns regarding AFI installations on the coast; 33% of the 200 (n = 66) chose to comment on their concerns. These were broadly categorised into maintenance, recreation, aesthetic, plastic pollution, disturbance and invasive species concerns (Fig 5). The definition of each term based on the respondents' answers are outlined in Table 2.

Plastic pollution (n = 33) and the long-term maintenance (n = 26) of an installed AFI were the key areas of concern by the respondents of the survey (Fig 5). The majority of the respondents would support the future installation of AFIs along the coast (90.9%, n = 181), with the remaining respondents either unsure or against the method of habitat creation.

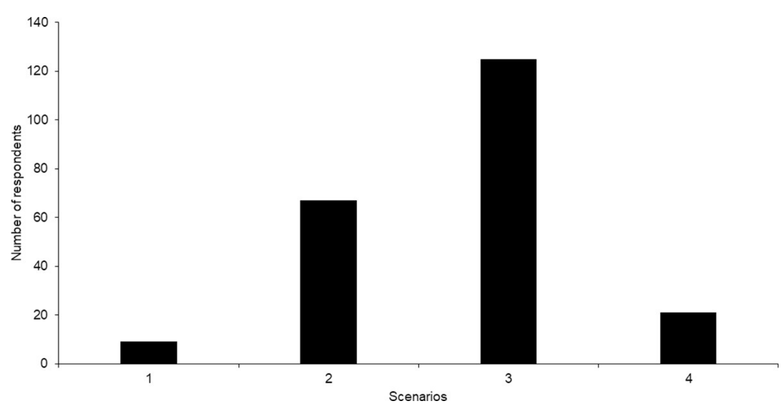

Fig 4. The respondents' preference of an installed artificial floating island in their local area based on five scenarios. (1) Bird activity and no plants; (2) Plants and fencing, with roots growing through the island for fish; (3) Plant growth, but not fully covering the island and bird activity; and (4) Not sure.

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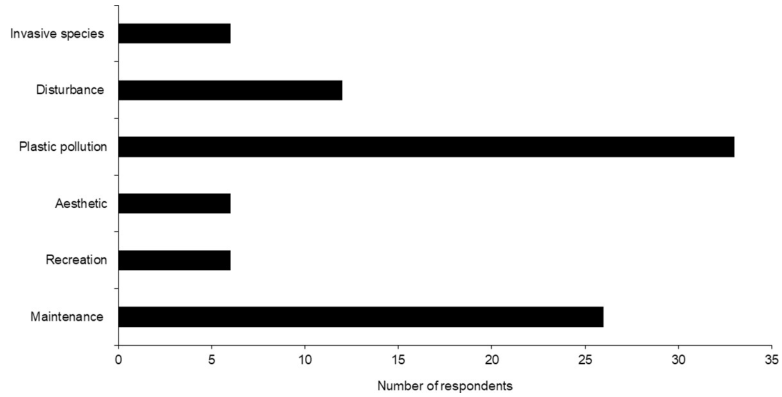

Fig 5. The number of concerns raised by respondents. These have been categorically organised into maintenance, recreation, aesthetic, plastic pollution, disturbance and invasive species.

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Discussion

Artificial structures are proliferating in marine environments in the form of coastal defences [13,14,17] and infrastructure to support shipping, transport, commercial, recreational and residential developments [1,7–12]. Current legislation including the European Convention on Biological Diversity and the UK Post-2010 Biodiversity Framework, address that novel techniques such as eco-engineering have a role to play to prevent any further loss of biodiversity and ecosystem services caused by anthropogenic activities [30–32,87]. Alongside meeting legislative targets, it is also important to engage with the public on environmental issues and conservation approaches that could be introduced. Without public engagement, the awareness and public support of future projects cannot be guaranteed. This study aimed to gain an understanding of the public's perception of coastal habitat loss and AFIs as a habitat creation method.

The majority of participants of this survey were concerned about the loss of coastal habitats in the UK and consider plastic pollution, habitat loss and urbanisation as very important factors negatively impacting on the coast (Fig 2). Due to the release of documentaries such as 'A Plastic Ocean' in 2016 and 'Blue Planet II' in 2017, public awareness has increased substantially on the impacts of litter and specifically, non-biodegradable material in ocean ecosystems. The UK public also demonstrated an understanding of the deterioration of marine environments in a previous study, where 95.8% of respondents considered marine habitats to be of 'fair to poor' health [72,78]. Pollution and climate change are consistently mentioned as the most concerning environmental issues for members of the public, in the UK and abroad [35,77,88]. In this survey, coastal urbanisation, flooding and invasive species were perceived as less important factors by some respondents (Fig 2). This could be due to a lack of understanding of

Table 2. Definition of the six concerns listed by respondents in Question 6 of the survey.

Concern	Definition
Maintenance	Damage or detachment of the island during severe weather or as a result of vandalism.
Recreation	Disrupt boating, kayaking or surfing activity on the coast.
Aesthetic	It is unnatural and a potential eyesore.
Plastic pollution	Degradation of the plastic matrix into the water body.
Disturbance	Noise pollution during installation and impact on natural processes.
Invasive species	Encourage the presence or spread of a non-native species that could cause damage to the ecosystem.

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secondary impacts of developments, such as light and noise pollution and fluctuating hydrodynamics that can result in flooding. The importance of flooding to the respondent can also be governed by personal experience [89]. The individuals' socio-economic status linked to education and occupation and their specific motivations and interests, have also been identified as factors that drive awareness of environmental issues [77,90]. These details were not included as part of this survey, as the information was not required to meet the study research objectives. However, this does limit comparisons to other public surveys.

The majority of the public desire greater protection and conservation of the UK marine environment, from fishing and other damaging, exploitative practices [72]. However, as part of this survey under a third of the respondents were aware of habitat restoration or creation projects in their area. The respondents that did mention restoration and/or creation projects mostly lived within 1–5 miles of the coast and 52% of the schemes were related to marine environments, rather than terrestrial or freshwater habitats. Examples of schemes mentioned across all habitat types included: dune slack management in Kenfig National Nature Reserve, Bridgend, to promote early succession of orchids; creating habitats for common kingfisher (*Alcedo atthis*) populations in the Lee Valley, Essex, via river management and; habitat restoration at Saltwells Local Nature Reserve, Dudley (Fig 3). The focus on marine conservation and policy could be a direct result of greater national awareness, personal interest based on residential location or occupation. The correlation between proximity to the coast, marine conservation and policy knowledge was discovered during a large scale survey in the United States [77,90]. However, this outcome could also be a result of the marine focus of the survey. To reduce potential bias towards marine projects, wildflower planting was also mentioned as a terrestrial habitat restoration and/or creation method in Question 3. The respondent was also asked to mention projects within their local area (Table 1).

For future research, more detailed demographic information would be desirable to gain deeper insight into relationships between social and economic background with views on marine conservation awareness and AFIs.

In this survey, the majority of respondents showed an understanding of the ecological functioning role of AFIs. This could be linked to a positive shift in perception in the UK of the importance of wetland biodiversity and support towards wetland restoration [91]. Overall, the survey confirmed that the public preferred a vegetated island utilised by birds (Fig 4). Within urban environments green landscapes play a significant role in health and mediating the stresses of daily life [92,93]. This could have contributed to the respondents' positive association with vegetation growth on the AFIs. Water quality of natural wetlands, the presence of emergent vegetation and trees and habitat value to local wildlife, were factors viewed as important in assessing wetland health in Australia [94]. There is however, evidence that a lack of understanding of ecological values is linked to a negative view of wetlands [94–96].

Public and stakeholder perception studies of artificially created habitats have largely focused on benthic habitats including artificial reefs, concrete flowerpots used in the intertidal zone and coastal defence structures [35,67,68,75,76,97]; therefore, limiting comparisons of the results from this study. In a preliminary study, stakeholders including engineering and ecological consultants, academics and statutory bodies unanimously supported the implementation of multi-functional artificial structures, which prioritised ecological benefits within coastal environments [66]. The study also highlighted that 'education and outreach' was one of the lowest assigned considerations by stakeholders, while a greater evidence base of the ecological benefits was seen as desirable. This illustrated the importance of accessible research and a strong evidence base for stakeholders [12]. It also demonstrated the lack of importance placed on public engagement by stakeholders, which could be limiting future public support of the implementation of eco-engineering and artificial habitat creation projects.

Nearly a third of the respondents had concerns about the installation of AFIs in the marine environment. These concerns largely focused on the future degradation of the AFI matrix and potential for the islands to become plastic pollution (Fig 5). Additionally, the public were concerned about the long-term maintenance and aesthetic of the island; 'would it look unnatural and therefore un-aesthetic?', 'how will they be maintained?', and 'would the plastic in the matrix enter the food chain?'. Other comments were related to the potential disturbance of commercial and recreational boating, surfers and native wildlife. During the planning stages of an AFI installation, it is important that research and monitoring is undertaken by the individual or company responsible, on the environmental conditions of a proposed island location. This includes factors such as average wind speed, water velocity and tidal height (if applicable). In addition, salinity and pH should be assessed as certain metals are susceptible to corrosion, based on the surrounding water chemistry. This information will aid decisions on the appropriate size, configuration and method of installation of an AFI, that minimises disruption of native fauna and ensures it is securely installed. Research and open communication with potential stakeholders and members of the public, will also ensure that no recreational activities are disrupted by the installed AFI.

AFIs have an approximate life span of 20 years and this varies depending on its location [50]. As most AFIs are installed in ponds, reservoirs and rivers, case studies of islands exposed to waves, tides, marine biofouling and saline conditions are limited. Laboratory experiments have demonstrated that the size and configuration of the AFI determines the force (kilonewton, kn) exerted on the islands structure. Prior to the installation of an AFI, a maintenance and potential disposal plan should be established and made publicly accessible. This will ensure the long-term success of an AFI and reassure local residents that the island will be maintained and disposed of appropriately, to prevent potential degradation of the plastic matrix. If the AFI is installed where invasive species are present, the island should not be translocated to prevent the potential spread of invasive species.

In conclusion, the majority of the respondents would support the installation of AFIs along the coast, as they recognised coastal habitat loss as an important environmental issue. The successful establishment of plants and positive benefits to local wildlife, were equally important factors valued by respondents. There were concerns regarding the longevity of an artificially created habitat, which must be rectified with thorough strategic planning and appropriate aims, based on the location of the proposed AFI installation. Further research is required on socio-economic factors that could be influencing public awareness of habitat loss and artificially created habitats within urban ecosystems.

Supporting information

S1 Appendix. Dataset of the survey. Includes the 200 respondents' answers to the eight questions of the survey that was open from 27th January– 5th April 2019.
(XLSX)

S2 Appendix. Survey questions. The eight survey questions answered by respondents.
(PDF)

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Author Contributions

Data curation: Jessica Ware.

Formal analysis: Jessica Ware.

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Methodology: Jessica Ware, Ruth Callaway.

Project administration: Jessica Ware.

Supervision: Ruth Callaway.

Visualization: Jessica Ware.

Writing – original draft: Jessica Ware.

Writing – review & editing: Ruth Callaway.

References

1. Bulleri F, Chapman MG. The introduction of coastal infrastructure as a driver of change in marine environments. J Appl Ecol. 2010; 47(1):26–35.
2. European Environment Agency. EEA Environment Statement 2006. The Changing Faces of Europe's Coastal Areas. [Internet]. EUR-OP; 2006 [cited 2018 Jul 3]. 1–67 p. Available from: https://www.eea.europa.eu/publications/report_2006_0707_150910
3. Mercader M, Mercière A, Saragoni G, Cheminée A, Crec'hriou R, Pastor J, et al. Small artificial habitats to enhance the nursery function for juvenile fish in a large commercial port of the Mediterranean. Ecol Eng [Internet]. 2017 Aug [cited 2018 Jun 11]; 105:78–86. Available from: http://linkinghub.elsevier.com/retrieve/pii/S0925857417301490
4. Sekovski I, Newton A, Dennison WC. Megacities in the coastal zone: Using a driver-pressure-state-impact-response framework to address complex environmental problems. Estuar Coast Shelf Sci. 2012; 96(1):48–59.
5. Beck M, Airoldi L. Loss, Status and Trends for Coastal Marine Habitats of Europe [Internet]. 2007. 345–405 p. Available from: http://www.crcnetbase.com/doi/abs/10.1201/9781420050943.ch7
6. Creel L. Ripple effects: Population and coastal regions. Mak link. 2003; 8.
7. Firth LB, Knights AM, Bridger D, Evans AJ, Mieszkowska N, Moore PJ, et al. Ocean sprawl: Challenges and opportunities for biodiversity management in a changing world. Oceanogr Mar Biol An Annu Rev. 2016; 54(September):193–269.
8. Chapman MG, Underwood AJ. Evaluation of ecological engineering of "armoured" shorelines to improve their value as habitat. J Exp Mar Bio Ecol [Internet]. 2011 Apr 30 [cited 2019 Sep 2]; 400(1–2):302–13. Available from: https://www.sciencedirect.com/science/article/pii/S0022098111000736
9. Firth LB, Mieszkowska N, Thompson RC, Hawkins SJ. Climate change and adaptational impacts in coastal systems: the case of sea defences. Environ Sci Process Impacts [Internet]. 2013 Aug 21 [cited 2019 Sep 2]; 15(9):1665. Available from: http://xlink.rsc.org/?DOI=c3em00313b https://doi.org/10.1039/c3em00313b PMID: 23900344
10. Moschella PS, Abbiati M, Åberg P, Airoldi L, Anderson JM, Bacchiocchi F, et al. Low-crested coastal defence structures as artificial habitats for marine life: Using ecological criteria in design. Coast Eng [Internet]. 2005 Nov 1 [cited 2019 Sep 2]; 52(10–11):1053–71. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0378383905001146
11. Airoldi L, Abbiati M, Beck MW, Hawkins SJ, Jonsson PR, Martin D, et al. An ecological perspective on the deployment and design of low-crested and other hard coastal defence structures. Coast Eng [Internet]. 2005 Nov 1 [cited 2019 Sep 2]; 52(10–11):1073–87. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0378383905001158
12. Evans AJ, Firth LB, Hawkins SJ, Hall AE, Ironside JE, Thompson RC, et al. From ocean sprawl to blue-green infrastructure–A UK perspective on an issue of global significance. Environ Sci Policy [Internet]. 2019; 91(November 2017):60–9. Available from: https://doi.org/10.1016/j.envsci.2018.09.008
13. Nicholls RJ, Cazenave A. Sea-level rise and its impact on coastal zones. Science [Internet]. 2010 Jun 18 [cited 2019 Sep 2]; 328(5985):1517–20. Available from: http://www.ncbi.nlm.nih.gov/pubmed/20558707 https://doi.org/10.1126/science.1185782 PMID: 20558707

14. Bader J, Mesquita MDS, Hodges KI, Keenlyside N, Østerhus S, Miles M. A review on Northern Hemisphere sea-ice, storminess and the North Atlantic Oscillation: Observations and projected changes. Atmos Res [Internet]. 2011 Sep 1 [cited 2019 Sep 2]; 101(4):809–34. Available from: https://www.sciencedirect.com/science/article/pii/S0169809511001001

15. Thompson RC, Crowe TP, Hawkins SJ. Rocky intertidal communities: Past environmental changes, present status and predictions for the next 25 years. Environ Conserv. 2002; 29(2):168–91.

16. Mercader M, Mercière A, Saragoni G, Cheminée A, Crec'hriou R, Pastor J, et al. Small artificial habitats to enhance the nursery function for juvenile fish in a large commercial port of the Mediterranean. Ecol Eng [Internet]. 2017; 105:78–86. Available from: http://dx.doi.org/10.1016/j.ecoleng.2017.03.022

17. Neumann B, Vafeidis AT, Zimmermann J, Nicholls RJ. Future coastal population growth and exposure to sea-level rise and coastal flooding—A global assessment. PLoS One. 2015; 10(3).

18. Chapman MG, Blockley DJ. Engineering novel habitats on urban infrastructure to increase intertidal biodiversity. Oecologia. 2009; 161(3):625–35. https://doi.org/10.1007/s00442-009-1393-y PMID: 19551409

19. McDonnell MJ, Pickett STA, Groffman P, Bohlen P, Pouyat R V., Zipperer WC, et al. Ecosystem processes along an urban-to-rural gradient. Urban Ecosyst [Internet]. 1997 [cited 2019 Aug 19]; 1(1):21–36. Available from: http://link.springer.com/10.1023/A:1014359024275

20. Marzluff JM. Island biogeography for an urbanizing world: how extinction and colonization may determine biological diversity in human-dominated landscapes. Urban Ecosyst [Internet]. 2005 Jun [cited 2019 Aug 19]; 8(2):157–77. Available from: http://link.springer.com/10.1007/s11252-005-4378-6

21. Bulleri F, Chapman MG. Intertidal assemblages on artificial and natural habitats in marinas on the north-west coast of Italy. Mar Biol [Internet]. 2004 Aug 10 [cited 2019 Jan 10]; 145(2):381–91. Available from: http://link.springer.com/10.1007/s00227-004-1316-8

22. Bishop MJ, Mayer-Pinto M, Airoldi L, Firth LB, Morris RL, Loke LHL, et al. Effects of ocean sprawl on ecological connectivity: impacts and solutions. J Exp Mar Bio Ecol [Internet]. 2017 Jul [cited 2018 May 30]; 492:7–30. Available from: http://linkinghub.elsevier.com/retrieve/pii/S0022098117300618

23. Barbier EB, Hacker SD, Kennedy C, Kock EW, Stier AC, Sillman BR. The value of estuarine and coastal ecosystem services. Ecol Monogr. 2011; 81(2):169–93.

24. Lotze HK, Lenihan HS, Bourque BJ, Bradbury RH, Cooke RG, Kay MC, et al. Depletion, degradation, and recovery potential of estuaries and coastal seas. Science [Internet]. 2006 Jun 23 [cited 2018 Jul 5]; 312(5781):1806–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16794081 https://doi.org/10.1126/science.1128035 PMID: 16794081

25. Worm B, Barbier EB, Beaumont N, Duffy JE, Folke C, Halpern BS, et al. Impacts of biodiversity loss on ocean ecosystem services. Science [Internet]. 2006 Nov 3 [cited 2018 Jul 5]; 314(5800):787–90. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17082450 https://doi.org/10.1126/science.1132294 PMID: 17082450

26. Halpern BS, Walbridge. A Global Map of Human Impact on Marine Ecosystems. 2008; 319(February):948–53.

27. Chu-Agor ML, Muñoz-Carpena R, Kiker G, Emanuelsson A, Linkov I. Exploring vulnerability of coastal habitats to sea level rise through global sensitivity and uncertainty analyses. 2011 [cited 2018 Oct 8]; Available from: https://ac.els-cdn.com/S136481521000321X/1-s2.0-S136481521000321X-main.pdf?_tid=99ae41c2-07d8-4457-8e82-5c0928cf3820&acdnat=1539014220_783830501c5a97d2ef72944e743f9122

28. Roberts CM. Connectivity and management of caribbean coral reefs. Science [Internet]. 1997 Nov 21 [cited 2019 Jan 10]; 278(5342):1454–7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/9367956 https://doi.org/10.1126/science.278.5342.1454 PMID: 9367956

29. Bouchoucha M, Darnaude AM, Gudefin A, Neveu R, Verdoit-Jarraya M, Boissery P, et al. Potential use of marinas as nursery grounds by rocky fishes: Insights from four Diplodus species in the Mediterranean. Mar Ecol Prog Ser. 2016; 547:193–209.

30. European Commission. Our life insurance, our natural capital: an EU biodiversity strategy to 2020. Communication [Internet]. 2011;(February):144. Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52011DC0244

31. Naylor LA, Coombes MA, Venn O, Roast SD, Thompson RC. Facilitating ecological enhancement of coastal infrastructure: The role of policy, people and planning. Environ Sci Policy. 2012; 22:36–46.

32. Strain EMA, Olabarria C, Mayer-Pinto M, Cumbo V, Morris RL, Bugnot AB, et al. Eco-engineering urban infrastructure for marine and coastal biodiversity: Which interventions have the greatest ecological benefit? J Appl Ecol. 2018; 55(1):426–41.

33. Defra JNCC. The UK Post-2010 Biodiversity Framework. 2019; Available from: http://jncc.defra.gov.uk/page-6189

34. Dafforn KA, Glasby TM, Airoldi L, Rivero NK, Mayer-Pinto M, Johnston EL. Marine urbanization: An ecological framework for designing multifunctional artificial structures. Front Ecol Environ. 2015; 13 (2):82–90.
35. Morris RL, Deavin G, Hemelryk Donald S, Coleman RA. Eco-engineering in urbanised coastal systems: Consideration of social values. Ecol Manag Restor. 2016; 17(1):33–9.
36. Mitsch W.J., Wu X., Nairn R.W., Weihe P.E., Wang N., Deal R., et al. Creating and Restoring Wetlands. Bioscience. 1998;
37. Dafforn KA. Eco-engineering and management strategies for marine infrastructure to reduce establishment and dispersal of non-indigenous species. 2017; 8(2):153–61.
38. Strain EMA, Morris RL, Coleman RA, Figueira WF, Steinberg PD, Johnston EL, et al. Increasing microhabitat complexity on seawalls can reduce fish predation on native oysters. Ecol Eng [Internet]. 2018; 120:637–44. Available from: http://dx.doi.org/10.1016/j.ecoleng.2017.05.030
39. Browne MA, Chapman MG. Ecologically Informed Engineering Reduces Loss of Intertidal Biodiversity on Artificial Shorelines. Environ Sci Technol [Internet]. 2011 Oct [cited 2019 Aug 15]; 45(19):8204–7. Available from: https://pubs.acs.org/doi/10.1021/es201924b PMID: 21875080
40. Morris RL, Chapman MG, Firth LB, Coleman RA. Increasing habitat complexity on seawalls: Investigating large- and small-scale effects on fish assemblages. Ecol Evol. 2017; 7(22):9567–79. https://doi.org/10.1002/ece3.3475 PMID: 29187990
41. Naylor LA, Coombes MA, Venn O, Roast SD, Thompson RC. Facilitating ecological enhancement of coastal infrastructure: The role of policy, people and planning. Environ Sci Policy [Internet]. 2012; 22:36–46. Available from: http://dx.doi.org/10.1016/j.envsci.2012.05.002
42. Martins GM, Thompson RC, Neto AI, Hawkins SJ, Jenkins SR. Enhancing stocks of the exploited limpet Patella candei d'Orbigny via modifications in coastal engineering. Biol Conserv [Internet]. 2010 Jan 1 [cited 2019 Aug 15]; 143(1):203–11. Available from: https://www.sciencedirect.com/science/article/pii/S0006320709004418
43. Browne MA, Chapman MG. Ecologically Informed Engineering Reduces Loss of Intertidal Biodiversity on Artificial Shorelines. Environ Sci Technol [Internet]. 2011 Oct 1 [cited 2018 Jan 3]; 45(19):8204–7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21875080 https://doi.org/10.1021/es201924b PMID: 21875080
44. Connell SD. Floating pontoons create novel habitats for subtidal epibiota. J Exp Mar Bio Ecol. 2000; 247(2):183–94. PMID: 10742503
45. Connell SD. Urban structures as marine habitats: an experimental comparison of the composition and abundance of subtidal epibiota among pilings, pontoons and rocky reefs. Mar Environ Res [Internet]. 2001 Aug [cited 2018 Oct 23]; 52(2):115–25. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11525426 PMID: 11525426
46. Chee SY, Othman AG, Sim YK, Mat Adam AN, Firth LB. Land reclamation and artificial islands: Walking the tightrope between development and conservation. Glob Ecol Conserv [Internet]. 2017 Oct 1 [cited 2019 Oct 10]; 12:80–95. Available from: https://www.sciencedirect.com/science/article/pii/S2351989417301336
47. Krzemińska AE, Zaręba AD, Dzikowska A, Jarosz KR. Cities of the future—bionic systems of new urban environment. Environ Sci Pollut Res [Internet]. 2019 Mar 7 [cited 2019 Oct 10]; 26(9):8362–70. Available from: http://link.springer.com/10.1007/s11356-017-0885-2
48. Pavlineri N, Skoulikidis NT, Tsihrintzis VA. Constructed Floating Wetlands: A review of research, design, operation and management aspects, and data meta-analysis. Chem Eng J [Internet]. 2017; 308:1120–32. Available from: http://dx.doi.org/10.1016/j.cej.2016.09.140
49. Yeh N, Yeh P, Chang YH. Artificial floating islands for environmental improvement. Renew Sustain Energy Rev. 2015; 47:616–22.
50. Frog Environmental. Biohaven Floating Wetland Systems Technical Information. 2016.
51. Chen Z, Cuervo DP, Müller JA, Wiessner A, Köser H, Vymazal J, et al. Hydroponic root mats for wastewater treatment—a review. Environ Sci Pollut Res [Internet]. 2016 Aug 11 [cited 2018 Aug 12]; 23 (16):15911–28. Available from: http://link.springer.com/10.1007/s11356-016-6801-3
52. Frog Environmental. Biohaven Floating Island Product Guide. 2019.
53. Burzaco AL, Frog Environmental. BioHaven floating wetlands. 2016. p. 1.
54. Kato Y, Takemon Y, Hori M. Invertebrate assemblages in relation to habitat types on a floating mat in Mizorogaike Pond, Kyoto, Japan. Limnology [Internet]. 2009 Dec 19 [cited 2019 Aug 20]; 10(3):167–76. Available from: http://link.springer.com/10.1007/s10201-009-0274-8
55. Shahid MJ, Arslan M, Ali S, Siddique M, Afzal M. Floating Wetlands: A Sustainable Tool for Wastewater Treatment. Clean—Soil, Air, Water. 2018; 46(10).

56. Lu HL, Ku CR, Chang YH. Water quality improvement with artificial floating islands. Ecol Eng. 2015; 74:371–5.
57. Overton CT, Takekawa JY, Casazza ML, Bui TD, Holyoak M, Strong DR. Sea-level rise and refuge habitats for tidal marsh species: Can artificial islands save the California Ridgway's rail? Ecol Eng [Internet]. 2015; 74:337–44. Available from: http://dx.doi.org/10.1016/j.ecoleng.2014.10.016
58. Floating Island International. BioHaven ® Living Shorelines BioHaven ® Floating Breakwaters. 2013;1–5.
59. John S, Dodds W. Ecosystems Enhancement Programme (EEP): Tidal Lagoon Power. 2016;(June):1–21.
60. Frog Environmental. Coastal and Inland Erosion Control [Internet]. 2016 [cited 2019 Feb 13]. Available from: https://frogenvironmental.co.uk/biohaven-floating-wetlands/coastal-inland-erosion-control/
61. Burgess ND, Hirons GJM. Creation and management of artificial nesting sites for wetland Birds. J Environ Manage [Internet]. 1992 Apr 1 [cited 2019 Aug 21]; 34(4):285–95. Available from: https://www.sciencedirect.com/science/article/pii/S0301479711800046?via%3Dihub
62. Nall CR, Schläppy ML, Guerin AJ. Characterisation of the biofouling community on a floating wave energy device. Biofouling [Internet]. 2017; 33(5):379–96. Available from: http://doi.org/10.1080/08927014.2017.1317755 PMID: 28508709
63. Perkol-Finkel S, Miloh T, Zilman G, Sella I, Benayahu Y. Floating and fixed artificial reefs: the effect of substratum motion on benthic communities. Mar Ecol Prog Ser. 2006; 317:9–20.
64. Pardue GB. Production Response of the Bluegill Sunfish, Lepomis macrochirus Rafinesque, to Added Attachment Surface for Fish-Food Organisms. Trans Am Fish Soc [Internet]. 1973 Jul [cited 2018 Oct 23]; 102(3):622–6. Available from: http://doi.wiley.com/10.1577/1548-8659(1973)102%3C622:PROTBS%3E2.0.CO;2
65. Neal JW, Lloyd MC. Response of Fish Populations to Floating Streambed Wetlands. J Southeast Assoc Fish Wildl Agencies. 2018; 5(2011):64–70.
66. Evans AJ, Garrod B, Firth LB, Hawkins SJ, Morris-Webb ES, Goudge H, et al. Stakeholder priorities for multi-functional coastal defence developments and steps to effective implementation. Mar Policy [Internet]. 2017; 75(June 2016):143–55. Available from: http://dx.doi.org/10.1016/j.marpol.2016.10.006
67. Strain EMA, Alexander KA, Kienker S, Morris R, Jarvis R, Coleman R, et al. Urban blue: A global analysis of the factors shaping people's perceptions of the marine environment and ecological engineering in harbours. Sci Total Environ [Internet]. 2019 Mar 25 [cited 2019 Aug 21]; 658:1293–305. Available from: https://www.sciencedirect.com/science/article/pii/S0048969718351581 https://doi.org/10.1016/j.scitotenv.2018.12.285 PMID: 30677991
68. Kienker SE, Coleman RA, Morris RL, Steinberg P, Bollard B, Jarvis R, et al. Bringing harbours alive: Assessing the importance of eco-engineered coastal infrastructure for different stakeholders and cities. Mar Policy [Internet]. 2018 Aug 1 [cited 2019 Aug 21]; 94:238–46. Available from: https://www.sciencedirect.com/science/article/pii/S0308597X18300666
69. Shi J, Visschers VHM, Siegrist M. Public Perception of Climate Change: The Importance of Knowledge and Cultural Worldviews. Risk Anal. 2015; 35(12):2183–201. https://doi.org/10.1111/risa.12406 PMID: 26033253
70. von Borgstede C, Andersson M, Johnsson F. Public attitudes to climate change and carbon mitigation—Implications for energy-associated behaviours. Energy Policy [Internet]. 2013 Jun 1 [cited 2019 Apr 9]; 57:182–93. Available from: https://www.sciencedirect.com/science/article/pii/S0301421513000785
71. Gelcich S, Buckley P, Pinnegar JK, Chilvers J, Lorenzoni I, Terry G, et al. Public awareness, concerns, and priorities about anthropogenic impacts on marine environments. Proc Natl Acad Sci. 2014; 111 (42):15042–7. https://doi.org/10.1073/pnas.1417344111 PMID: 25288740
72. Hawkins JP, O'Leary BC, Bassett N, Peters H, Rakowski S, Reeve G, et al. Public awareness and attitudes towards marine protection in the United Kingdom. Mar Pollut Bull. 2016; 111(1–2):231–6. https://doi.org/10.1016/j.marpolbul.2016.07.003 PMID: 27393214
73. Horwich RH, Lyon J. Community conservation: practitioners' answer to critics. Oryx [Internet]. 2007 Jul 17 [cited 2019 Apr 25]; 41(3):376–85. Available from: https://www.cambridge.org/core/product/identifier/S0030605307002141/type/journal_article
74. Jefferson R, McKinley E, Capstick S, Fletcher S, Griffin H, Milanese M. Understanding audiences: Making public perceptions research matter to marine conservation. Ocean Coast Manag [Internet]. 2015 Oct 1 [cited 2019 Apr 25]; 115:61–70. Available from: https://www.sciencedirect.com/science/article/pii/S0964569115001672
75. Sayer MDJ, Wilding TA. Planning, licensing, and stakeholder consultation in an artificial reef development: The Loch Linnhe reef, a case study. ICES J Mar Sci. 2002; 59(SUPPL.):178–85.

76. Ramos J, Santos MN, Whitmarsh D, Monteiro CC. Stakeholder perceptions regarding the environmental and socio-economic impacts of the Algarve artificial reefs. In: Biodiversity in Enclosed Seas and Artificial Marine Habitats [Internet]. Dordrecht: Springer Netherlands; 2007 [cited 2019 Apr 26]. p. 181–91. Available from: http://link.springer.com/10.1007/978-1-4020-6156-1_16

77. Fletcher S, Potts JS, Heeps C, Pike K. Public awareness of marine environmental issues in the UK. Mar Policy. 2009; 33(2):370–5.

78. Jefferson RL, Bailey I, Laffoley D d. A, Richards JP, Attrill MJ. Public perceptions of the UK marine environment. Mar Policy [Internet]. 2014; 43:327–37. Available from: http://dx.doi.org/10.1016/j.marpol.2013.07.004

79. Chilvers J, Lorenzoni I, Terry G, Buckley P, Pinnegar JK, Gelcich S. Public engagement with marine climate change issues: (Re)framings, understandings and responses. Glob Environ Chang [Internet]. 2014; 29:165–79. Available from: http://dx.doi.org/10.1016/j.gloenvcha.2014.09.006

80. Myatt-bell LB, Scrimshaw MD, Lester JN, Potts JS. Public perception of managed realignment: Brancaster. Mar Policy. 2002; 26:45–57.

81. Myatt LB, Scrimshaw MD, Lester JN. Public perceptions and attitudes towards an established managed realignment scheme: Orplands, Essex, UK. J Environ Manage. 2003; 68(2):173–81. PMID: 12781757

82. Tudor DT, Williams AT. Public Perception and Opinion of Visible Beach Aesthetic Pollution: The Utilisation of Photography [Internet]. Vol. 19, Journal of Coastal Research. Coastal Education & Research Foundation, Inc.; 2006 [cited 2019 Apr 9]. p. 1104–15. Available from: https://www.jstor.org/stable/4299252

83. Haggett C. Over the Sea and Far Away? A Consideration of the Planning, Politics and Public Perception of Offshore Wind Farms. J Environ Policy Plan [Internet]. 2008 Sep [cited 2019 Apr 9]; 10(3):289–306. Available from: http://www.tandfonline.com/doi/abs/10.1080/15239080802242787

84. Hancock M. Artificial floating islands for nesting Black-throated Divers *Gavia arctica* in Scotland: construction, use and effect on breeding success. Bird Study [Internet]. 2000 Jul 29 [cited 2018 Jul 31]; 47(2):165–75. Available from: http://www.tandfonline.com/doi/full/10.1080/00063650009461172

85. European Environment Agency. Great Britain shapefile [Internet]. 2019 [cited 2019 May 23]. Available from: https://www.eea.europa.eu/data-and-maps/data/eea-reference-grids-2/gis-files/great-britain-shapefile

86. UK Postcode. Shapefile of UK administrative counties [Internet]. 2012 [cited 2019 May 10]. Available from: http://www.ukpostcode.net/shapefile-of-uk-administrative-counties-wiki-16.html

87. Defra JNCC. The UK Post-2010 Biodiversity Framework. 2019;

88. Ruiz-Orejón LF. Floating plastic debris in the central and western Mediterranean sea: current status and its social perception. TDX (Tesis Dr en Xarxa) [Internet]. 2018 Jul 2 [cited 2019 Apr 26]; Available from: https://upcommons.upc.edu/handle/2117/121045

89. Drosou N, Soetanto R, Hermawan F, Chmutina K, Bosher L, Hatmoko JUD. Key Factors Influencing Wider Adoption of Blue–Green Infrastructure in Developing Cities. Water [Internet]. 2019 Jun 13 [cited 2019 Sep 2]; 11(6):1234. Available from: https://www.mdpi.com/2073-4441/11/6/1234

90. Steel BS, Smith C, Opsommer L, Curiel S, Warner-Steel R. Public ocean literacy in the United States. Ocean Coast Manag [Internet]. 2005 Jan 1 [cited 2019 Apr 25]; 48(2):97–114. Available from: https://www.sciencedirect.com/science/article/pii/S0964569105000190

91. Rispoli D, Hambler C. Attitudes to wetland restoration in Oxfordshire and Cambridgeshire, UK. Int J Sci Educ [Internet]. 1999 May [cited 2019 Apr 26]; 21(5):467–84. Available from: http://www.tandfonline.com/doi/abs/10.1080/095006999290525

92. Zhang H, Chen B, Sun Z, Bao Z. Landscape perception and recreation needs in urban green space in Fuyang, Hangzhou, China. Urban For Urban Green [Internet]. 2013 Jan 1 [cited 2019 Apr 26]; 12(1):44–52. Available from: https://www.sciencedirect.com/science/article/pii/S161886671200115X

93. van den Berg AE, Maas J, Verheij RA, Groenewegen PP. Green space as a buffer between stressful life events and health. Soc Sci Med [Internet]. 2010 Apr 1 [cited 2019 Apr 26]; 70(8):1203–10. Available from: https://www.sciencedirect.com/science/article/pii/S0277953610000675 https://doi.org/10.1016/j.socscimed.2010.01.002 PMID: 20163905

94. Dobbie M, Green R. Public perceptions of freshwater wetlands in Victoria, Australia. Landsc Urban Plan [Internet]. 2013; 110(1):143–54. Available from: http://dx.doi.org/10.1016/j.landurbplan.2012.11.003

95. Gobster PH, Nassauer JI, Daniel TC, Fry G. The shared landscape: what does aesthetics have to do with ecology? Landsc Ecol [Internet]. 2007 [cited 2019 Apr 26]; 22:959–72. Available from: https://www.ncrs.fs.fed.us/pubs/jrnl/2007/nrs_2007_gobster_003.pdf

96. Nassauer JI. Monitoring the success of metropolitan wetland restorations: cultural sustainability and ecological function. Wetlands [Internet]. 2004 [cited 2019 Apr 26]; 24(4):756–65. Available from: https://deepblue.lib.umich.edu/bitstream/handle/2027.42/49338/wetlands.pdf;sequence=1

97. Gray JDE, O'Neill K, Qiu Z. Coastal residents' perceptions of the function of and relationship between engineered and natural infrastructure for coastal hazard mitigation. Ocean Coast Manag [Internet]. 2017 Sep 1 [cited 2019 Sep 2]; 146:144–56. Available from: https://www.sciencedirect.com/science/article/pii/S0964569116303325