Critical Evaluation of Public Interest in Citizen Science for Coastal and Marine Conservation in Langstone Harbour

Ibrahim LAWAN

Student ID: 915328

MSc Coastal and Marine Resource Management

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School of the Environment, Geography and Geosciences

Statement of Originality

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Abstract

Citizen science provides an avenue for the public to participate in coastal and marine research for conservation purpose; still much remains unknown on their interest in participation. This study critically evaluated the public level of interests in participating in coastal and marine citizen science. Building on the existing literature on public interest in citizen science, it asks: what segment of the public will be more confident and interested in assisting coastal and marine research? The study used a mixed research method by combining an in-depth quantitative web-survey of 110 coastal and marine users and qualitative interviews of five key players in citizen science projects in Langstone Harbour. The qualitative data obtained were analysed using Pearson Chi-squared Statistics and Multinomial Logistic Regression, and quantitative data using NVivo themeing data. Although the study found considerable varying level of interests, the most enthusiastic tended to be men, highly educated, and both younger and older individuals, primarily those with science background and enjoyed beachcombing, Sailing, Kayaking and Swimming. Citizen science community encourages involving public in all research aspects; however, the study found that the participants were mainly interested in helping to collect data, communicate findings to broader community, collect litter around beaches, and monitor beach morphology. The type of organisations research associated with and the term used to describe it played a role in participants' willingness to share information. Feedback appeared to be a significant motivator for retaining volunteers in a project. The findings also indicate that citizen science projects, influence management, policy, and foster synergistic roles in improving engagement and ocean literacy for coastal and marine conservation. Based on the findings, the study recommended potential means in which citizen-science project organisers will effectively recruit, engage and retain volunteers.

Keywords: citizen science; coastal and marine conservation; public participation, interest and confidence.

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Chapter Summary

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CHAPTER ONE: INTRODUCTION

1.1 Introduction

This chapter tends to discuss the rationale and focus of the project, then critically discusses the research background and identifies the study location characteristics and conservation issues. It also sets the study basis by identifying the aim and objectives, formulating a null hypothesis, presenting study structure layout, and finally concluding the chapter key points.

1.2 Project Rationale and Focus

The citizen science research is bourgeoning, and the public participate in different projects to help professional scientists collect data (Dickinson, Zuckerberg, & Bonter, 2010; Shirk *et al*. 2012). Like other fields (e.g., terrestrial and freshwater, Roy *et al.* 2012; Theobald *et al.* 2015), coastal and marine citizen science is experiencing increase in volunteer participation (Silvertown, 2009), still little is known about strategies of influencing potential participants (Martin *et al.,* 2016c). Therefore, studies on perceptions of existing volunteers in citizen science have witnessed a considerable growth (e.g. Jordan, Gray, Howe, Brooks, & Ehrenfeld, 2011; Jordan, Brooks, Howe, & Ehrenfeld, 2012; Crall *et al.*, 2013; Dean, Church, Loder, Fielding, & Wilson, 2018), as for opinions of professional scientists on their research (Riesch, & Potter, 2014). Despite these studies, researches that focused on studying and examining the interests and/or confidence of potential volunteers in participating in citizen science are very few (e.g. Martin, Christidis, Lloyd, & Pecl, 2016a; Martin, Christidis, & Pecl, 2016b; Martin *et al.,* 2016c; Lewandowski, Caldwell, Elmquist, & Oberhauser, 2017; and Martin, 2017). Of all these, only Martin *et al*. (2016b) focused their studies on interest of potential volunteers on coastal and marine citizen science in Australia, and Lewandowski *et al.* (2017) focused on attitudes and knowledge of general public as potential volunteers in the United States. Until now this kind of study has not been practised in the Langstone Harbour.

Considering the Solent area, Langstone Harbour, in particular, no other studies on interests, perceptions, knowledge, and attitudes of the public that are directly or indirectly engage with coastal and marine activities, in participating in citizen science projects for conservation purpose have been conducted. Therefore, to critically determine the potential means of increasing involvement at the onset of citizen science projects, promoting recruitment as well as enhancing volunteers' retention, this study focuses on enlightening and evaluating public interests and inspirations for participation (Raddick *et al*., 2013). Fletcher, Johnson, and Hewett (2007) explained that various stakeholder groups could play a part in ensuring effective management of the Solent to balance conservation purpose and sustainable development. For

this study, the 'public' means different group of people that are directly or indirectly engaged in (Martin *et al.,* 2016b) or affected by coastal and marine environment in some way (Fletcher, & Potts, 2007), and the 'coastal and marine environment' encompasses estuaries, coastal beaches, and oceans (Martin *et al.*, 2016a).

This study tends to bridge the knowledge gap by providing a baseline data and addressing the following key research questions;

a. What is the public level of familiarity with the term 'citizen science' and its concepts concerning coastal and marine environment conservation?
b. What segment of the public will show more confidence and interest in assisting to participate in coastal and marine citizen science projects?
c. Do the citizen science projects have the potential to influence interests, literacy, management, and policy of the environment towards conservation?

1.3 Research Background

The coastal and marine environment and the resources thereof contribute significantly to supporting the humans' well-being and the planet earth's health (Halpern *et al.,* 2012). This environment serves as the blue heart of the planet earth, regulator of climate and source of all life (Laffoley *et al*., 2019). Despite the vastness of human reliance and use of the coastal and marine environment, yet its importance is often overlooked habitually (Garcia-Soto *et al.,* 2017). When compared with other ecosystems, the health of this environment is deteriorating at a faster rate (UNEP, 2006). For example, the House of Commons emphasised that the increased in anthropogenic activities in both the UK coastal and open ocean led to biological and physical pressures on this ecosystem, which include but not limited to climate change, pollution and overfishing impacts (Sara, Elena, Rebecca, & Alex, 2017).

The Solent coastal and marine environment experiences management issues due to its dynamic situation, political pressures and variety of economic and recreational impacts which forecasted to persist and increase (Fletcher, Johnson & Hewett, 2007). Therefore, engaging interested volunteers to work together with professional scientists would make this environment accessible and significantly gather enough information to increase literacy and inform management decision for conservation purpose (Santoro *et al.,* 2017; Mackenzie *et al.,* 2019). Therefore, meaningful stakeholder involvement in scientific research to support evidence-based decision making for the use of natural resources and ecosystems sustainably (Maguire,

Potts, & Fletcher, 2011), and improve environmental knowledge through dialogue and participation in scientific projects is essential (Kelly *et al.*, 2019). Citizen science is considered as an appropriate tool to achieve such active public participation (Kelly *et al*., 2019). Citizen science is a means of engaging the public in scientific research to help professional scientists (Shirk *et al.*, 2012). Therefore, citizen science is considered as a cost-effective means of collecting and analysing data, generating information over varied temporal and spatial scales (Bonney *et al*. 2009; Aceves-Bueno *et al.*, 2015), as well as communicating and publicising scientific findings for conservation issues via wide-ranging outlets (Kelly *et al*., 2019). However, participation in citizen science goes beyond collecting, analysing and communicating data, because the public may partner with professional scientists or conduct the research on their own as a community-based work for conservation purpose (Bonney, Cooper, & Ballard, 2016).

In the coastal and marine environment, citizen science provides volunteers around the globe with opportunities of generating literacy of the environment, empowering and (re)connecting them with nature (Blossom, 2012) as well as engaging them in conservation activities such as identifying extinct and endangered species (Shamir *et al*., 2014), tracking coastal and marine debris (Smith & Edgar, 2014) and alien species (Delaney, Sperling, Adams, & Leung, 2008). Therefore, the perceptions and interests of volunteers in citizen science projects can influence further recruitment, retention and confidence in the research (Lewandowski *et al.* 2017), which can be used as management decisions basis as well as strategies for informing policy on ecology and conservation (McKinley *et al*. 2015). However, citizen-science needs adequate planning (Kelly *et al.*, 2019) because the source of scientific findings influences how public members and authorities interpret and trust such knowledge (Jenkins 1999). Therefore, public buy-in, interests and perceptions are crucial to effective conservation, and improving confidence in citizen science findings plays a vital role in conserving marine environment (Martin *et al.*, 2016b). Besides, citizen-science project is not a panacea to coastal and marine environmental issues because it faces some challenges (Cigliano *et al.*, 2015). For example, logistical challenges due to inaccessibility nature of the marine environment, which causes lack of stakeholder participation (Roy et al., 2012). Insufficient funding to support scientific research also hinders accurate and pertinent data generation because it poses limitations on public engagement and project initiation (Schläppy *et al*. 2017). Also, the need of expensive and specialised gears to access the environment causes challenges for participation (Theobald *et al*., 2015).

1.3.1 Study Area Location and Characteristics

The study area is Langstone Harbour (Figure 1.1), which lies between Longitude: -1.001708; Easting: 470421 (-1° 00' 6.15"), Latitude: 50.818039; Northing: 102530 (50° 49' 4.94"), and –4m below ordnance datum. The harbour is located in the Solent area (Figure 1.2) which is "a sub-region that is highly dependent upon the sea, through trade, commercial, passenger and military port operations, recreational sailing, and associated industrial and recreational support industries. As such it is an area that is shaped by the sea, both in terms of the physical environment and the prevailing economic and social conditions" **(**Fletcher *et al.*, 2007, p. 586).

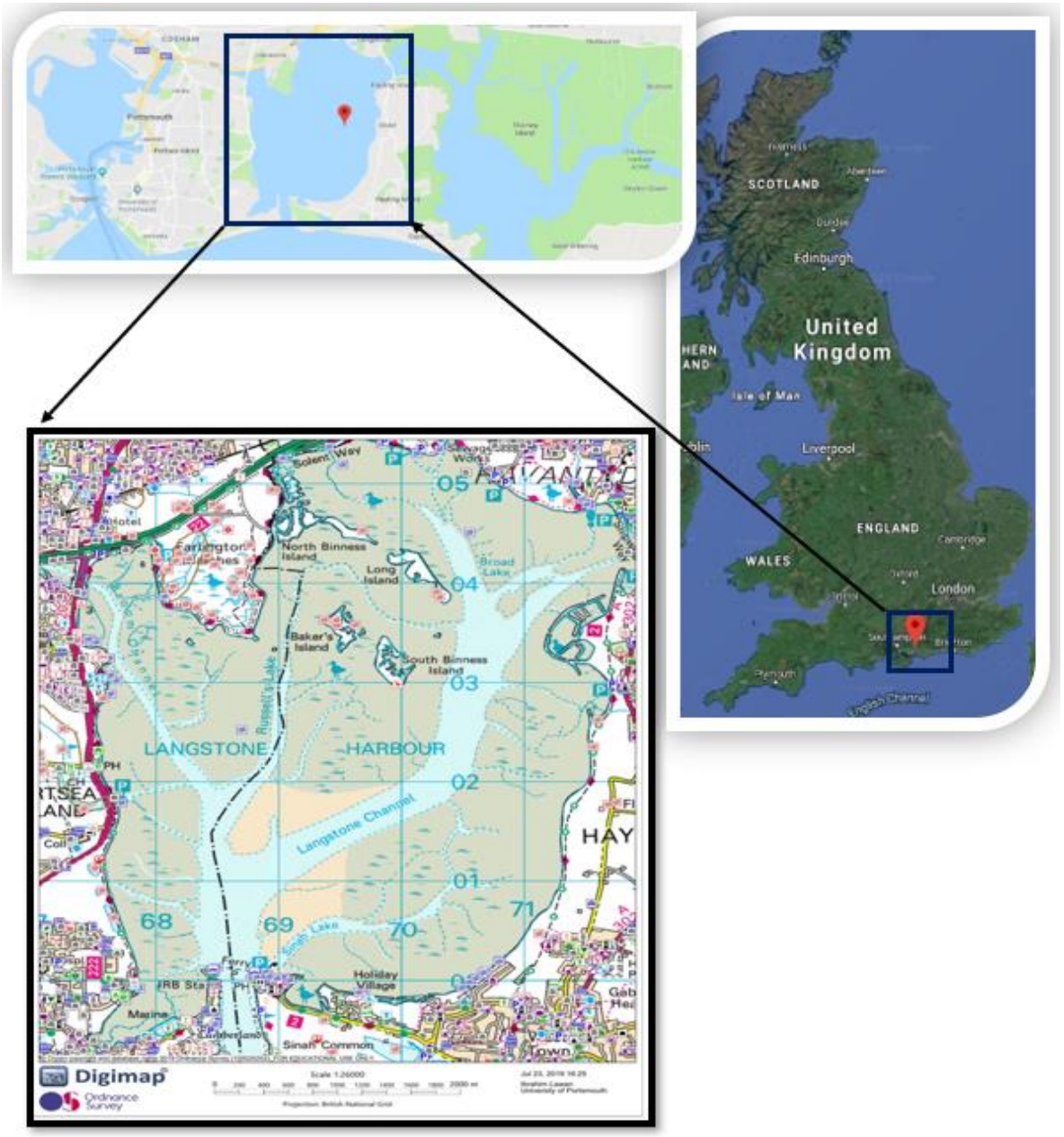

Figure 1.1. **Map of Langstone Harbour. Source: (Generated using Digimap, 2019).**

Figure 1.2. **Geographical extent of the Solent forum area. Source: (Fletcher *et al.*, 2007)**

Langstone Harbour lies between Hayling Islands and Portsea, has around 25km long shoreline and it is one of the three harbour complex: Portsmouth, Langstone and Chichester in the south coast of England (UK Harbours Directory, N.D). The harbour is designated as both the UK and international Special Area of Conservation and other Nature Reserves sites due to biodiversity, especially birdlife (Langstone Harbour, N.D). Also, the harbour is internationally recognised as a haven or house for myriad of aquatic wildlife and bird species of conservation concern (LHB, 2019). For example, Langstone Harbour (2009, P. 1) mentioned that it "is within the Solent Maritime Special Area of Conservation (SAC) which was designated for its extensive range of marine, coastal and maritime habitats, in particular, its estuaries, Atlantic salt meadows and cordgrass swards. The site is part of the wider Solent European Marine Site (SEMS) which provides the basis for the implementation of the Habitats Directive and the Birds Directive in the marine environment" (Figure 1.3).

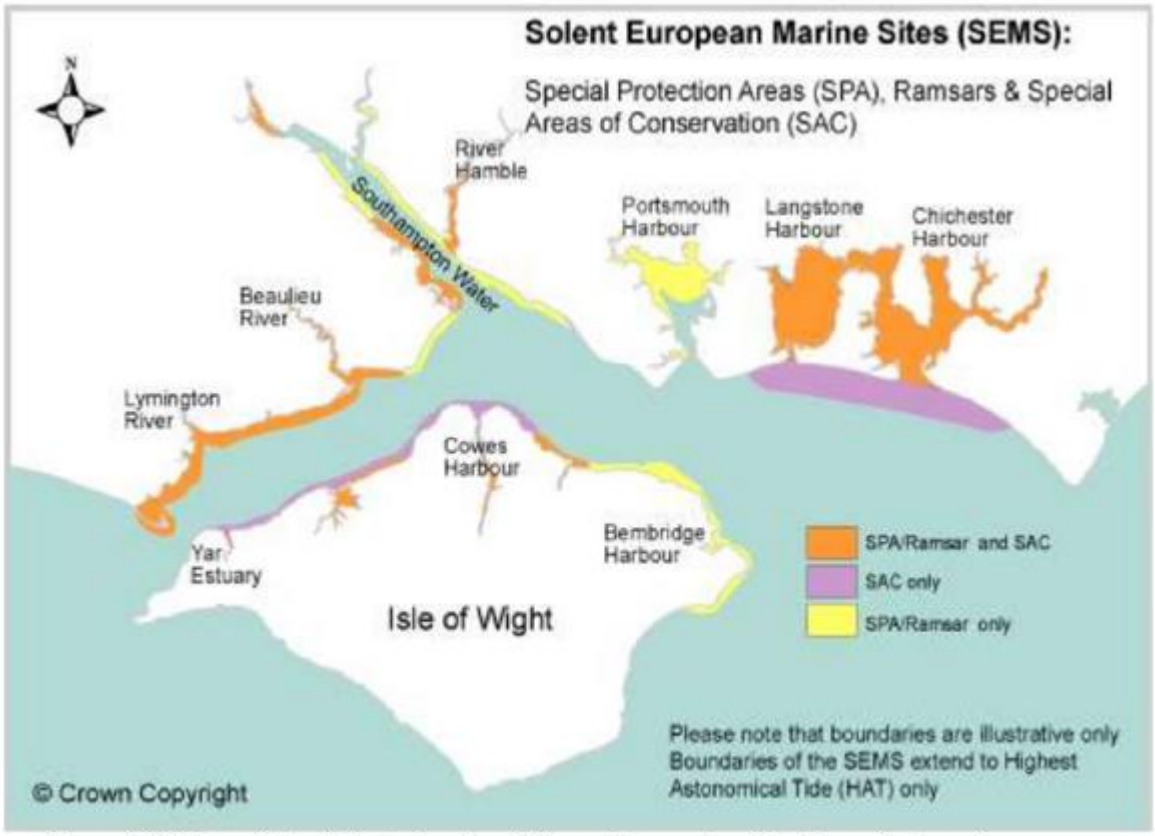

Figure 1.3. **Map of the Solent showing different Langstone Harbour designations**
Source: (Adapted from Harding *et al.*, 2016)

The nature of the Langstone Harbour makes it attractive to diverse recreational and commercial coastal and marine activities. The recreational activities that have registered clubs with LHB include; water and jet skiing, windsurfing, angling, rowing, canoeing, yachting and motor boating (LHB, 2019). The area commercial berths are only accessible at High Water because at Low Water Spring not less than 70% of it, is used to dry off. However, commercial activities dominating the area include; fishing, charter boats, ferry, pilotage, shipping, and two aggregate wharves (Langstone Harbour, 2009). These diverse activities pose issues that call for conservation concerns in the harbour area (LHB, 2019), because they impact the surrounding environment in various ways, such as;

a. Pollution from oil, fuel, bilge water and littering
b. Wildlife disturbances as a result of visitors' intrusion and fireworks
c. Shipping disturbances that causes stresses to beached wildlife and creates erosion due to vessels wash
d. Nitrogen pollution due to sewage discharged into the harbour (Langstone Harbour, 2009; LHB, 2019), and
e. Eutrophication and dredging that cause saltmarsh loss (Baily & Pearson, 2007).

1.4 Aim and Objectives

The overarching aim of this study is to critically evaluate the public level of interests in participating in coastal and marine citizen science projects (CSP) in Langstone Harbour area. In more detail, to critically analyse and determine potential ways of increasing volunteer numbers and participation in coastal and marine citizen science for conservation purpose. Therefore, the detailed specific objectives which will enable the achievement of the stated aim are:

S/N	Specific Objectives
1.	To undertake a critical literature review to evaluate how the concepts of Citizen Science are implemented concerning Integrated Coastal Zone Management (ICZM) Principles and other Marine Policy Directives for Conservation
2.	To undertake a critical and detailed literature review to evaluate the benefits of public participation, recruitment and engagement in coastal and marine citizen science
3.	To critically analyse the public level of familiarity with the term coastal and marine citizen science around Langstone Harbour
4.	To critically analyse the public interest levels in assisting coastal and marine citizen science in Langstone Harbour
5.	To critically determine the segment of the public to be confident in conducting coastal and marine citizen science tasks in Langstone Harbour
6.	To critically assess the importance of coastal and marine environment to various users
7.	To evaluate how citizen science projects, influence management, policy, public interests and literacy of the coastal and marine environment for conservation
8.	To develop and put forward a series of recommendations for coastal and marine citizen science future best practice around Langstone Harbour and UK in general

1.5 Research Hypothesis

The predictors of the public level of interest, confidence and familiarity with citizen science are their demographic information, experience in citizen science, and professions. For the hypothesis testing, the following null hypothesis (Table 1.1) were formulated and tested at 0.05 levels of significances:

Table 1.1

The Formulated Research Null Hypothesis

S/N	Hypotheses
1	There is no statistically significant relationship between participants demographic information and familiarity with citizen science
2	There is no statistically significant relationship between participants experience in citizen science and familiarity with it
3	There is no statistically significant relationship between participants level of education and interest in participating in citizen science
4	There is no statistically significant association between participants demographic status and interest in assisting coastal and marine citizen science
5	There is no statistically significant relationship between participants demographic status and confidence in conducting coastal and marine citizen science tasks
6	There are no statistically significant differences among participant groups (by profession) on the importance of coastal and marine environment

1.6 Dissertation Structure

The complete dissertation structure is outlined below

Chapter	Explanation
Chapter One: Introduction	Discusses the rationale and focus of the project, the research background and identifies the study area characteristics. It also presents the aims and objectives and formulates the null hypothesis.
Chapter Two: Literature Review	Provides a critical literature review on the contextual and theoretical background to evaluate the concepts of citizen science for coastal and marine conservation concerning Integrated Coastal Zone Management and other Marine Conservation Policies
Chapter Three: Methodology	Provides an overview of the research topic and case study. It also outlines the adopted approach for the research methods and techniques used in the study.
Chapter Four: Questionnaire Results and Analysis	Presents and analyses the web survey responses using both descriptive and inferential statistics. It also presents the findings in a graphical and statistical form to identify the level of interests of potential citizen scientists.
Chapter Five: Interview Results and Analysis	Presents and analyses the interview responses using NVivo software. It also uses a phenomenological approach to presents interviewees own experiences from their projects.
Chapter Six: Overall Discussions & Recommendations	Presents the overall discussions of the key analysed questionnaire results and interview responses presented in chapters four and five. It also suggests thoughtful recommendations for both new and ongoing coastal and marine citizen science project organizers
Chapter Seven: Conclusions	Concludes the whole project by discussing the overall study settings, outlining the key findings and making a conclusion, and lastly highlighting some limitations from the study.

1.7 Chapter Conclusion

In conclusion, this introductory chapter has discussed the research background and study area characteristics. It outlined that the coastal and marine environment and the resources therein support human's well-being and regulate the planet earth's health. Despite these, the environment is with conservation issues that require an integrated and holistic approach to address them. The approach can be through engaging the public actively in citizen science. However, the citizen science is not a panacea to such issues because it faces some challenges. The chapter also sets out the overarching aim and specific objectives that are prime to the project and will be evaluated critically throughout the dissertation.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter critically reviews a considerable amount of literature on the contextual and theoretical background of citizen science for coastal and marine conservation to evaluate it concerning Integrated Coastal Zone Management and other Marine Conservation policies. The chapter is divided into two sections to provide a benchmark to the achievement of the first two identified objectives of this study. The first section critically reviews how the concepts of citizen science are implemented, and how they will be incorporated with Integrated Coastal Zone Management (ICZM) principles and other marine policy directives for conservation purpose. The second part, critically reviews and evaluates the benefits of public participation, recruitment and engagement in coastal and marine citizen science and establishes the strategy of volunteer retention.

2.2 Concepts of Citizen Science, ICZM and Marine Policy

This section provides critical evaluation of how the concepts of citizen science are implemented, including definition, historical and conceptual background of citizen science with a focus on incorporating coastal and marine citizen science with ICZM principles and other European marine policy directives for conservation purpose.

2.2.1 Critical Evaluation of the Concept of Citizen Science

The overarching concept of citizen science is public involvement in scientific research (Shirk *et al.*, 2012), and the number of projects considering this concept has dramatically increased around the globe (Conrad & Hilchey, 2011). Before the 19th-century science professionalisation, engaging public in scientific research is not new, and it has a long history even in extensive scale (Vetter, 2011). For examples, in Europe, volunteer bird surveys started in the eighteenth century (Louv & Fitzpatrick, 2012). At present, the merging of information technology and ecology promotes the recent increase in interest and immediate form of involvement in citizen science, because it allows covering large spatial and temporal scales than ever before for environmental research (Hecker, Haklay, Bowser, Makuch & Vogel, 2018). It also allows collection and processing of large amount and fine-grained data than conventional research methods (Miller-Rushing, Primack & Bonney, 2012). Therefore, Cigliano and Ballard (2017, p. 4) explained that the concept gives people opportunities to "collaborate with professional scientists to collect, categorise, transcribe, or analyse scientific data, and may also help define the research questions and design, as well as communicate and

act on the project's findings". However, citizen science goes these opportunities; it gives free opportunity to drive community-based projects on their own (Bonney *et al.*, 2016).

Coastal and marine citizen science plays a significant role in impacting conservation (Theobald *et al.*, 2015). For example, it engages public in coastal and marine research by promoting ocean literacy (Garcia-Soto *et al.*, 2017), influencing policy and management (Dean *et al.*, 2016), and strengthen community capacity (Nursey-Bray, Palmer & Pecl, 2018). It provides stakeholders with a means to have a say in decision-making which might otherwise disregard them for resource management (Cigliano *et al*., 2015). For example, volunteers can use the acquired knowledge during participation to directly input decision-making and comment on policy action (Kelly *et al.*, 2019), and indirectly affect policy through information dissemination to their communities by motivating and educating others to become involved in discussing policy and conserving natural resources (McKinley *et al.*, 2017, Figure 2.1).

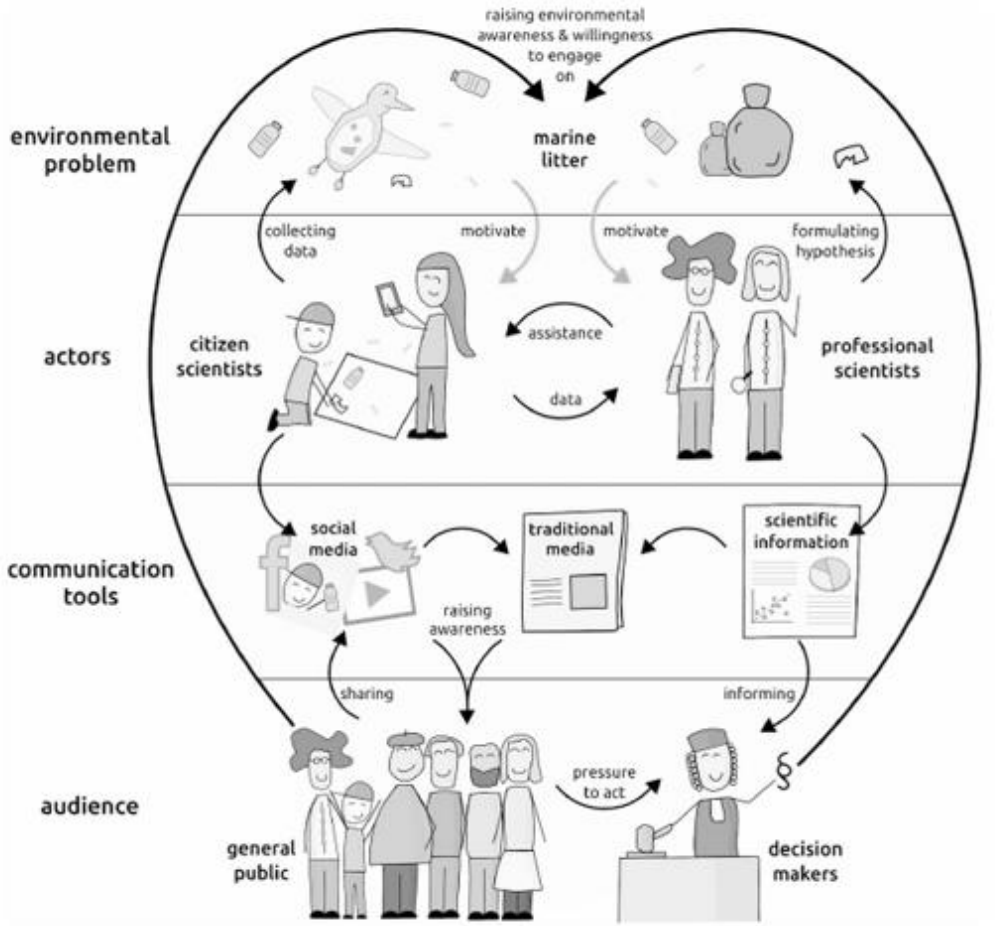

Figure 2.1: **Diagrammatical example showing marine litter problem where professional scientists, general public and decision-makers use citizen science to provide solutions for natural resource management. Source: (Adapted from Thiel *et al.*, 2017)**

However, despite these significant contributions of citizen science for coastal and marine conservation, it is often underrepresented (Roy *et al.*, 2012), and it is with challenges and issues of employing volunteers compared with freshwater and terrestrial scientific research (Cigliano & Ballard, 2017). These challenges are mainly logistical, stemming from gaining access to the environment (Cigliano *et al.*, 2015). For example, research in this environment requires expertise (e.g. diving and snorkelling), expensive equipment (e.g. diving gear and boats) and cost of transportation (Cigliano & Ballard, 2017). Besides, some challenges are social issues that lead to conflicts, for example, competing interests in coastal land use and fisheries (Cousins, Huxham & Winton, 2017). Therefore, scientists can overcome these challenges by conducting bottom-up co-created or collaborative scientific research which involves volunteers in all walks-of-life to build a good rapport and mitigate conflicts (Cigliano & Ballard, 2017; Crane, *et al.*, 2017). Also, the formation of forums and networks such as the Citizen Science Association (CSA), Australian Citizen Science Association (ACSA), and European Citizen Science Association (ECSA) globally helps develop best practice in citizen science practice to carter the challenges (Rasmussen & Cooper, 2019). Therefore, ECSA (2015) formulated ten guiding principles for citizen science best practice (Table 2.1).

Table 2.1

The Ten Guiding Principles of Citizen Science for Best Practice

S/N	Principles	Clarification statement
1.	***Citizen science projects actively involve citizens in scientific endeavour that generates new knowledge or understanding***	Citizens may act as contributors, collaborators, or as project leader and have a meaningful role in the project.
2.	***Citizen science projects have a genuine science outcome***	For example, answering a research question or informing conservation action, management decisions or environmental policy.
3.	***Both the professional scientists and the citizen scientists benefit from taking part.***	Benefits may include the publication of research outputs, learning opportunities, personal enjoyment, social benefits, satisfaction through contributing to scientific evidence, for example, to address local, national and international issues, and through that, the potential to influence policy, and connecting the wider community with science.
4.	***Citizen scientists may, if they wish, participate in multiple stages of the scientific process.***	This may include developing the research question, designing the method, gathering and analysing data, and communicating the results.
5.	***Citizen scientists receive feedback from the project***	For example, how their data are being used and what the research, policy or societal outcomes are.
6.	***Citizen science is considered a research approach like any other, with limitations and biases that should be considered and controlled for.***	However unlike traditional research approaches, citizen science provides opportunity for greater public engagement and democratisation of science.
7.	***Citizen science project data and metadata are made publicly available and where possible, results are published in an open access format.***	Data sharing may occur during or after the project, unless there are security or privacy concerns that prevent this from occurring.
8.	***Citizen scientists are acknowledged in project results and publications.***	This may include acknowledgement in project communications, result reporting and publications.
9.	***Citizen science programmes are evaluated for their scientific output, data quality, participant experience and wider societal or policy impact.***	Communication and evaluation of projects could include scientific outputs, data quality, participant experience and learning, knowledge sharing, social benefits, capacity building, new ways of science engagement, enhanced stakeholder dialogue, and wider societal or policy impact.
10.	***The leaders of citizen science projects take into consideration legal and ethical considerations of the project***	These considerations include copyright, intellectual property, data sharing agreements, confidentiality, attribution, participant safety and wellbeing, traditional owner consultation, and the environmental impact of any activities

Source: (ECSA, 2015; Robinson *et al.*, 2018; ACSA, 2019)

2.2.2 Critical Analyses of Incorporating Concept of Citizen Science with ICZM Principles, and other Marine Policy Directives for Conservation

The increasing complexity of issues and diversification of human uses in the coastal and marine environment has prompted widespread concern on how appropriately this environment and the resources therein can be conserved (Collie *et al.*, 2013). Therefore, the concept of marine conservation emerged for effective management of this environment (Probert, 2017). IUCN/WWF (1980, P. 1) defined conservation as "the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations". One of the examples of global concerns for the management and conservation of this environment is the 1992 Earth Summit conference (Cicin-Sain and Knecht, 1998, Table 2.2). Besides, Costanza *et al.* (1998) proposed some guidelines known as Lisbon principles (Table 2.3) for sustainable oceans governance. Therefore, the formulation of policies that centre on ICZM concepts to conserve this environment is essential (Beeharry *et al.*, 2014; SPICOSA, 2018).

Table 2.2

***Some Major International Forums Concerning Global Management and Conservation of* the Natural Environment**

S/N	Forum/Conference
1.	***UN Conferences on the Law of the Sea (1958, 1960, 1973)*** UN Convention on the Law of the Sea (adopted 1982, entry into force 1994). Rules for delimiting jurisdictional zones by coastal states, legal framework for major uses of the oceans and management of marine resources.
2.	***UN Conference on the Human Environment (1972)*** Emergence of international environmental law and modern approaches to environmental management. United Nations Environment Programme (UNEP) and UNEP Regional Seas Programme established.
3.	***World Conservation Strategy (1980)*** Develops the concept of sustainable development and aims to help advance the achievement of sustainable development through the conservation of living resources.
4.	***World Commission on Environment and Development (1983 – 7)*** The Brundtland Commission's elaboration of a new perspective on sustainable development, published as *Our Common Future*
5.	***UN Conference on Environment and Development (1992)*** Agenda 21 for sustainable development, Convention on Biological Diversity, Framework Convention on Climate Change, and Promotion of the precautionary principle.
6.	***World Summit on Sustainable Development (2002)*** The Johannesburg Declaration and plan of action
7.	***UN Conference on Sustainable Development (2012)*** A third global summit on sustainable development.
8.	***Our Ocean, An Ocean for Life, Malta (2017)*** The 4th edition of Our Ocean Conference for Marine protection and building the sustainable blue economy.

Source: (Adapted from Probert, 2017).

Table 2.3

Lisbon Principles for Sustainable Governance of the Oceans

Principle	Explanation
Principle 1: Responsibility	Access to environmental resources carries attendant responsibilities to use them in an ecologically sustainable, economically efficient, and socially fair manner. Individual and corporate responsibilities and incentives should be aligned with each other and with broad social and ecological goals.
Principle 2: Scale-matching.	Ecological problems are rarely confined to a single scale. Decision-making on environmental resources should (i) be assigned to institutional levels that maximize ecological input, (ii) ensure the flow of ecological information between institutional levels, (iii) take ownership and actors into account, and (iv) internalize costs and benefits. Appropriate scales of governance will be those that have the most relevant information, can respond quickly and efficiently, and are able to integrate across scale boundaries.
Principle 3: Precaution.	In the face of uncertainty about potentially irreversible environmental impacts, decisions concerning their use should err on the side of caution. The burden of proof should shift to those whose activities potentially damage the environment.
Principle 4: Adaptive management.	Given that some level of uncertainty always exists in environmental resource management, decision-makers should continuously gather and integrate appropriate ecological, social, and economic information with the goal of adaptive improvement.
Principle 5: Full cost allocation.	All of the internal and external costs and benefits, including social and ecological, of alternative decisions concerning the use of environmental resources should be identified and allocated. When appropriate, markets should be adjusted to reflect full costs.
Principle 6: Participation.	All stakeholders should be engaged in the formulation and implementation of decisions concerning environmental resources. Full stakeholder awareness and participation contributes to credible, accepted rules that identify and assign the corresponding responsibilities appropriately.

Source: (Adapted from Costanza *et al.*, 1998)

2.2.2.1 Incorporating Concept of Citizen Science with ICZM Principles

The European Commission in 2002 outlined the eight fundamental ICZM principles, enshrined within its recommendation (Table 2.4). They are major guiding principles and drivers for effective management of coastal and marine environment that member states urged to follow (Ballinger, n.d.). In the UK, for example, each devolved administration developed its ICZM strategy (Table 2.5). These English ICZM strategies are of relevance to citizen science because they emphasised on partnership working for their implementations. However, the emergence of Marine Planning with more priority putting into it limited their efficacy (Defra, 2009).

Table 2.4

***Key ICZM Principles which Member States Follow in Formulating their National Strategies* for Integrated Coastal Zone Management (ICZM)**

S/N	EU Principle	Explanation
1.	*A broad holistic approach*	(thematic and geographic) which will consider the interdependence and disparity of natural systems and human activities with an impact on coastal areas;
2.	*A long-term perspective*	perspective which will consider the precautionary principle and the needs of present and future generations
3.	*Adaptive management*	management during a gradual process which will facilitate adjustment as problems and knowledge develop. This implies the need for a sound scientific basis concerning the evolution of the coastal zone;
4.	*Local specificity*	local specificity and the great diversity of European coastal zones, which will make it possible to respond to their practical needs with specific solutions and flexible measures;
5.	*Working with natural processes*	working with natural processes and respecting the carrying capacity of ecosystems, which will make human activities more environmentally friendly, socially responsible and economically sound in the long run;
6.	*Participatory Approach*	involving all the parties concerned (economic and social partners, the organisations representing coastal zone residents, non-governmental organisations and the business sector) in the management process;
7.	*Support and involvement of all relevant administrative bodies*	support and involvement of relevant administrative bodies at national, regional and local level between which appropriate links should be established or maintained with the aim of improved coordination of the various existing policies. Partnership with and between regional and local authorities should apply when appropriate;
8.	*A Combination of Instruments*	use of a combination of instruments designed to facilitate coherence between sectoral policy objectives and coherence between planning and management.

Source: (Adapted from Fletcher, Jefferson, Glegg, Rodwell, & Dodds, 2014).

Table 2.5

The Devolved Administrations ICZM Strategies in the UK

Country	Date	Author	Title
England	2009	Defra	A strategy for promoting an integrated approach to the management of coastal areas in England
Northern Ireland	2006	Northern Ireland Assembly	An integrated coastal zone management strategy for Northern Ireland 2006–2026
Scotland	2005	Scottish Executive	Seas the opportunity: a strategy for the long-term sustainability of Scotland's coasts and seas
Wales	2007	The Welsh Assembly Government	Making the most of Wales' coast

Source: (Adapted from Fletcher *et al.*, 2014).

In general, the concept of citizen science holds a promise to support the implementation of these ICZM principles, especially when considering the substantive criticism that their implementation is embedded with inadequate stakeholder involvement (Fletcher, 2007). Therefore, the citizen science ensures a collaboration between policy decision-makers, marine managers, professional and citizen scientists, often with environmental and conservation objectives (Miller-Rushing *et al.*, 2012, Figure 2.2) to help mitigate natural resource management conflicts and promote better environmental outcomes (McKinley *et al.*, 2017). However, merely engaging stakeholder cannot be assumed as a panacea to coastal and marine conservation issues or resulted in public acceptance and support of management strategies; thus, in-depth and meaningful relationships between ocean environment management authorities and user groups are required (Mercer-Mapstone, 2018).

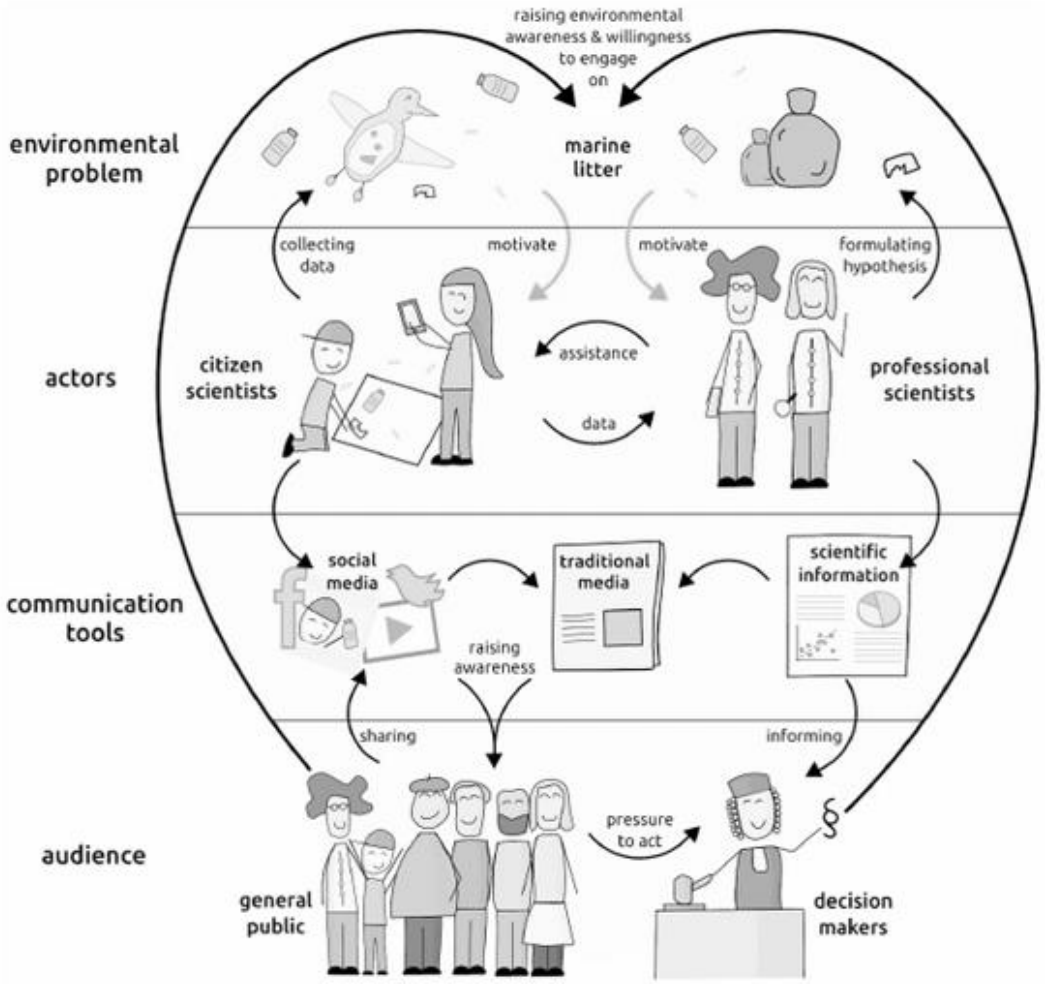

Figure 2.2: **Example of how citizen scientists contribute valuable scientific data to professional scientists and may influence the general public by reporting about their experience. This in turn, encourages the general public and eventually decision-makers to act on the environmental problem in question.**
Source: (Adapted from Thiel *et al.*, 2017)

2.2.2.2 Incorporating Concept of Citizen Science with other Marine Policy Directives

The other European coastal and marine environmental concerns focused more on protecting biodiversity and the environment healthy, sustainable development and growth, as well as both mitigating and understanding the climate change impacts (Garcia-Soto *et al.*, 2017). Most of the EU's adopted frameworks and policy directives revealed these concerns (Table 2.6). The coastal and marine citizen science remains a viable option for effective implementation of these policies and broader understanding of this environment (Garcia-Soto *et al.*, 2017). It appeared that coastal and marine policies developed by involving all relevant stakeholders (civil society and science) are more potent than those developed by society or scientists alone (Townhill & Hyder, 2017). Citizen science could provide an avenue for directly involving general public to have a voice for policy development at international, regional or local levels (Hyder *et al.*, 2015). However, these EU marine policies lack a clear definition of when and how to

involved stakeholders as external contributors (Fletcher, 2007). Therefore, for the effective marine policy plans implementation, Maguire *et al.* (2011) suggested that stakeholder involvement should be through early and active participation as well as establishing two-way communication exchange method (Table 2.7).

Table 2.6

Some European Union Adopted Marine Policy Frameworks and Directives

S/N	*Framework/Directive*	*Source*
1.	***The Habitats Directives***	Habitats Directives (1992)
2.	***The Common Fisheries Policy***	Churchill and Owen (2010)
3.	***The Integrated Marine Policy***	Meiner (2010)
4.	***The Water Framework Directive***	Hering *et al.* (2010)
5.	***The Marine Strategy Framework Directive***	Borja *et al.* (2010),
6.	***Marine Spatial Planning***	Brennan, Fitzsimmons, Gray and Raggatt (2014).

Table 2.7

Type of Participation at Each Level of Stakeholder Involvement

Level of involvement	Type of participation	Participation goal
Minimal	Information	Inform
Infrequent	Consultation	Consult
Frequent	Dialogue	Involve
Regular	Concentration	Collaborate
Full	Negotiation	Empower

Source: (Adapted from Maguire *et al.*, 2011)

Citizen science is directly benefiting coastal and marine environment by providing an interface between ocean literacy and marine science within the society (Kelly *et al.*, 2019), and increasing public stewardship and understanding of the environment that could be used for policy changes (Au *et al.*, 2000; Townhill & Hyder, 2017). To this end, the European Marine Board (EMB) urged the EU policies and researches to formally incorporate coastal and marine citizen science because there is need of large evidence-based datasets to inform decisions and policy about the management of this environment (Hyder *et al.*, 2015; Garcia-Soto *et al.*, 2017). However, evidence alone cannot influence policy but rather with politics and society each playing a part (Figure 2.3) to contribute to the evidence-based data to underpin decision-making (Hyder *et al.*, 2015). Although science is an essential component of informing policy

(Fletcher, 2007), yet the power of citizen science to achieve this is often overlooked (Evans, Birchenough & Fletcher, 2000). However, Evans *et al.* (2000) stressed that citizen science outcomes could influence policy and reach political agenda due to its volunteer-based status and extensive temporal and spatial scales coverage. Therefore, the higher the public involvement in environmental research, the quicker the generated data to be used for decision-making (Danielsen *et al.*, 2010). Figure 2.4 shows how citizen science could achieve these intents.

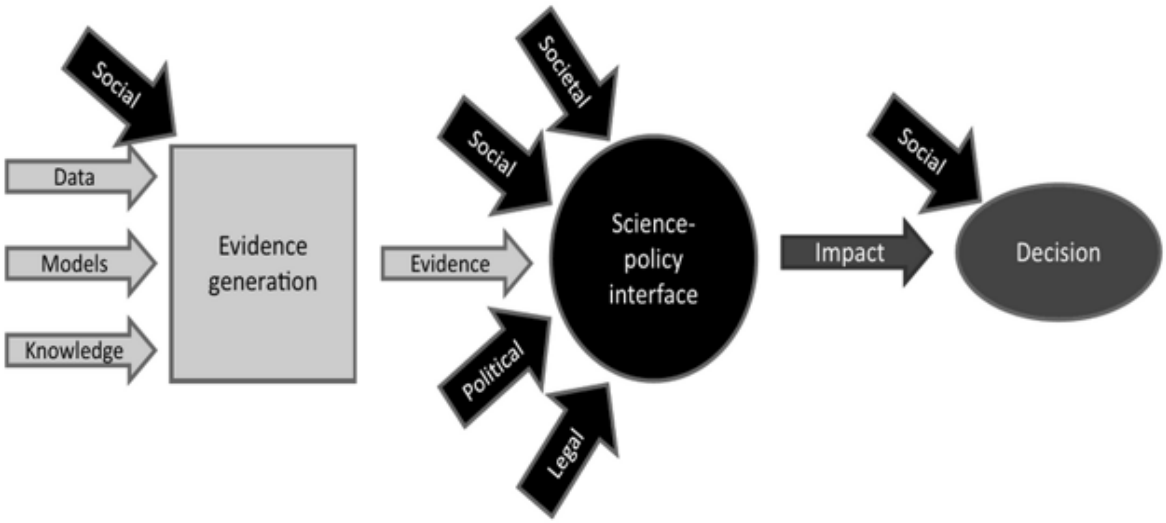

Figure 2.3. **The external factors affecting evidence generation, the science-policy interface, and decisions. Source: (Townhill & Hyder, 2017)**

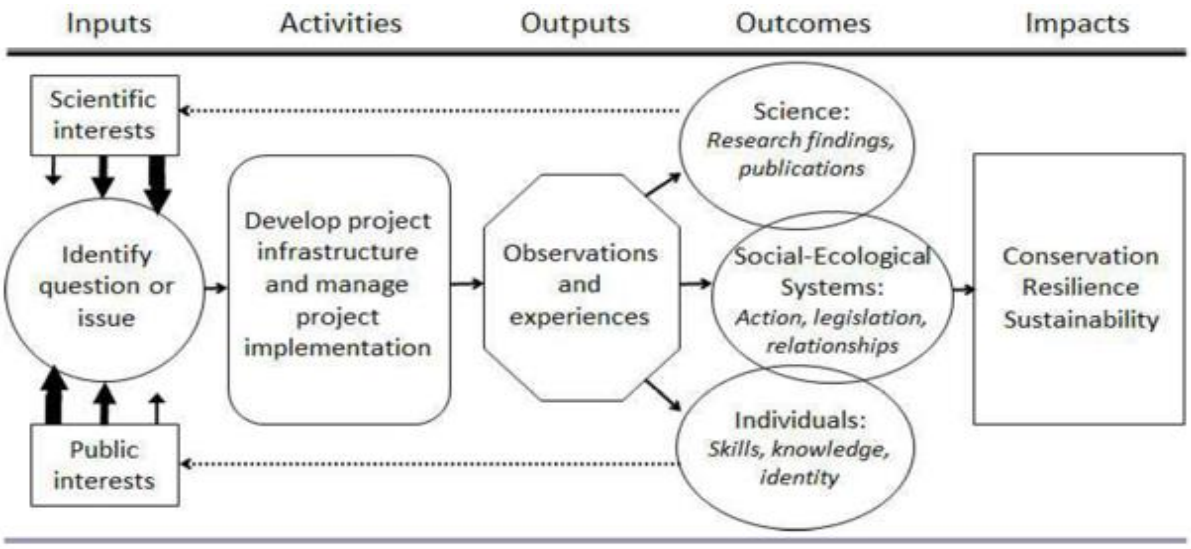

Figure 2.4. **The framework for volunteer participation in citizen science. Each project includes input from either scientific or public interests, and must use these to produce scientific, socio-economic, or individual outcomes. Source: (Shirk *et al.*, 2012)**

The policy-makers, conservationists and marine managers can coordinate both international and national conservation efforts using good quality evidenced citizen science data (Hochachka *et al.*, 2012, Figure 2.5 and Table 2.8). These efforts require sound ecological trends evidence-based knowledge to make management decisions (Danielsen *et al.*, 2009), and informed policy appraisal (Defra, 2011, Figure 2.6). Therefore, citizen science achieved these, for example, in the UK, the Wildlife Trust's Shoresearch and Seasearch dive surveys influenced the designation of Marine Conservation Zones (MCZ, Townhill & Hyder, 2017). Besides, most of the UK biodiversity indicators of developing policy rely on citizen scientists generated data (Bain, 2016). Also, the EU Marine Strategy Framework Directive (MSFD) used the Marine Litter Action Network (MLAN) data to implement policy on plastic bags disposal (MCS, 2019). Lastly, the manta rays' habitat citizen science surveys in Australia informed conservation in the Great Barrier Reef (Jaine *et al.*, 2012).

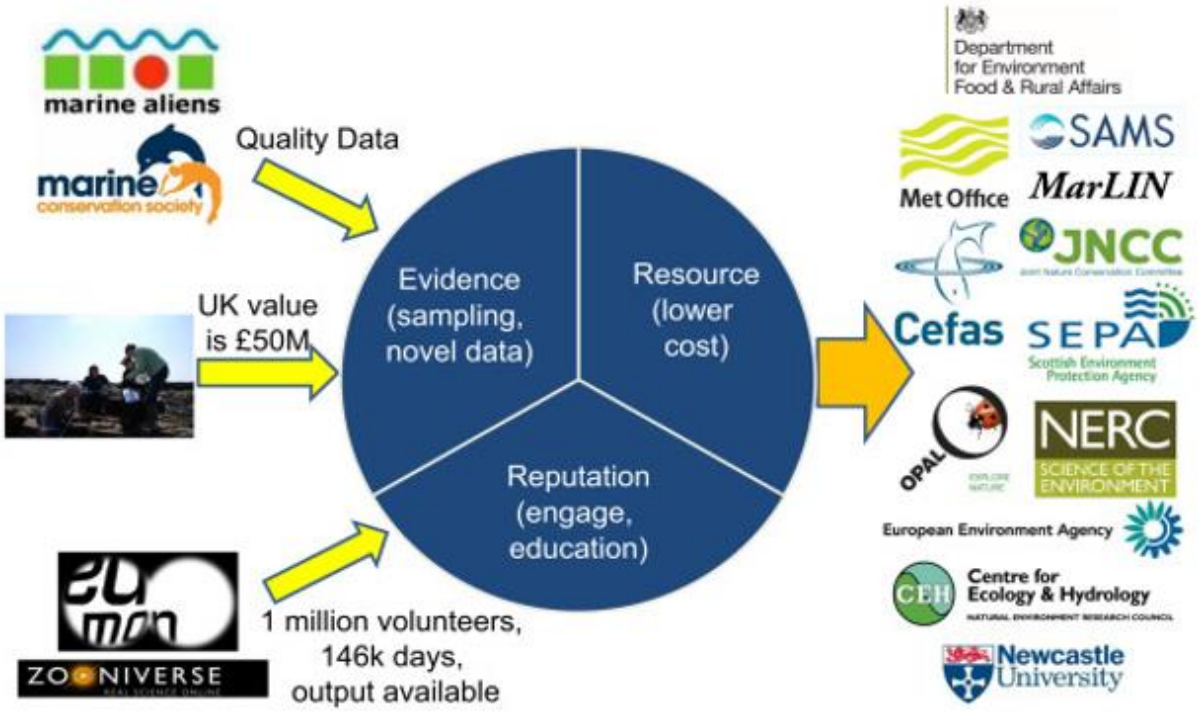

Figure 2.5. **Why should policy-makers be interested in citizen science? Showing motivations for citizen science in policy context in terms of delivery of evidence, provision of resource, and reputation. Source: (Adapted from Hyder *et al.*, 2015)**

Table 2.8

***Steps for Reducing Sources of Inaccuracy, Error, and Variation to Improve the Quality of* Data Collected by Volunteers in Coastal and Marine Citizen Science**

S/N	Aspect	Explanation
1.	*Simplicity of the task*	Several studies emphasized that the research questions investigated by citizen scientists should be straightforward and adjusted to the skills and capabilities of the participating volunteers.
2.	*Training and support materials*	Correct identification of species, items, or categories (e.g., type of plastic, sex, adult or juvenile) can be improved by training, which should be adequately implemented before volunteers collect data.
3.	*Consistency*	If data are collected by different groups of citizen scientists at the same place (quadrats or transects), it is desirable that the separate sets of data have high similarity.
4.	*Representativeness*	Studies relying on incidental reports from volunteers may not be representative for the entire range or temporal presence of a species. These shortcomings can be overcome by complementing data sets generated by volunteers with the coordinator's own systematic observations or measurements, other sources or pieces of information, or improving the probability of encounter.
5.	*Abundance estimation*	Abundance assessments based on direct counts are less prone to produce errors than quadrat estimates of per cent coverage. Correct estimations are influenced by the ability in estimating coverage, but also depend on the correct identification of species, and again, training can enhance accuracy.
6.	*Accuracy estimation*	The statistical test needed for estimating accuracy depends on the type of data collected, and although the majority of tests used are relatively straightforward (e.g., correlation methods and error matrices), it is wise to seek expert help in the selection of an appropriate method.
7.	*Verification*	If verification is made using photographs, authors usually do not include any statistical evaluation to obtain a quantitative assessment of correct identification, but efforts could be made to obtain some assessment of accuracy.

Sources: (Adopted from Thiel *et al.*, 2014)

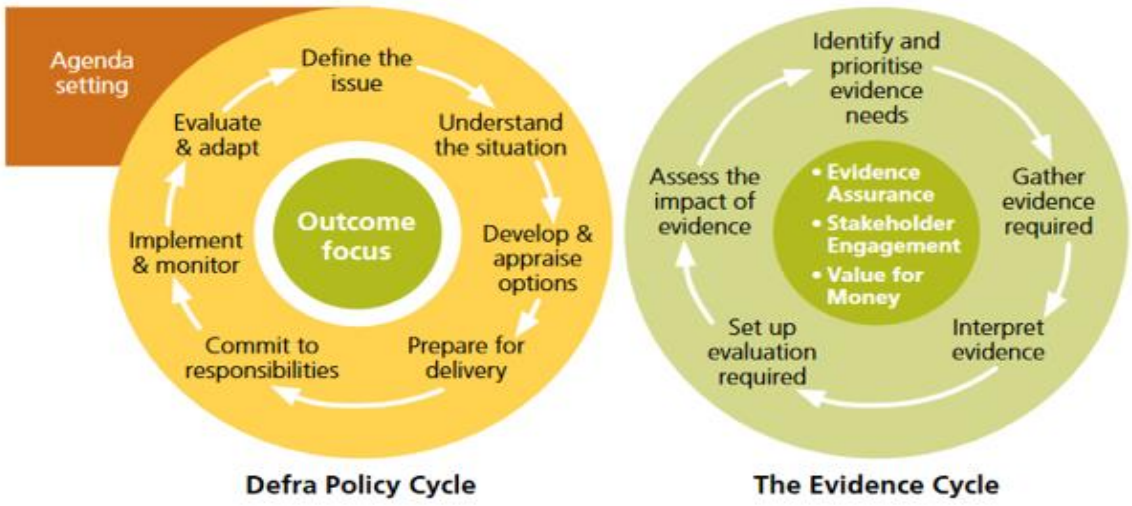

***Figure 2.6.* The policy and evidence cycles and how they can work alongside to inform policy decisions. Source: (Defra, 2011).**

Therefore, incorporating the concept of citizen science with ICZM and other marine policy strategies for coastal and marine conservation will influence and inform policy, but it requires adequate planning. Project coordinators could plan it well by designing the projects with the end in mind, defining policy questions, choosing appropriate technology, and conducting trials on the methodologies before commencing data collection. Also, the policymakers and professional scientists should carefully identify where citizen science is needed so to appropriately direct funds and efforts to right areas (Hyder *et al.*, 2015). Also, knowing when and how to engage volunteers is essential (Maguire *et al.*, 2011) to achieve the benefits of linking policy and coastal and marine citizen science (Townhill & Hyder, 2017).

2.3 Public Participation in Coastal and Marine Citizen Science

This section reviews and discusses critically the benefits of public participation in coastal and marine citizen science by first analysing the benefits of volunteer participation in coastal and marine citizen, then evaluating the quality and degree of participation, presenting engagement and participation level for citizen science activities, and finally evaluating the participants' recruitment and engagement.

2.3.1 Critical Analyses of the Benefits of Volunteer Participation in Coastal and Marine Citizen

Citizen science is highly relevant and timely option to achieve collaborative actions for protecting the coastal and marine environment (Roy *et al.*, 2012; Garcia-Soto *et al.*, 2017) because it allows volunteer participation to contribute to a plethora of scientific projects about the environment (Thiel *et al.*, 2014). It also results in an increased number of volunteers to detect environmental changes and perturbations, thereby filling in the data gaps and leading to adaptive management practice (Cigliano & Ballard, 2017).

The benefits of public participation in citizen science go beyond just increasing the number of volunteers to solve issues. However, volunteers can conduct when professional scientists are not amenable to collect data (Miller-Rushing *et al.*, 2012), or where their activities are insubstantial by the available workforce (Thiel *et al.*, 2014). Moreover, volunteers can conduct a project which would not be conducted by professional scientists, for example, if the scope of the issue is too small for professional scientists to appeal to broader researcher communities (Miller-Rushing *et al.*, 2012). Besides, volunteers help professional scientists among the stakeholders to understand the projects' social dimensions and refine research questions because they are locally affected by and connected to the issues in question (McKinley *et*

al., 2015). Finally, volunteer participation provides platforms to facilitate effective collaboration, improve capacity building, trust and communication between volunteers and project organisers (Thiel *et al.,* 2014). Despite all these benefits, citizen science projects (CSP) are faced with difficulties of achieving significant global coverage for coastal and marine conservation (Garcia-Soto *et al.,* 2017), this necessitates more efforts and research activities to generate volunteers over large temporal and spatial scales (Thiel *et al.,* 2014).

2.3.2 Evaluation of Degree and Quality of Participation in Citizen Science

Participation in coastal and marine environmental citizen science serves as a platform for engaging different stakeholders and acquiring new knowledge for the environment (Wulfhorst, Eisenhauer, Gripne & Ward, 2012). Shirk *et al.* (2012, p.3) defined participation as "a wide spectrum of approaches for engaging individuals and communities, with each approach often tied to different intentions and outcomes". Therefore, there is need to identify the relationships between the degree and quality of participation and how they support, inform and influence projects design for particular outcomes (Cornwall, 2008). The degree of participation is defined "as the extent to which individuals are involved in the process of scientific research: from asking a research question through analysing data and disseminating results" (Shirk *et al.* (2012, p.3). The individuals' degree of participation is standardised, compared and quantified base on the power they possess in the research process (Shirk *et al.,* 2012), extent of their involvement (Wilmsen and Krishnaswamy 2012), diversity and number (Cheng, Bond, Lockwood & Hansen, 2012), efforts put in the research (Dickinson *et al*., 2010), and the duration of involvement (Ballard, Trettevick & Collins, 2012). While the "quality of participation describes the extent to which a project's goals and activities align with, respond to, and are relevant to the needs and interests of public participants" (Shirk *et al.* (2012, p.3). Therefore, there is a need for establishing high-quality relationships between the project coordinators, volunteers and scientists to enhance quality outcomes for participants' retention and conservation (Pahl-Wostl, Mostert & Tàbara, 2008). The degree of participation could, therefore, generate a wide range of project outcomes if the quality of participation is thoughtfully considered (Wulfhorst *et al.,* 2012). Considering this interrelatedness of the quality and degree of participation in generating quality research outcomes, Shirk *et al.* (2012) established models for 'degree of participation' (Table 2.9) and project development framework for 'quality of participation' (Figure 2.7) in a scientific research.

Table 2.9

***Five Models of Projects Based on Degree of Participation in Scientific Research. Three of* which (2 – 4) Indicate Contribution from Citizen Scientists in Collaboration with Professional Scientists**

S/N	Project Model	Explanation
1.	***Contractual projects***	Projects where communities ask professional researchers to conduct a specific scientific investigation and report on the results;
2.	***Contributory projects***	Projects designed by professional scientists and for which citizen scientists primarily contribute data; these are often projects that need to collect data on a large geographic or temporal scale
3.	***Collaborative projects***	Projects that are also designed by professional scientists and for which citizen scientists primarily contribute data but may also help to refine project design, analyse data, and/or disseminate findings;
4.	***Co-Created projects***	Projects designed by professional scientists and members of the public, where at least some of the public participants are actively involved in most or all aspects of the research process; these projects are often initiated by the public, and collaborating with scientists is done to ensure that the project is conducted in a scientifically rigorous manner
5.	***Collegial contributions***	Projects where non-credentialed individuals conduct research independently with varying degrees of expected recognition by institutionalized science and/or professionals.

Source: (Adapted from Shirk *et al.* 2012)

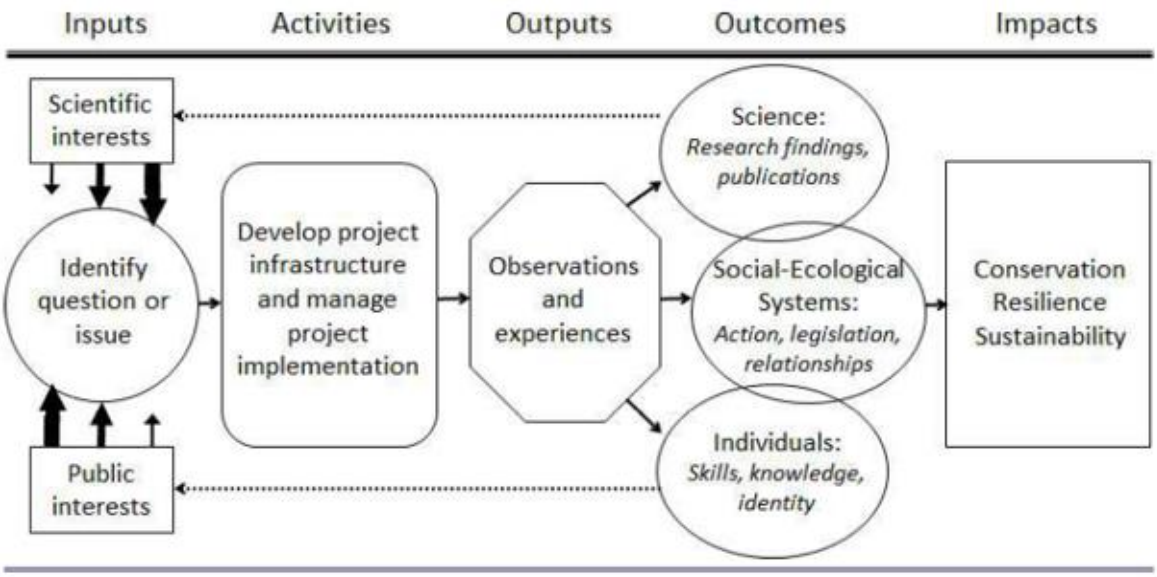

Figure 2.7. **Framework for project development based on quality of participation in scientific research.** The *inputs* (hopes, desires, goals, and expectations of both the professional and citizen scientists); *activities* (tasks necessary to design, establish, and manage a project); *outputs* (initial products or results of activities); *outcomes* (measurable elements such as skills, abilities, and knowledge that result from the specific outputs of a project; measured within 1 – 3 years); and *impacts* (long-term and sustained changes; occur 4 – 6+ years).
Source: (Adapted from Shirk *et al.* 2012)

2.3.3 Engagement and Participation Level in Citizen Science Activities

Considering the levels of public engagement and participation in citizen science activities, Haklay (2013) developed a ladder of participation (Figure 2.8) that is similar to Shirk et al. (2012)'s degree and quality of participation models. This ladder focuses on the level at which citizen science engages and integrates participants and scientists as well as participants among themselves to expose how knowledge and other outcomes are discovered and produced in science. Cigliano and Ballard (2017) reported that this ladder is ultimately relevant to coastal and marine citizen science projects because it shows that at each level of participation there is data collection opportunity for use in planning, decision-making, and management.

Level	Project	Explanation
Level 4	*Extreme citizen science*	The project here is truly collaborative science; is a completely integrated activity, where professional and non-professional scientists are involved in deciding on which scientific problems to work and the nature of the data collection so it is valid and answers the needs of scientific protocols while matching the motivations and interests of the participants.
Level 3	*Participatory science*	The research question is set by the citizen scientists in consultation with professional scientists and experts to develop data collection and analysis method. Thus, the professional and citizen scientists are directly engaged. The citizen scientists are then engaged in data collection, but require the assistance of the experts in analysing and interpreting the results.
Level 2	*Distributed intelligence*	Here the cognitive ability of the citizen scientists is the resource that is being used. They are asked to take some basic training, and then collect data or carry out a simple interpretation activity. Usually, the training activity includes a test that provides the scientists with an indication of the quality of the work that the participant can carry out.
Level 1	*Crowdsourcing*	At this level the participation is limited to the provision of resources, and the cognitive engagement is minimal; it's obtaining data by soliciting contribution from a large group of people, especially from an online community and citizen scientists act as sensors.

Figure 2.8. **Ladder of Levels of participation and engagement in Citizen Science projects.** Some of the participants will be at the bottom level, while participants that become committed to a project might move to the second level and assist other volunteers when they encounter technical problems. Highly committed participants might move to a higher level and communicate with a scientist who coordinates the project to discuss the results of the analysis and suggest new research directions.
Source: (Adapted from Haklay, 2013)

2.3.4 Evaluation of Volunteer Recruitment and Engagement

Recruitment of volunteers is central to achieving project objectives because they involve in various aspects of the research, ranging from projects design through findings dissemination (West & Pateman, 2016). Also, citizen science projects are required to meet both volunteer engagement and scientific objectives for sustainable activity, gaining support from host institutions and funding bodies, and both professional and citizen scientists' participation (Pecl *et al.*, 2019). That is why a decline in participation or low-level recruitment often lead to projects termination (Morais *et al.*, 2013). Therefore, understanding the factors influencing volunteer recruitment and engagement are integral to the success of a project (West & Pateman, 2016). Also, understanding such factors is crucial because "people become citizen scientists on a voluntary basis. As unpaid volunteers who invest their own time and resources, they have other motivations for contributing to a project" (Prager *et al*., 2014, p. 21). In addition, these volunteers are not free workers, but individuals who will continue participating if their desires are satisfied (Ryan, Kaplan & Grese, 2001). Therefore, understanding factors of motivating their recruitment is essential to project continuation (Measham and Barnett 2008).

However, factors of influencing individuals to participate and engage in a project are varied. Consequently, project organisers should carefully identify those that are specific to their existing and potential volunteers (Crall *et al.*, 2013). For example, some volunteers feel valued when they receive thanks as feedbacks, have ownership of the outcomes or consulted about the methods (Lawrence, 2006; Pecl *et al.*, 2019). Therefore, sending feedbacks to volunteers whether as a thank-you message, informing future use of data, automated provision of notifications, or statistical results and interpretation is effective volunteer retention strategy (Silvertown, 2009, Figure 2.9). In coastal and marine policy context, motivations specifically relate to three significant benefits: "delivery of evidence, provision of resource, and reputation" (Hyder *et al.*, 2015, p. 113, Figure 2.10). In conservation of biological diversity, Hobbs and White (2012) categorised different motives that influence individuals' participation and engagement into intrinsic and extrinsic factors (Table 2.10). For example, awareness of opportunity existence and its appropriateness, outdoor recreation, and motivations (West & Pateman, 2016, Figure 2.11).

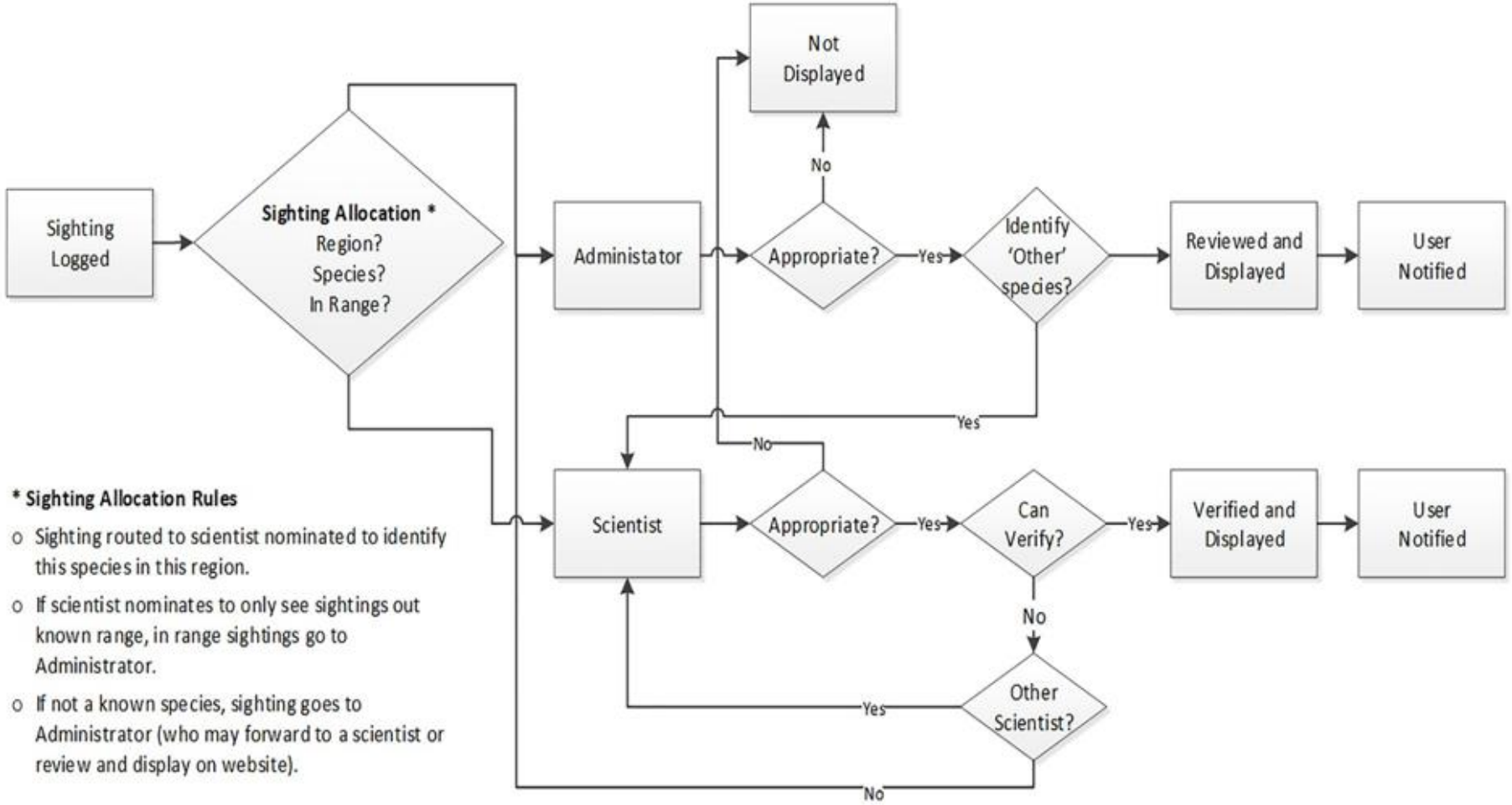

***Figure 2.9*. Overview of the management workflow for observations submission in managed crowdsourcing citizen science. Showing how feedback is provided to the contributor and the semi-automated observation verification system. Source: (Pecl *et al.*, 2019)**

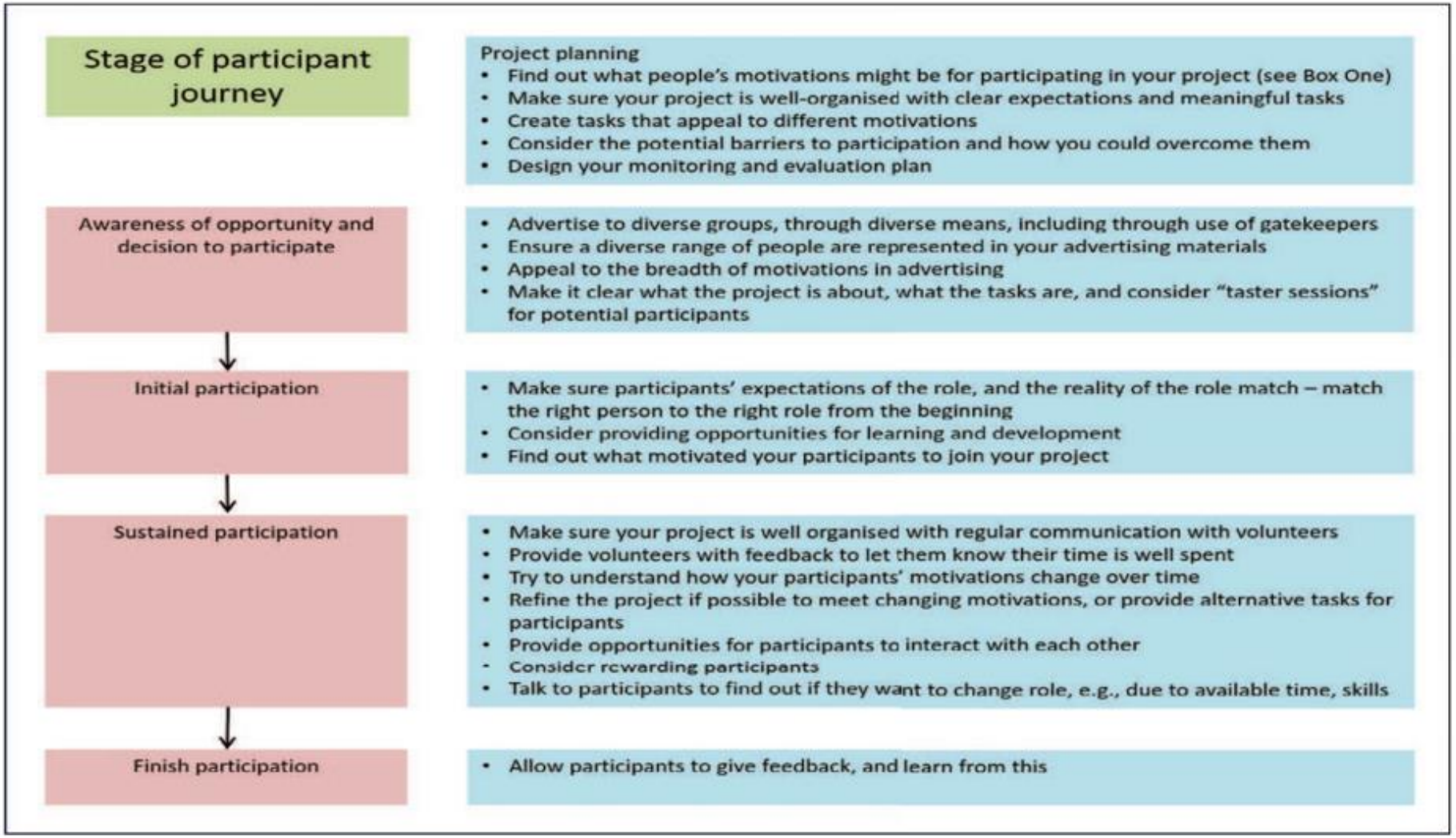

Figure 2.10. **The journey that a participant takes when participating in a project (left side), with a checklist for project organisers corresponding to each of these stages (right side) to maximise the changes of people having a positive experience of participating. Source: (Adapted from West & Pateman, 2016)**

Table 2.10

***List of the Motivations that May be Held by Citizen Science Volunteers, and Lead to Effective* Participant Recruitment and Engagement**

S/N	Motivation	Example	
1.	***Intrinsic Motivations*** Describe the desire to volunteer because volunteering is in some way inherently interesting or satisfying.	***Understanding:*** Where people want to learn new things.	Wanting to learn new things
			Wanting to share existing knowledge with others
		Values: Where people have an altruistic concern for others.	Helping other people
			Helping science
			Helping the environment
			Help a particular site
		Social: Where people are motivated by the desire to meet new people and because volunteering is a socially desirable thing to do.	
		Enhancement: Where people wish to improve themselves personally through volunteering	
		Protective: Where people volunteer to reduce negative feelings or to address personal problems	
2.	***Extrinsic Motivations*** describe the willingness to volunteer because it leads to some other outcome, such as getting a new job	***Career:*** Where people hope to gain experience that will benefit their future careers	

Source: (Adapted from West & Pateman, 2016)

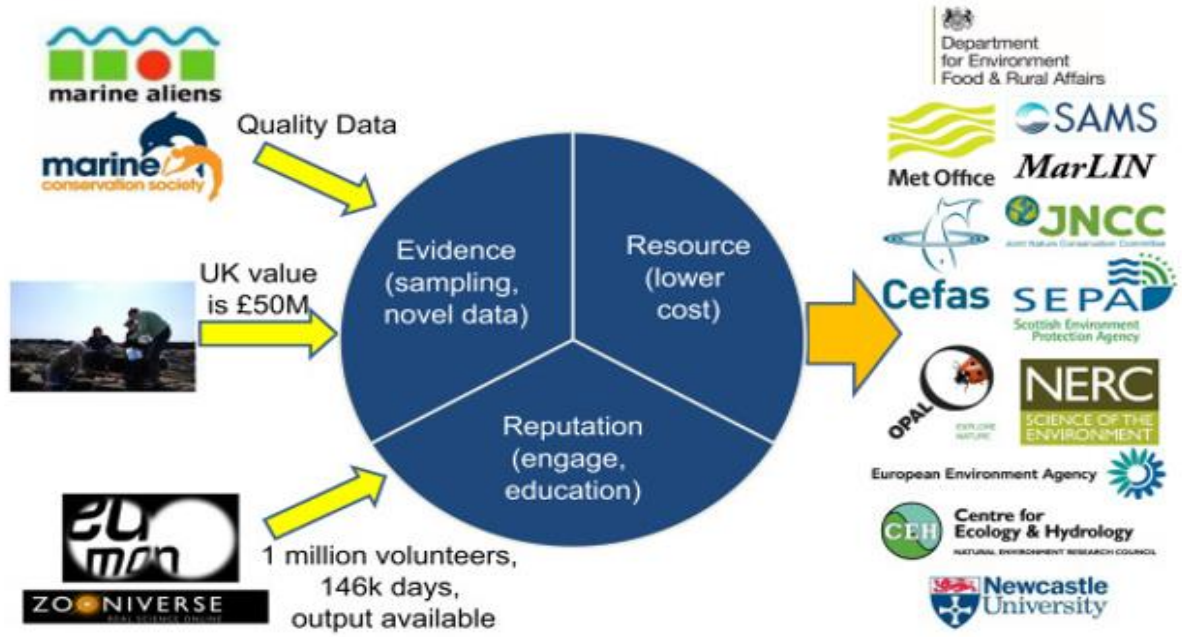

Figure 2.11. **Three motivation values for citizen science projects in the policy context: -delivery of evidence, provision of resource, and reputation. Source: (Adapted from Hyder *et al.*, 2015)**

2.4 Chapter Conclusion

In conclusion, the chapter evaluated a vast amount of literature and identified the potential of citizen science in achieving the first two study objectives. The concept of citizen science appeared to be well incorporated with and significantly support the ICZM principles and other marine policy directives to impacting conservation of coastal and marine environment. Also, it established that citizen science projects that are more contributory, collaborative and co-created based seem to develop deliberate consortium with individuals that have vested interest in the natural resource conservation (Cigliano & Ballard, 2017). While regarding retaining the participants for continuing participation over time, keeping respectful, informative and continual communication is necessary to maintaining committed individuals in the projects (Hind-Ozan, Pecl, & Ward-Paige, 2017). However, recruiting, engaging and retaining citizen scientists in a project goes beyond just collaborating and co-creating project or keeping in touch with them, but they want their contributions to be valued and know how it makes a difference (Wasser, 2017).

CHAPTER THREE: METHODOLOGY

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter provides an overview of the rationale behind selecting this particular research topic and case study. It also outlines the overview of the adopted approach for the research methods and techniques used in this study to answer the outlined aim and specific objectives.

3.2 The Research Topic and Study Area Selection

This section provides the rationale behind the choice of the particular study topic and area.

3.2.1 Research Topic Selection

The increased use of citizen science for coastal and marine research around the globe to tackle conservation issues makes the European Marine Board (EMB) to encourage member states to use it as a vital tool for promoting ocean literacy for conservation purpose (Garcia-Soto *et al.,* 2017). However, within the UK, there is a lack of evaluation of potential volunteers' interests in participating in coastal and marine research. Also, this specific research area lacks sufficient investigations within Langstone Harbour; thus, this allows selecting the topic to bridge this knowledge gap in the existing literature by producing an original study in this field.

3.2.2 Case Study Selection

Langstone Harbour is known with myriad of substantial recreational and commercial activities (Foster, Hudson, Bray, & Nicholls, 2014), which pose environmental impacts that call for conservation concern (Langstone Harbour, 2009). Besides, it is part of the Solent areas designated for conservation purpose because of its wildlife, salt-marshes, mudflats, migratory and overwintering wildfowls, and wading birds (Figure 3.1 and Table 3.1). Other nature conservation designations of the area include: 'Special Protection Area (SPA)', Ramsar, Mudflat, and Saltmarsh 'Sites of Special Scientific Interest (SSSI)' and Special Area of Conservation (SAC)' (Cope, Bradbury, & Gorczynska, 2008; Figures 3.2, 3.3 and 3.4). Consequently, this richness in natural resources attracted some organizations (e.g. Friends of Langstone Harbour, Hampshire and Isle of Wight Wildlife Trust, RSPB and JustOneOcean) to conduct various citizen science projects in the Harbour (LHB, 2019). Therefore, these reasons informed the selection of the harbour as a case study to evaluate public interest in participating in citizen science projects for conservation purpose.

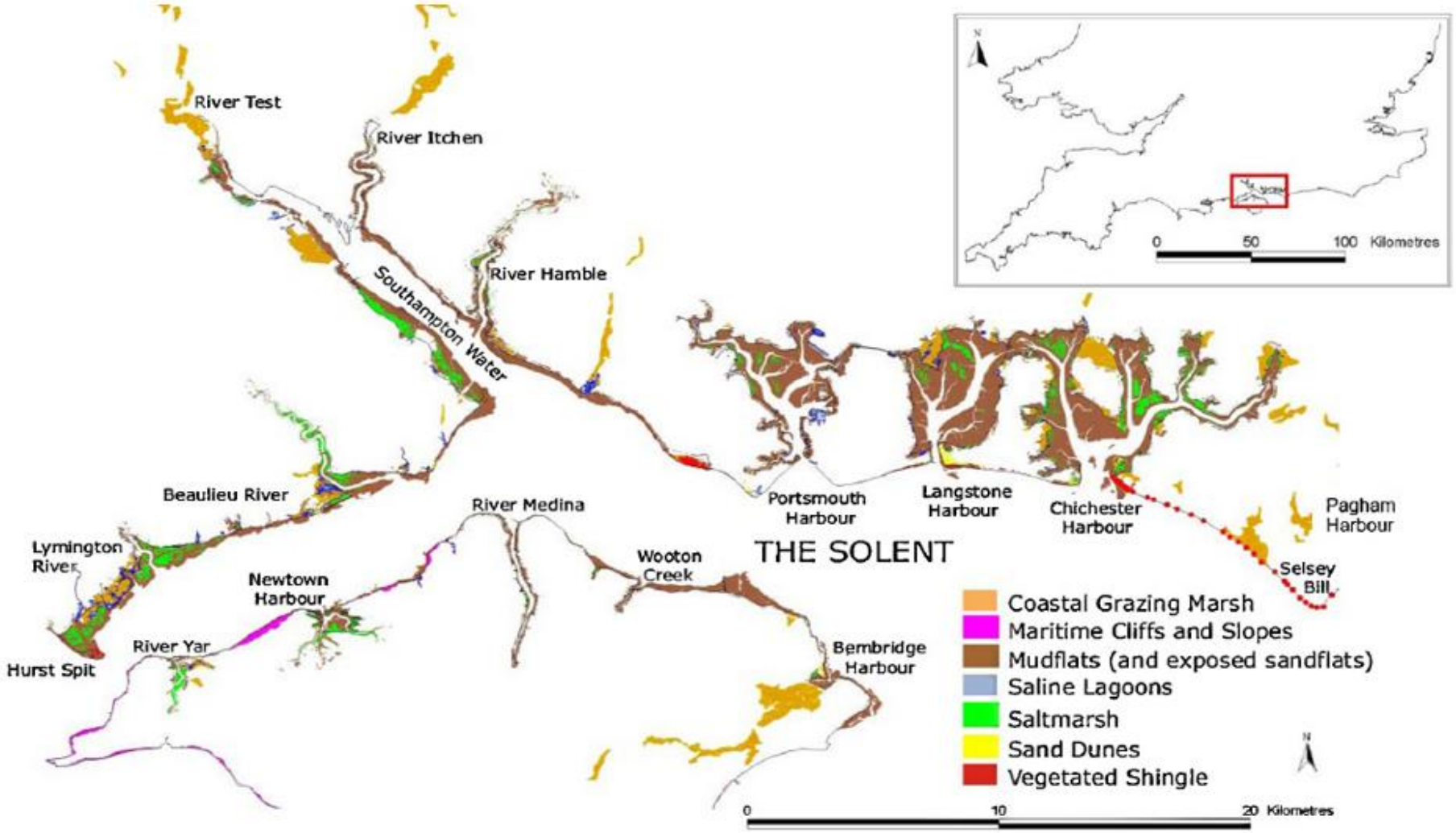

Figure 3.1. **Solent Estuarine System, showing Langstone Harbour Sand Dunes, Mudflats, Saltmarsh and Coastal Grazing Marsh.**

Source: (Cope *et al.*, 2008 cited in Foster *et al.*, 2014

Table 3.1

Langstone Harbour Wildlife

S/N	Wildlife	Overview
1.	***Birds***	Ranked within the top 10 most important places for birds in the UK. In the winter months, houses over 40,000 birds for roosting or feeding on the mudflats Species include: Shelduck, Dunlin, Plover, Godwit, and Redshank and up to 6% of the world population of Brent Geese. In the Summer months, provides breeding location for Gulls and Terns
2.	***Mammals***	The harbour provides haul out sites for approximately 25 Harbour seals Bottlenose Dolphins, Harbour Porpoise and Otters are occasionally spotted in the harbour Spot Roe Deer, Water Voles and Wily fox are also present around the harbour perimeter
3.	***Fish***	In the past up to 58 different species of fish live in the harbour waters The harbour is a designated Bass nursery, and also provides an important home for Mackerel, Bream, Herring and Sandeels
4.	***Invertebrates***	The wealth of strange and colourful invertebrates live in the harbour. Snakelocks anemones, Porcelain Crabs and Purse Sponges filter plankton from the water to survive, while prawns and whelks scavenge for carrion. Buried in the mud an amazing variety of worms and molluscs reside, including Ragworms, Lugworms, Cockles and Clams. Butterflies such as the Red Admiral and Gatekeeper are common sights, and many species of Dragonfly can also be seen swooping overhead.
5.	***Plants***	Bladderwrack, Sea Lettuce and Kelp are all commonly seen, as well as the alien species Japanese Wireweed. Langstone Harbour also provides a home for beds of Eelgrass. Around the margins of the harbour grow extensive areas of Atlantic Salt Marsh Further ashore, Bee Orchids, and over 50 species of grass can be found around the harbour perimeter.

Source: (Adapted from LHB, 2019)

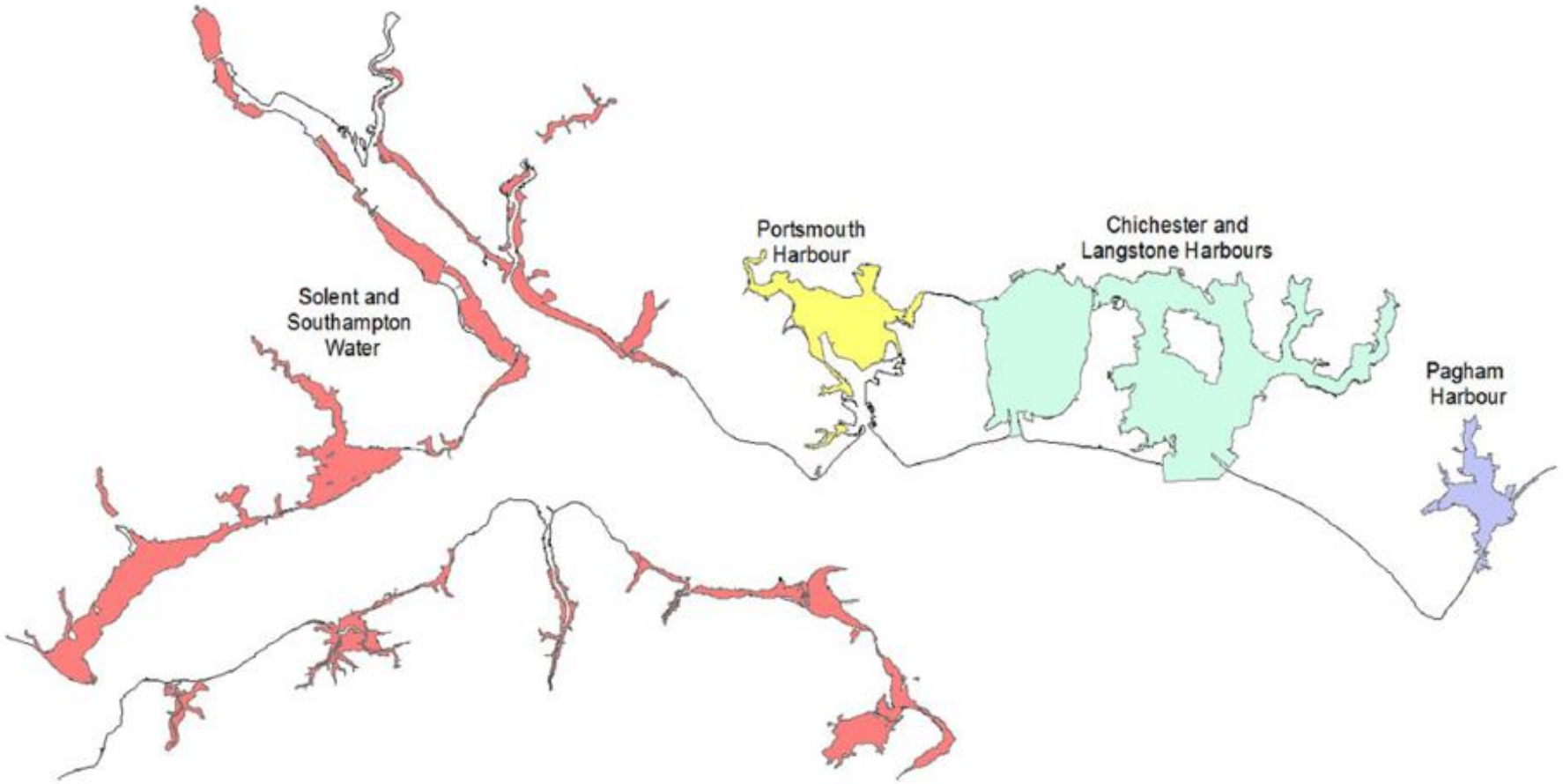

Figure 3.2. **Showing four designated Ramsar sites of significance to the conservation and sustainable use of intertidal mudflats and saltmarshes in the Solent.**
Source: (Foster *et al.*, 2014).

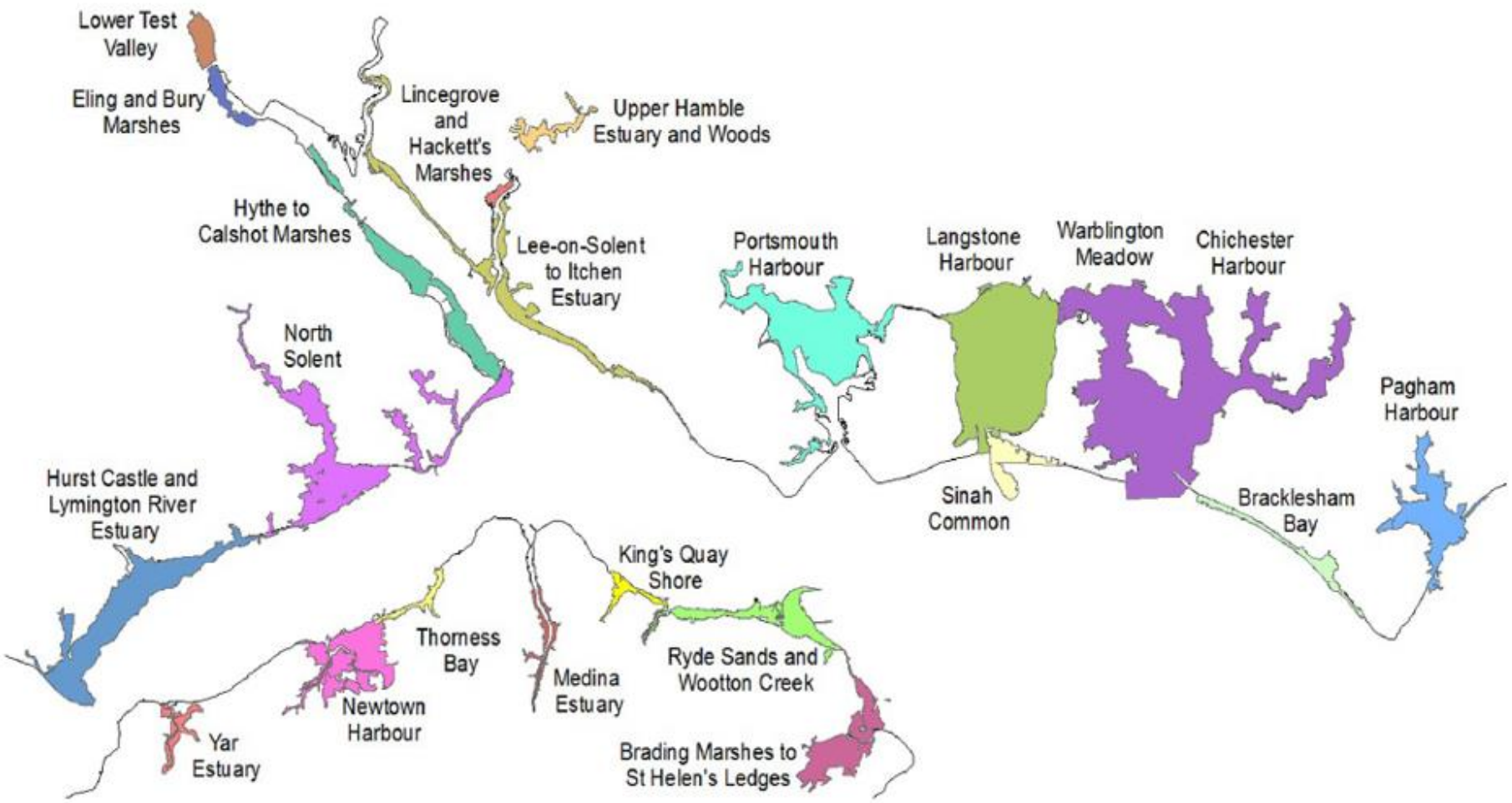

Figure 3.3. **Showing 22 Sites of Special Scientific Interest (SSSIs) designated for the conservation and sustainable use of intertidal mudflats and saltmarshes in the Solent.**
Source: (Foster *et al.*, 2014).

Figure 3.4. **Intertidal mudflat and saltmarsh in the Solent showing one SAC designated site.**
Source: (Foster *et al.*, 2014).

3.3 Methodology Overview

Research methodology is described as the process that is systematically used to solve a research problem (Kothari, 2004; Hamilton, 2010). Appropriate methodology selection provides researchers with the opportunity to understand and choose suitable methods or techniques for their studies (Howell, 2012). That is why researchers use methodology to discuss the logic of using particular methods in their studies and explain why they reject other methods so that the results of such studies would be evaluated by themselves or other researchers (Singh, 2006; Howell, 2012; & Kilubi, 2017). Kothari (2004, p. 8) supported this explanation and emphasised that methodology stated "why a research study has been undertaken, how the research problem has been defined, in what way and why the hypothesis has been formulated, what data have been collected and what particular method has been adopted, why particular technique of analysing data has been used and a host of similar other questions are usually answered". Therefore, the study used mixed research method (Bryman, 2016) by combining an in-depth quantitative survey of various coastal and marine users and qualitative interview of different key players in citizen science projects.

3.3.1 Questionnaire Method Selection

Questionnaire as a research method is a set of systematically structured questions written or used by researchers to ask for data to be used in their researches (Oppenheim, 1992; McLeod, 2018). The questionnaire is of different types and has several advantages over other methods (Table 3.2). Self-administered electronic questionnaire was selected to deeply and actively engage participants to collect primary data. This method was chosen because it is one of the most economical, feasible and practical ways adopted by many coastal and marine researchers (e.g. Boyes & Elliott, 2003; van Broekhoven, 2010; Prior, 2011), who have reported effective responses rates. However, it has some disadvantages (Table 3.3). Therefore, to cater for these disadvantages, various strategies and recommendations were followed. For instance, the questionnaire was embedded with a good covering letter (see Appendix A) that explained the researcher's background information, research rationale and importance (Bryman, 2016). It also clearly mentioned why the respondent is selected, the bursary support to conduct the study, and statement of confidentiality (Bryman, 2016). Moreover, salient instructions on how to respond to questions, attractive layout, and the university logo were all embedded to make the questionnaire more attractive and formal (Dillman, Smyth & Christian, 2014). Finally, the questionnaire was designed starting with the questions that are likely to engage respondents,

then demographic questions were taking to the last part, and researcher's email was added for follow-up or enquiry (Bryman, 2016).

Table 3.2

Advantages of the Self-administered Questionnaire Over Other Methods

Advantage	Explanation
Cheaper to administer	Interviewing can be expensive especially for geographically dispersed samples. Postal self-administered questionnaire will be much cheaper because of the time and cost of travel. Even when compare with telephone interviewing, self-administered questionnaire is cost effective.
Quicker to administer	Thousands of questionnaires can be sent out through the web surveys, post or otherwise distributed in batch at the same time, but, even with a team of interviewers, it would take a long time to conduct personal interviews with a sample of that size.
Absence of interviewer effects	Interviewer characteristics such as ethnicity, gender, and social background may combine to bias the answers the respondents provide. Obviously, since there is no interviewer present these effects are eliminated.
No interviewer variability	Do not suffer from the interviewer asking questions in a different order ways.
Convenience for respondents	Respondents can complete questionnaire when they want and at the speed they want to go.

Source: (Adapted from Bryman, 2016).

Table 3.3

Disadvantages of the Self-administered Questionnaire Over Other Methods

Disadvantage	Explanation
Cannot be prompt	There is no one present to help respondents if they are having difficulty answering a question.
Cannot probe	There is no opportunity to probe respondents to elaborate an answer when open-ended questions are being asked.
Cannot ask many questions that are not salient to respondents	Questionnaire respondents are more likely to become tired of answering questions that are not very salient to them and that they perceive as boring than interview respondents.
Do not know who answers	With web survey for example, researcher can never be sure whether the right person has answered the questionnaire. It is also impossible to have any control over the involvement of non-respondents in the answering of questions
Cannot collect additional data	Cannot collect snippets of information about the home, school, film, or whatever
Difficult to ask a lot of questions	Long questionnaires are rarely feasible. They can result in respondents fatigue or greater tendency for questionnaire not to be answered
Not appropriate for some kinds of respondents	Respondents whose literacy is limited or whose facility with English is restricted will not be able to answer the questionnaire.
Greater risk of missing data	It is easier for respondent to actively decide not to answer a question when on their own because of lack of prompting or supervision.
Lower response rate	One of the most damaging limitations is that surveys by web or post typically result in lower response rates. Unless it can be proven that those who do not participate do not differ from those who do, there is likely to be the risk of bias.

Source: (Adapted from Bryman, 2016).

3.3.1.1 Survey Development

Several sources of information and guides were used to develop the survey. In general, the questionnaire was prepared according to the procedures outlined by Potts (1999), Dillman, Smyth and Christian (2014) and Bryman (2016) (Figure 3.5). The questionnaire was designed to take approximately 5 – 8 minutes to complete, thus, to gain high response and avoid respondent's fatigue. Also, easy to follow and respond to instructions and questions (Bryman, 2016) were formulated under the headings below:

- Level of familiarity and confidence in citizen science
- Type of activities in Langstone Harbour
- Use of coastal and marine environment
- Level of interest in assisting coastal and marine citizen science projects
- Preferred involvement type in citizen science projects
- Willingness to share data or information, and
- Demographic information

Survey questions on respondents' confidence and familiarity with the term 'citizen-science' were taken from Lewandowski *et al.* (2017) and adapted to suit the study. Also, the citizen science definition and synonymous were added to spur the respondents' memories of the term.

The different activities occur in the harbour (Harbour Guide, 2019) informed the formulation of the questions on coastal and marine activities to ensure representation of a broad range of users. Also, the study used Martin *et al.* (2016a)'s questions to ask the frequency and participation rate in an activity as well as the importance of the environment. Besides, The Shirk *et al.* (2012) and Irwin (2002) model of participation informed the formulation of the questions on participants confidence and interest in participation in citizen-science (using a 5-point scale). Another question with list of different citizen-science tasks as proposed in Garcia-Soto *et al.* (2017) was formulated and asked respondents to record (on a 5-point scale) their predicted self-confidence in participating in each task.

The UKEOF citizen science motivations manual (Geoghegan *et al.*, 2016) guided the development of questions on the importance of feedback to have an insight on how it will affect volunteer retention. Also, the office for national statistics data (Team, 2012) helped in developing the demographic information questions. Lastly, Cormick, (2012) criteria on gaining people's interest in science informed the development of questions on participants interest and education in science.

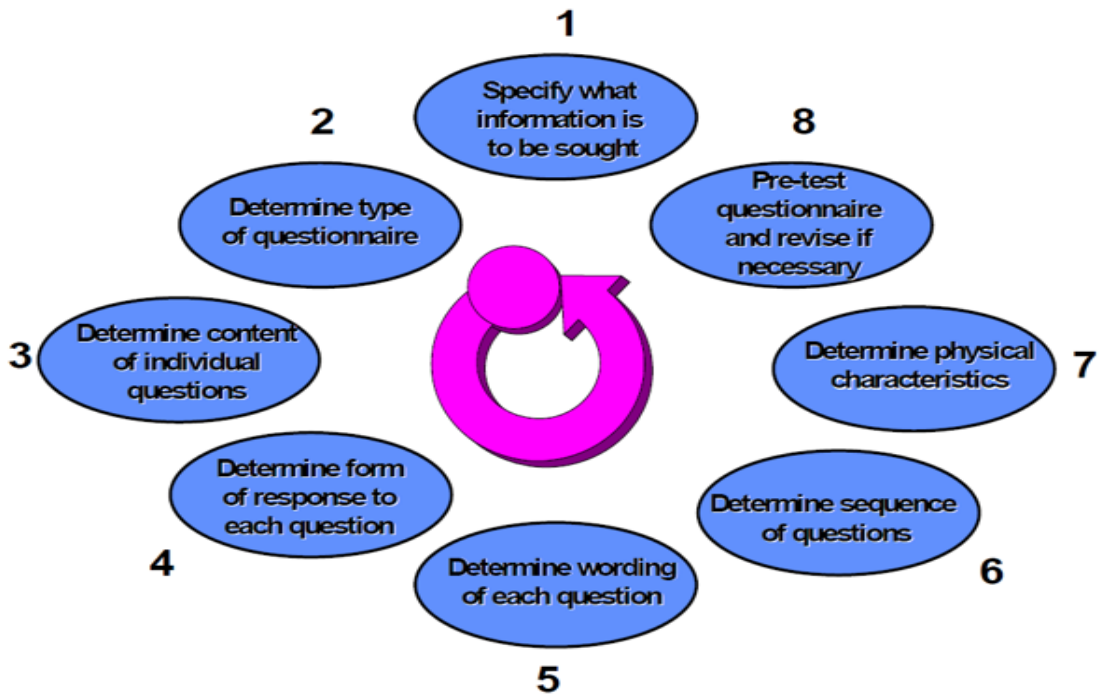

Figure 3.5. **Questionnaire development process.** **Source: (Potts, 1999 cited by Maguire, 2010)**

3.3.1.2 Pilot Survey Distribution

The developed questionnaire in Microsoft word document was pilot tested by sending it to eight presidents and commodores of different marine users' associations who were known to lead different Water-sport clubs and Organizations in Langstone Harbour. The Langstone Harbour environment management office received one pilot survey also. Besides, some locals around Langstone Harbour filled five pilot survey questionnaires. All in all, 14 questionnaires were sent as pilot studies, to assess feasibility of the study, uncover potential problems and test the simplicity of conducting the survey, thus, to reduce respondents' fatigue and generate high response rate (Teijligen, & Hundley, 2001). At this point, some minor amendments were made to the questions' wordings, and the questionnaire was sent to Langstone Harbour environment office for comment again. After this, additional minor amendments to the wordings and order of some questions were made again.

3.3.1.3 Web Survey Design and Distribution

The software package used to design the web survey was *SurveyMonkey*. It provides the advantages of formatting the questionnaire appearance (response style and colour) and adding filter (logic) that allow respondents to answer the questions that apply to them only and skip others (Bryman, 2016). Therefore, after the pilot survey, the questions were refined and entered into the *SurveyMonkey*. Then, pilot-tested further by sending the survey weblink to four locals in different areas across the harbour. Finally, minor wording adjustments for clarity were made, and the survey was opened for six weeks from 26th June to 9th August.

3.3.1.4 Sample Selection and Survey Distribution

The survey aimed at various coastal and marine users in Langstone Harbour. The study recruited a total of fifteen presidents and commodores of different coastal and marine organizations (see Appendix B). These participants were contacted via emails and phone numbers with the help of Langstone Harbour environment office, and all agreed to participate in the survey. Therefore, Snowball Sampling approach was used to promote the survey around the harbour, recruit hard-to-reach marine users and collect data in a cost-effective manner (Bryman, 2016). The survey weblink was emailed to these presidents and commodores and pleaded them to distribute it among their members. Besides, Hayling Sewage Watch and Southsea Beachwatch promoted the survey via their facebook page, likewise Langstone Harbour environment office to reach groups and individuals with interest in coastal and marine citizen science research.

3.3.2 Interview Method Selection

The interview is a research method in which interviewer, the researcher, attempts to inquire information verbally from interviewee, the respondent (Gray, 2018). The interview as a research method has different types (Table 3.4). The structured interview approach was chosen to ensure the evaluation of views of various key players in citizen science projects on the potential of their projects to influence interests, literacy, management, and policy of the environment towards conservation. This method was used in this study, akin to that of Kelly *et al.* (2019) because it represents a ground-breaking alternative to conducting an interview where potential participants are hard-to-reach (Kothari, 2004). Following the web survey, five different organizations who were known to directly or indirectly conduct or involve in various citizen science projects in Langstone Harbour were identified, sampled using Criterion Sampling (see Appendix C, Patton, 1990), and invited for the interview. Therefore, the phenomenological qualitative approach was used for this study to capture participants' experiences on their citizen science projects (Creswell & Poth, 2017).

Table 3.4

Types of Interview

S/N	*Type*	*Explanation*
1.	***Structured interview***	The researcher asks a predetermined set of questions, using the same wording and order of questions as specified in the interview schedule. Questions may be open ended or closed, prepared for use by an interviewer in a person-to-person interaction (this may be face to face, by telephone or by other electronic media).
2.	***Unstructured interview***	A flexible format, usually based on a question guide but where the format remains the choice of the interviewer, who can allow the interview to 'ramble' in order to get insights into the attitudes of the interviewee. No closed format questions.
3.	***Semi-structured interview***	One that contains structured and unstructured sections with standardized and open type questions.

Source: (Adapted from Walliman, 2017).

3.3.2.1 Interview Questionnaire Development and Pilot Study

Various sources of information and guides were used to develop the interview questions. In order to minimize errors in the study, the interview schedule was designed following the Bryman (2016), Gray (2018) and Kumar (2019) guides on designing a credible interview

(Figure 3.6). Also, considering the potential interviewees' tight schedules, the 'Interview Schedule' – a list of opened-ended questions used for data collection (see Appendix D, Kumar, 2019), was designed for interview to approximately last for 15 minutes. The questions were formulated under the following headings:

- Interviewee coastal and marine environment citizen science project(s)
- Interviewee opinions on volunteer engagement and interest

Therefore, questions on interviewee citizen science project(s) were taken from Kelly *et al.* (2019), then modified and redesigned to ask the participants an overview of their projects and volunteer motivations. Whereas the questions on volunteer engagement and interest were taken from Vann-Sander, Clifton and Harvey (2016), then adapted and redesigned to evaluate the interviewees' opinions on volunteer awareness and interest as well as the power of their citizen science to influence management of coastal and marine environment.

After this, the 'Interview Schedule' was pilot tested to one of the coordinators of citizen science projects. At this point, some minor amendments were made to the questions and the expected interview duration adjusted to approximately 20 minutes. Then, cover letter (see Appendix E) was sent to all potential interviewees, asking their consent to partake in the interview, ensuring confidentiality of their responses, and requesting them to select a medium that is convenient for them to conduct the interview. In all cases, participants' consent was obtained. Four of the participants agreed with the telephone interview using mobile phones and one face-to-face. Finally, the 'Interview Schedule' containing structured open-ended questions was sent to all of them beforehand (Kumar, 2019).

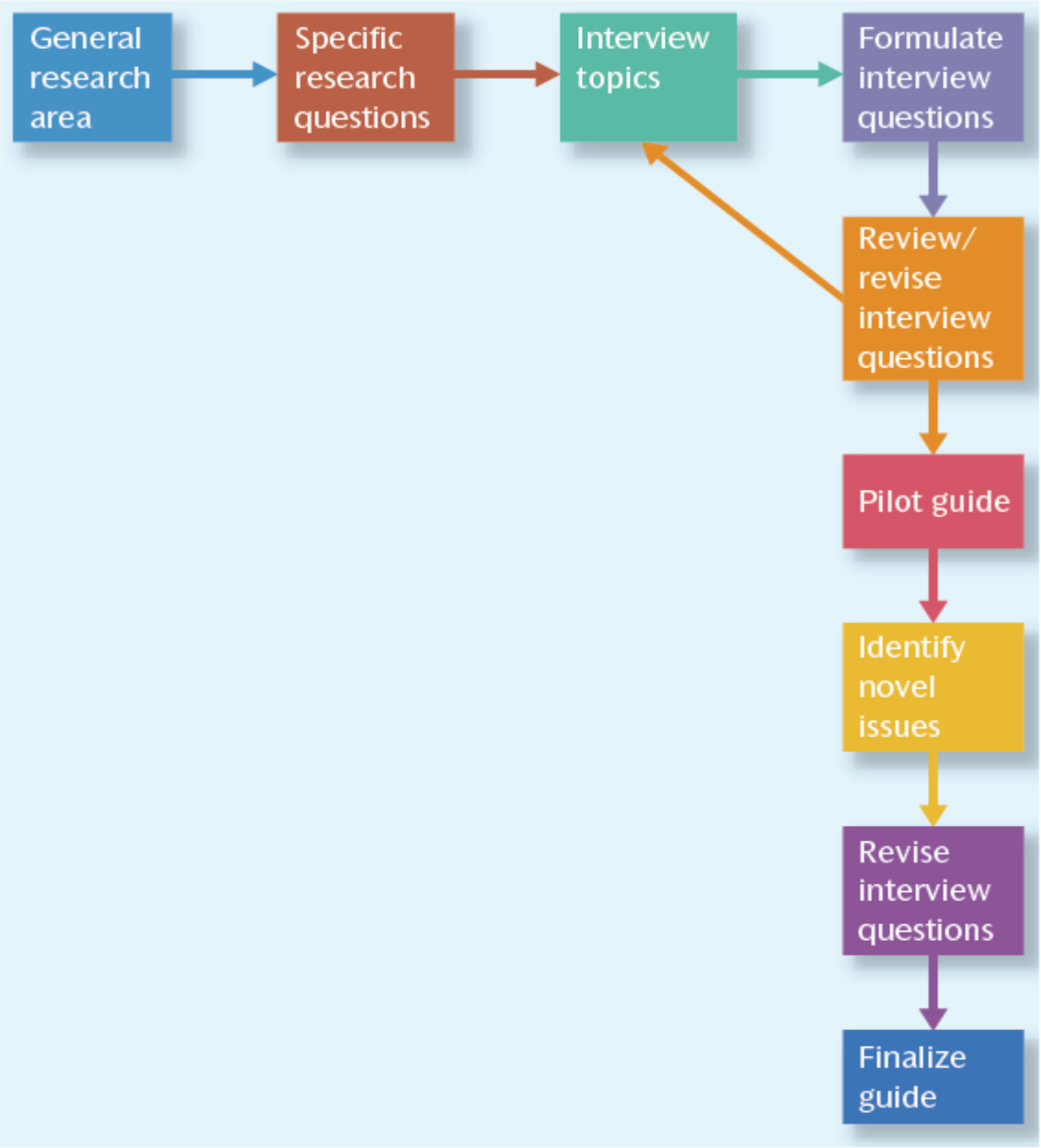

Figure 3.6. **Formulating questions for an interview guide.**
Source: (Bryman, 2016)

3.3.2.2 Conducting Interview

Of the five interviews performed, four were over the phone and one face-to-face in August and September. All interviews lasted for approximately 15 to 20 minutes, and responses were audio recorded. During the interviews, Gray (2018) dos and don'ts for conducting interview (Table 3.5) and Bryman (2016) interviewing tips and skills (Table 3.6) were adequately followed. Finally, to ensure anonymity of all interviewees, their names were coded (using letter, P), used during thematic analysis and when identifying any quotations (Saldaña, 2016).

Table 3.5

Checklist of Dos and Don'ts of Interviewing

Do	Don't
Establish clearly what the interview thinks	Do not give an indication to the interviewee of your meanings and understandings or appear to judge their responses
Provide a balance between open and closed questions	Do not ask leading questions or questions to which it is easy for interviewees to simply agree with all you say
Listen carefully to all responses and follow up points that are not clear	Do not rush on to the next question before thinking about the last response
Give the interviewee plenty of time to respond	Do not rush, but do not allow embarrassing silences
Where interviewees express doubts or hesitate, probe them to share their thinking	Avoid creating the impression that you would prefer some kinds of answers rather than others
Be sensitive to possible misunderstandings about questions, and if appropriate repeat the question	Do not make any assumptions about the ways in which the interviewee might be thinking
Be aware that the respondent may make self-contradictory statements	Do not forget earlier responses in the interview
Try to establish an informal atmosphere	Do not interrogate the interviewee
Be prepared to abandon the interview if it is not working	Do not continue if the respondent appears agitated, angry or withdrawn

Source: (Adapted from Gray, 2018)

Table 3.6

Interviewing Tips and Skills Considerations for an Interview Introductory Statement

S/N	Principal Considerations
1.	Make clear the identity of the person who is contacting the respondent
2.	Identify the auspices under which the research is being conducted
3.	Mention the source of any research funding, or, if you are a student doing an undergraduate or postgraduate dissertation or doing research for a thesis, make this clear
4.	Indicate what the research is about in broad terms and why it is important, and give an indication of the kind of information to be collected
5.	Indicate why the respondent has been selected
6.	Make it clear that participation is voluntary
7.	Reassure the respondent that he or she will not be identified or be identifiable in any way
8.	Provide reassurance about confidentiality of any information provided
9.	Provide the respondent with the opportunity to ask any questions

Source: (Adapted from Bryman, 2016)

3.4 Web Survey Data Storage and Statistical Analysis

The data were obtained using *SurveyMonkey*, and its management/analysis was performed using software package, IBM SPSS Statistics 25. The survey generated a total of 115 responses from the *SurveyMonkey*, then transferred to SPSS, screened and cleaned following the Field (2018) guide to recode the negatively worded variables. This data cleaning and screening results in the removal of five responses for participants ticked not interested in participating in the survey. The generated SPSS data file with 110 responses was carefully handled, and the variables with missing values undergone five-step multiple imputation, which formed the complete data file (van Ginkel, & van der Ark, 2005; Schlomer, Bauman & Card, 2010).

The SPSS package was used to perform both descriptive and inferential statistics. Therefore, it performed the non-parametric statistical analysis tests, Pearson Chi-squared Statistics (Field, 2018), and Multinomial Logistic Regression (Smith & McKenna, 2013; Osborne, 2014; Osborne, 2016) for the test of variables significant differences and relationships among the participants. These analysis procedures were chosen because the study variables were in nominal and ordinal levels of measurements with more than two levels (Osborne, 2014; Field, 2018). All statistical results, figures, and tables were presented in chapter four, according to the American Psychological Association (2010) preference.

3.5 Interview Data Storage and Analysis

The software package, NVivo 12, was used for qualitative data storage and analysis. All the audio-recorded interviews were transcribed and typed in a Microsoft word document (see Appendix F, Bryman, 2016). The transcripts were In vivo coded by subjecting them to NVivo 12 for thematic analytical evaluation so that to enable the using of participants' own words in discussion (Saldaña, 2016; Adu, 2019). This thematic analysis resulted in developing four key themes of this study. The generated themes served as the synthesised interviewees' responses as opposed to the asked questions. Therefore, the detail qualitative data analysis and results are presented in chapter five.

3.6 Chapter Conclusion

In conclusion, this chapter concluded that citizen science is one of the viable options for addressing Langstone Harbour coastal and marine conservation issues. These challenges cannot be addressed by professional scientists alone due to the inaccessibility, scale, and variety of the environment. The concept of citizen science will help scientific research to cover a substantial temporal and spatial scale. However, there is a lack of research on public interest in

participating in citizen science projects. Therefore, mixed research method was used to generate data from the general public on their interest in citizen science. These data were analysed using statistical and qualitative data analysis packages for revealing the public level of interest.

CHAPTER FOUR:

QUESTIONNAIRE RESULTS AND ANALYSIS

4.0 Familiarity, Interest and Confidence in Coastal and Marine Citizen Science and Participant Motivations

4.1 Introduction

This chapter presents and analyses the quantitative responses gained from the web survey, which was completed by different coastal and marine users around Langstone Harbour in June and July 2019. It uses both descriptive and inferential statistics to analyse the data collected. The data were presented in a graphical and statistical form to identify the level of interests of potential volunteers in participating in coastal and marine citizen science, their familiarity with citizen science and behavioural trends as well as to aid in interpretation and discussion. Also, the chapter uses the questionnaire headings to set out the different sections in it, and they corresponded to both the overarching project aim and specific objectives.

4.2 Characteristics of Participants

To fully understand the participants of this study, their characteristics which include: age group, gender, level of education, area of living, organisations/clubs and professional titles were all presented as frequencies and percentages in this section.

4.2.1 Participants' Age Group

Of the study population, 23% were at the age-group of 25 – 34 and 19% in their 65 – 74 (Figure 4.1). The mean age of the participants comes to 3.95, which could be interpreted as 45 – 54 age group. This mean age is consistent with Martin *et al.* (2016b). Besides, most of the respondents were younger people in their 20s and older personalities in 60s. These findings correlate favourably with Lewandowski *et al.* (2017), and contrast McAuliffe (2011) and Allen (2015), whose majority of the respondents around Langstone Harbour were more likely to be older only.

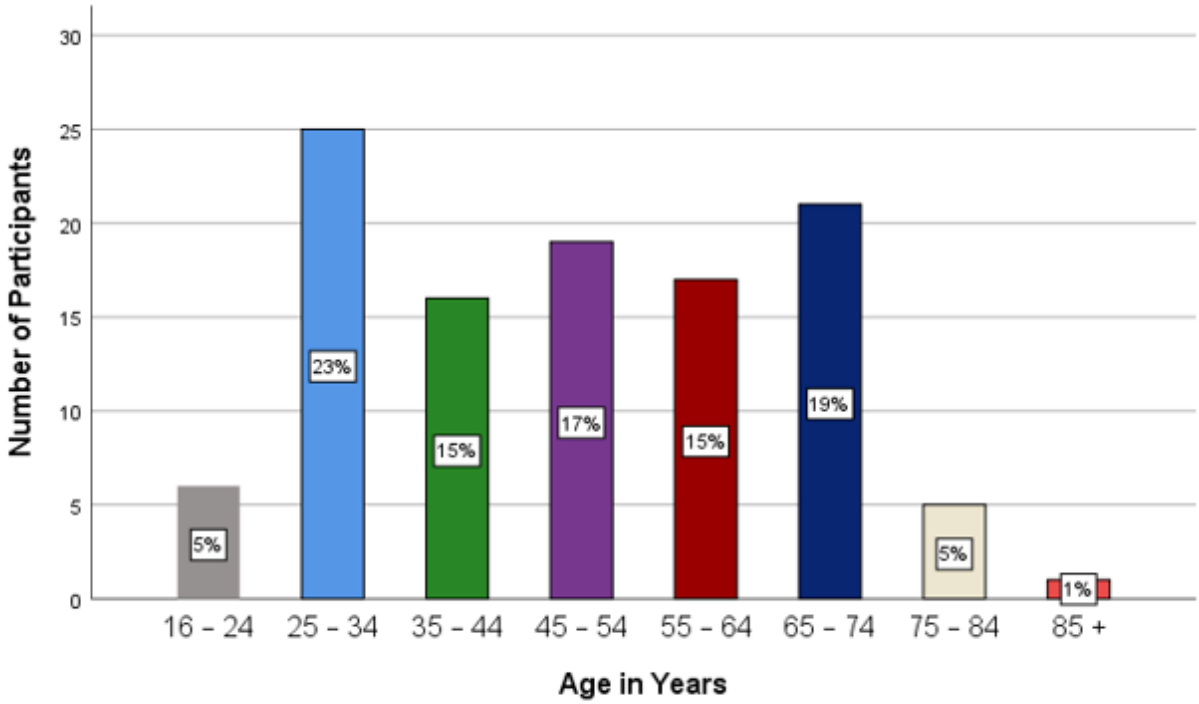

Figure 4.1. Age group of participants. N = 110.

4.2.2 Gender of Participants

Of the 110 participants who completed the web survey, approximately two-thirds (68%) were male, and one-third (31%) were female; hardly any, 1%, preferred not to reveal their gender (Figure 4.2). The predominance of male respondents found in this study is in complete agreement with Gray *et al.* (2010), McAuliffe (2011), Foster, (2013), and Allen (2015) who studied stakeholder attitudes and perceptions in coastal and marine environment. However, this result refuted Lewandowski *et al.* (2017) who conducted a similar study in the US and found that most of their respondents comprised of females.

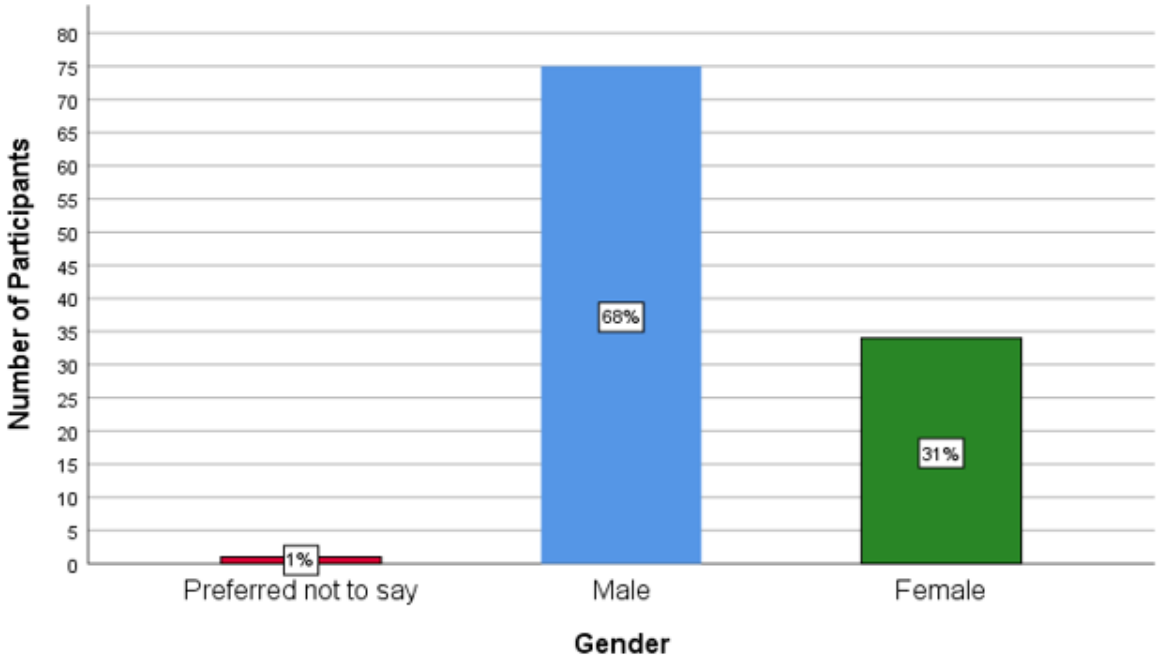

Figure 4.2. Gender of participants. N = 110.

4.2.3 Participants Level of Education and Science Experience

When respondents were asked about the level of education they have completed, 35.5% indicated that they had completed postgraduate education. Surprisingly, the number of those who have completed college, and bachelor's degree were nearly the same, 29.1% and 28.2% respectively. A very few participants (7.3%) completed only secondary school education (Figure 4.3). The participants' level of education was higher than average for the UK populations (Department for Education, 2017). The level of science education was also higher than the UK average (Leonardi, Lamb, Howe, & Choudhoury, 2017) with most respondents (40.9%) studied science after leaving school (Figure 4.4). However, only 31.8% of the participants reported that they were currently practising or working in the science industry (Figure 4.5). These findings have some similarities with Martin *et al.* (2016b) who conducted a similar study in Australia and their participants level of education higher than average Australians.

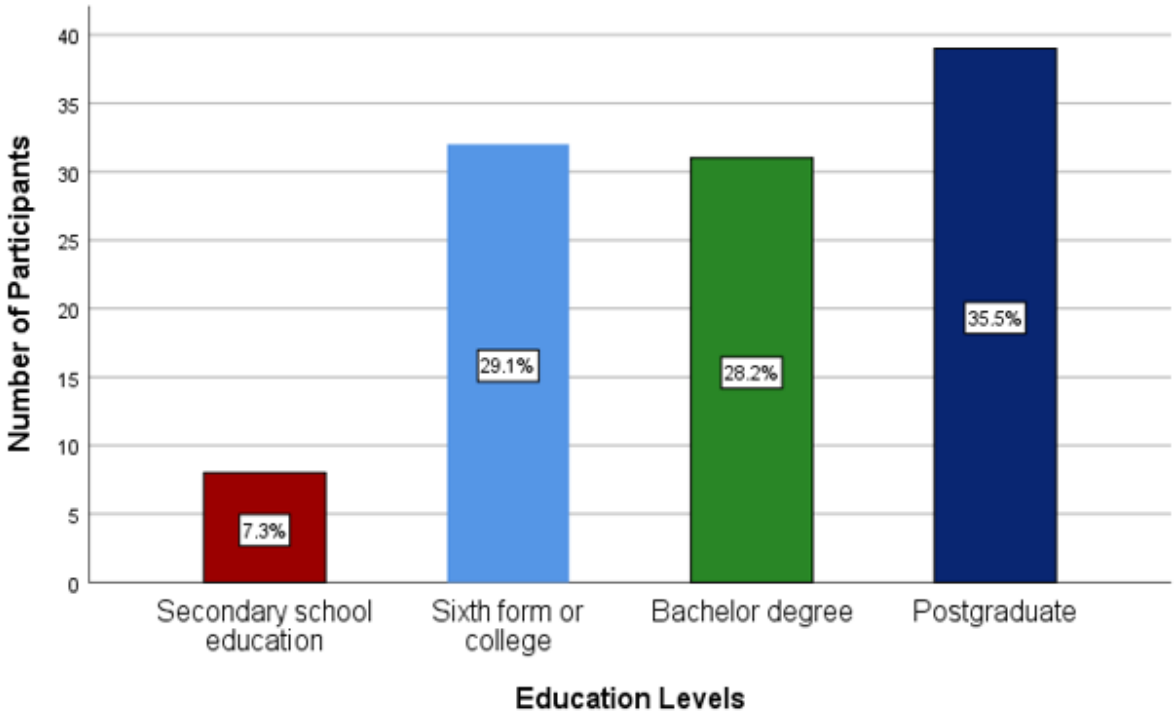

Figure 4.3. Level of education participants have completed. N = 110.

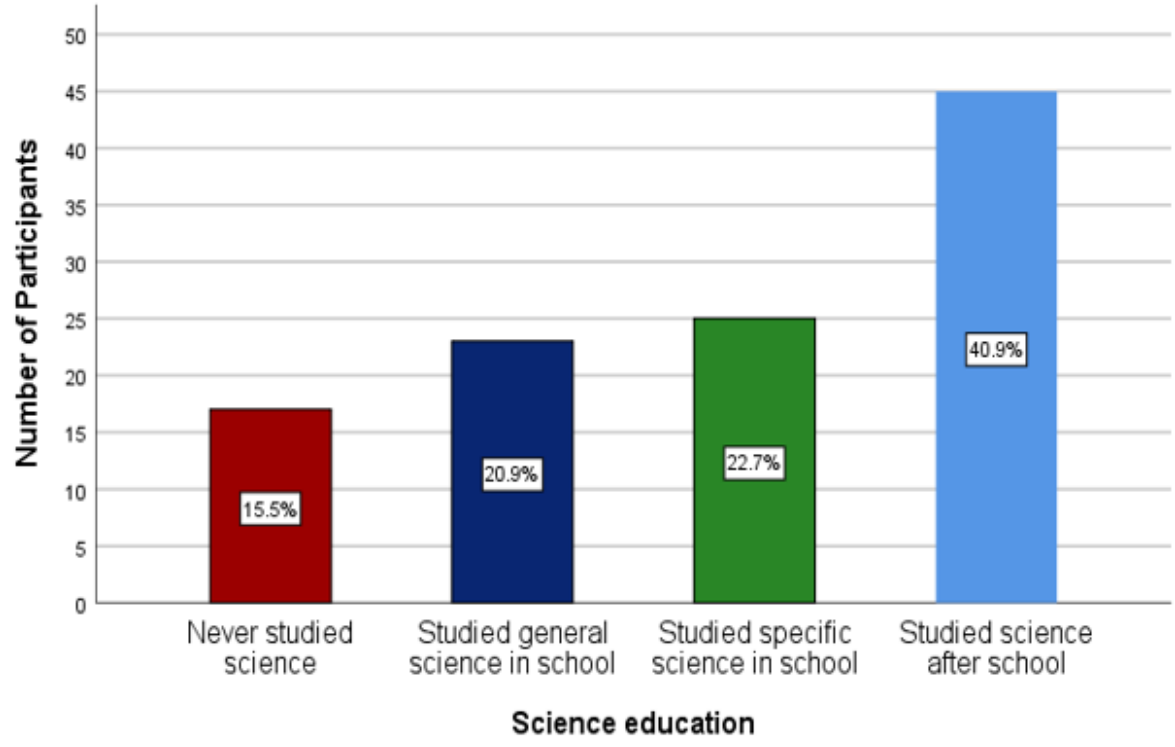

Figure 4.4. Participants level of science education. N = 110.

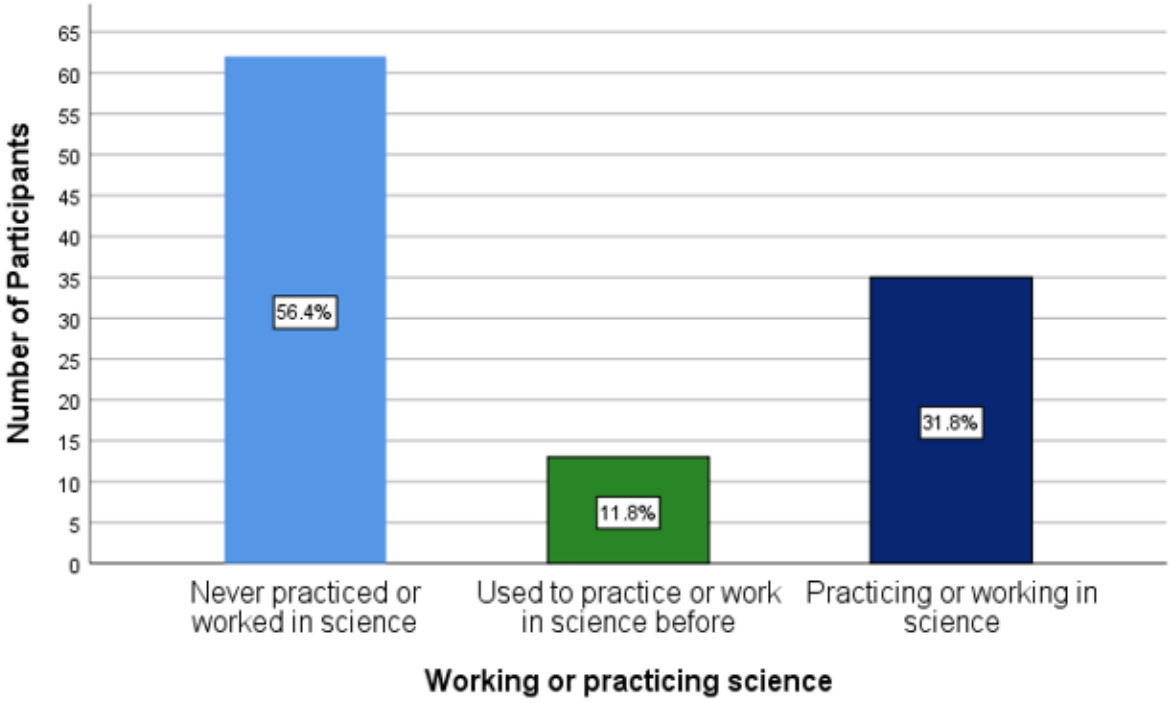

Figure 4.5. Participants experience in working or practicing science. N = 110.

4.2.4 Location Participants Live around Langstone Harbour

Of the 101 participants whose areas of living appeared in the survey, over one-fifth (22.8%) indicated that they are living in Portsmouth, slightly over 16% living in Hayling Island and Farlington each, and 12% in Baffins. Very few participants (almost 7%) residing in Havant, South Hayling, and Langstone each. Whereas residents of Milton (4.0%), and Drayton (3.0%). Hardly any participants are living in Purbrook (2.0%) and Copnor (1.0%, Figure 4.6). Areas reported as others in the survey with one participant each were: Fareham, Horndean, Petersfield, Worthing, Wickham, Gosport, Denmead, Titchfield, Cosham, while two living in Emsworth. Therefore, the survey attracted responses from all over the harbour. The map indicated that response increased with proximity to the harbour (Figure 4.7, Petersfield and Worthing did not appear due to distance). This increase may be due to environmental experiences and concerns, as found in Jefferson *et al.* (2014). This finding is in good agreement with Yu, Cai, Jin, & Du (2018), who found the proximity as one of the factors influencing willingness to pay for marine conservation.

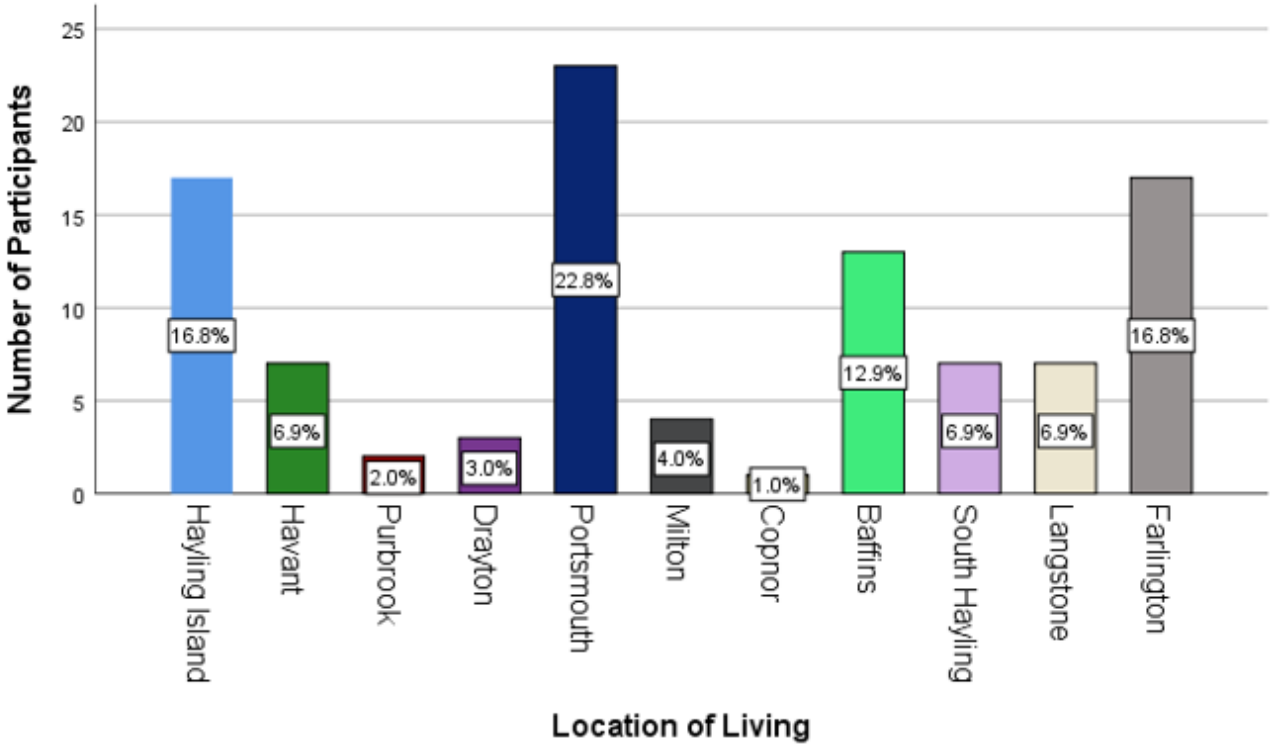

Figure 4.6. Participants' location of living around Langstone Harbour. N = 101.

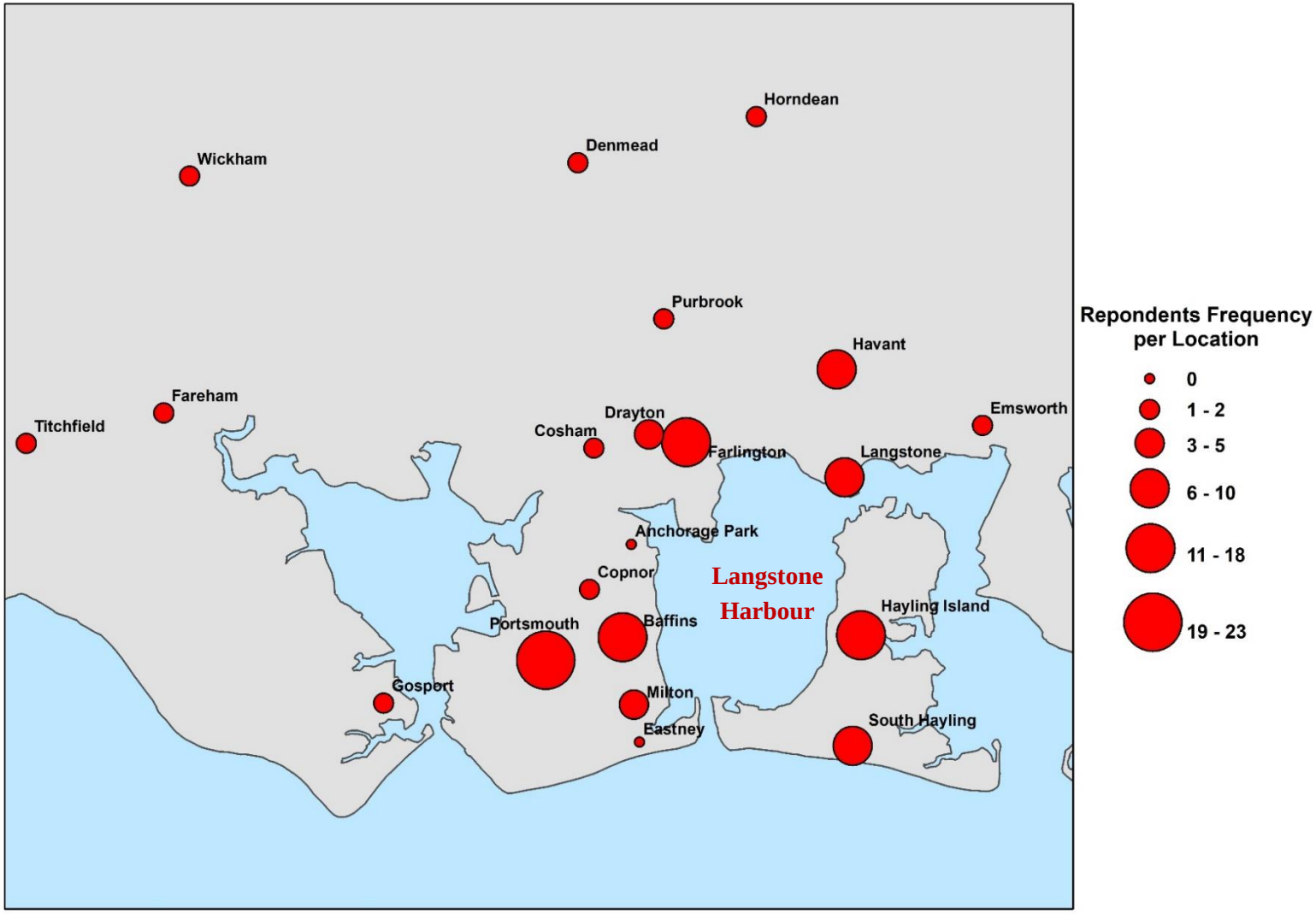

Figure 4.7. Map showing participants' location of living around Langstone Harbour according to responses.

4.2.5 Participants Clubs/Organisations and Professional Titles

When the question was asked about their type of clubs/organisations, there were 177 'Yes responses' (205.8%) because they were given the option to select as many clubs/organisations as possible. Of the 177 responses, the club with the highest response was Sailing/Yachting (36.0%), followed by SCUBA diving (32.6%), Kayaking (30.2%), Birdwatching (30.2%), Snorkelling (27.9%), Swimming (27.9%). The highest response from Sailing/Yachting club types was expected because the club types have a significant number of members across the harbour (LHB, 2019), and it concurred with the findings of Allen (2015). A small minority of participants indicated Cycling (7.0%), motor boating (5.8%), Beach Combing/Walking (4.7%) and Fishing (3.5%) as their types of clubs/organisations (Figure 4.8). Types of clubs/organisations reported as others were: Jet Skiing, Running, Hayling Island Beach Hut Association, Stand-up-paddle boarding, and Hayling Sewage Watch. Besides, the key respondents were Sailors/Yachtspersons (33.7%), Beachcombers/Walkers (29.8%), Kayakers (26.0%) and Swimmers (23.1%, Figure 4.9). These contradicted Martin *et al.* (2016b), who conducted a similar study in Australia and reported Divers and Fishers as the key participants.

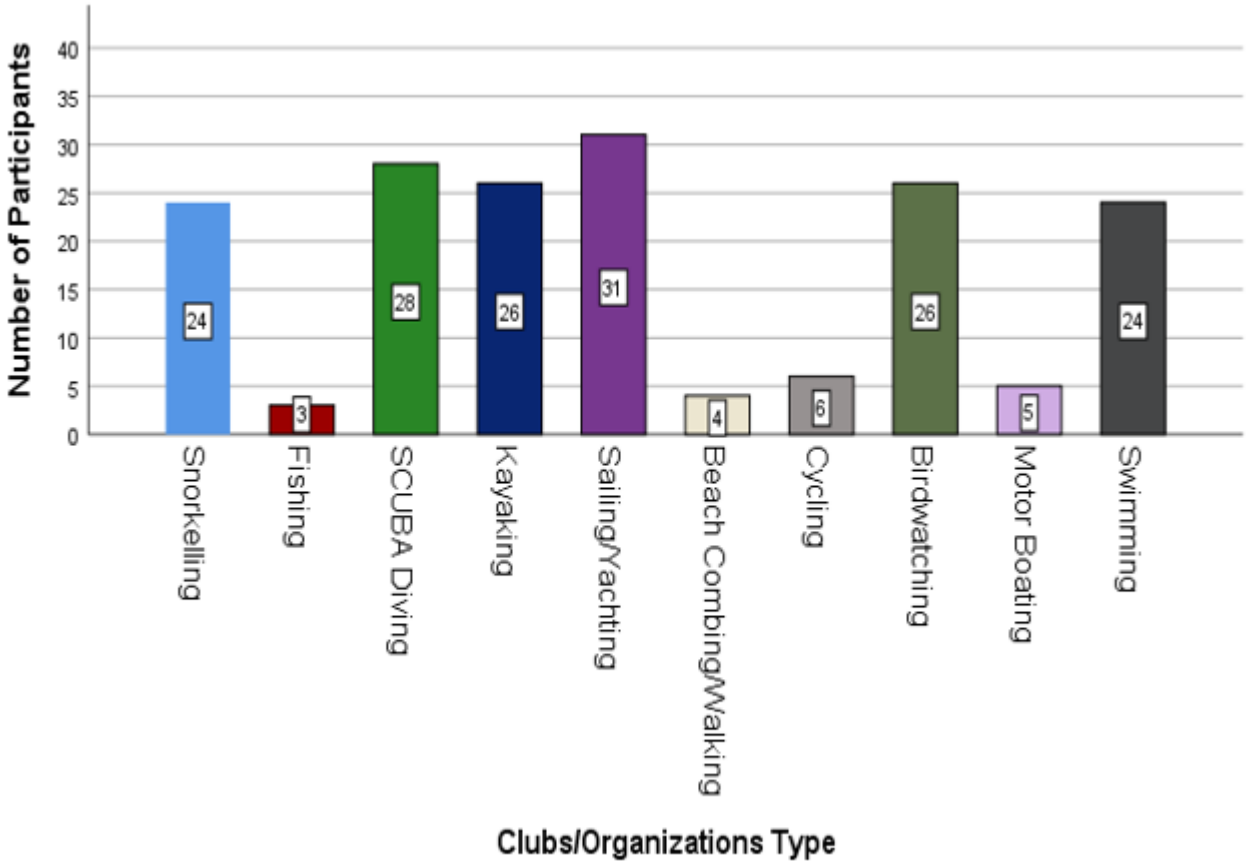

Figure 4.8. Clubs/Organizations participants belong to around Langstone Harbour. N = 177.

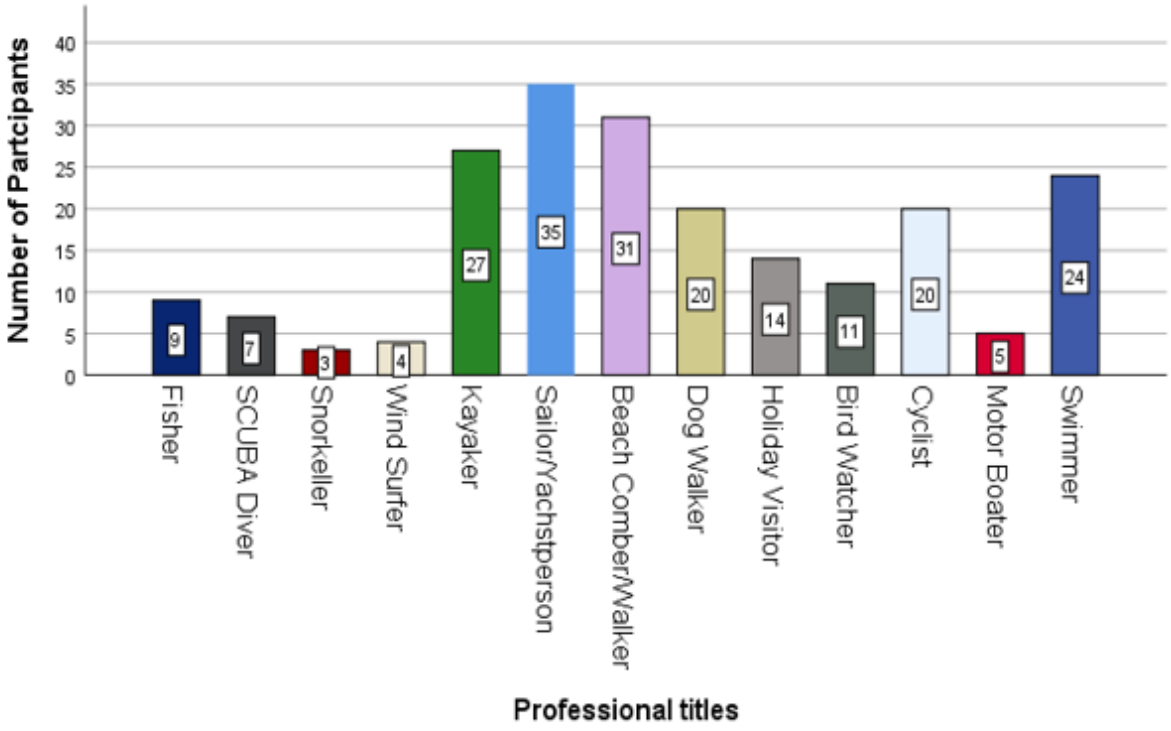

Figure 4.9. Professional titles participants preferred to be described with. N = 210.

4.3 Public Familiarity with Citizen Science

A multinomial logistic regression was performed to model the association between familiarity with citizen-science (knowing the term, recalling it by definition and knowing it in other terms) as dependent variables and the predictors (gender, age, education level, science education, and citizen science experience).

When the question about familiarity with the term citizen science was asked initially, of the 110 participants, 41% indicated that they were familiar with it (Figure 4.10). This value was much higher compared with what reported in Soen and Huyse (2016) and Lewandowski *et al.* (2017). The result of first multinomial logistic regression with knowing the term as dependent variable, χ^2 (34, N = 110) = 57.592, McFadden R^2 = .292, p = .007. The evidence of unique association was made by citizen science experience, and it is the only positive predictor of familiarity with the term (Table 4.1). The statistics indicates that individuals with citizen science experience were more likely to be familiar with the term (Figure 4.11), and it is consistent with Lewandowski *et al.* (2017) found the same result besides higher levels of education.

Over one-third of the participants, 38.4% (n = 86) reported that they recall seeing or hearing the term when they were provided with its definition (Figure 4.10). This result fits well with

Soen and Huyse (2016) and Lewandowski *et al.* (2017). The definition of the term was used as dependent variable in the second regression, χ^2 (34, N = 86) = 58.237, McFadden R^2 = .383, p = .006. The participants' age, level of education and science education revealed evidence of significant unique associations and were the positive predictors of familiarity with the term (Table 4.1). The participants in the 25-34 age group were more likely to recall the term (Figure 4.12). This finding contrasts with Soen and Huyse (2016) who found younger respondents not familiar with citizen-science, and Lewandowski *et al.* (2017) found only experience as a predictor in the second regression. In term of education, participants who studied science after school were more likely to recall the term, as were those with postgraduate degrees (Figures 4.13 & 4.14). These results substantiate previous findings in Martin *et al.* (2016b) and Lewandowski *et al.* (2017).

When provided with other names that occasionally used to describe citizen-science with: community-based monitoring, crowd-sourced science, crowd science, and public participation in scientific research, over half of those responded, 60.0% (n = 80), reported that they were familiar with these terms (Figure 4.11), like what Lewandowski *et al.* (2017) reported. Familiarity with these terms was used as dependent variable in the third regression, χ^2 (34, N = 80) = 53.942, McFadden R^2 = .389, p = .016. In this third regression, participants' gender was the only conspicuous positive predictor of familiarity with citizen-science (Table 4.1). It concurred well with what Soen and Huyse (2016) has put forward. The higher number of males (Figure 4.15) in knowing citizen science with these other terms is not surprising given that other studies have also proposed more males' participation in marine-related activities (Allen, 2015; Martin *et al.*, 2016a; Henry, & Lyle, 2003).

Table 4.1

Predictors' Unique Association in the Multinomial Logistic Regression, Using Three Measures of Familiarity with Citizen Science (Knowing the term, recalling it by definition and knowing it in other terms), n = 110

Familiarity	Gender	Age	Education Level	Science Education	CS Experience	Pseudo R^2
Term	0.979	0.250	0.114	0.501	**0.002	0.292
Definition	0.343	*0.037	*0.010	**0.009	0.163	0.383
Other terminologies	*0.019	0.054	0.203	0.244	0.245	0.389

Note. CS = citizen science. The asterisks indicate significant p-values for the predictors: ***p < 0.001, **p < 0.01, *p < 0.05.

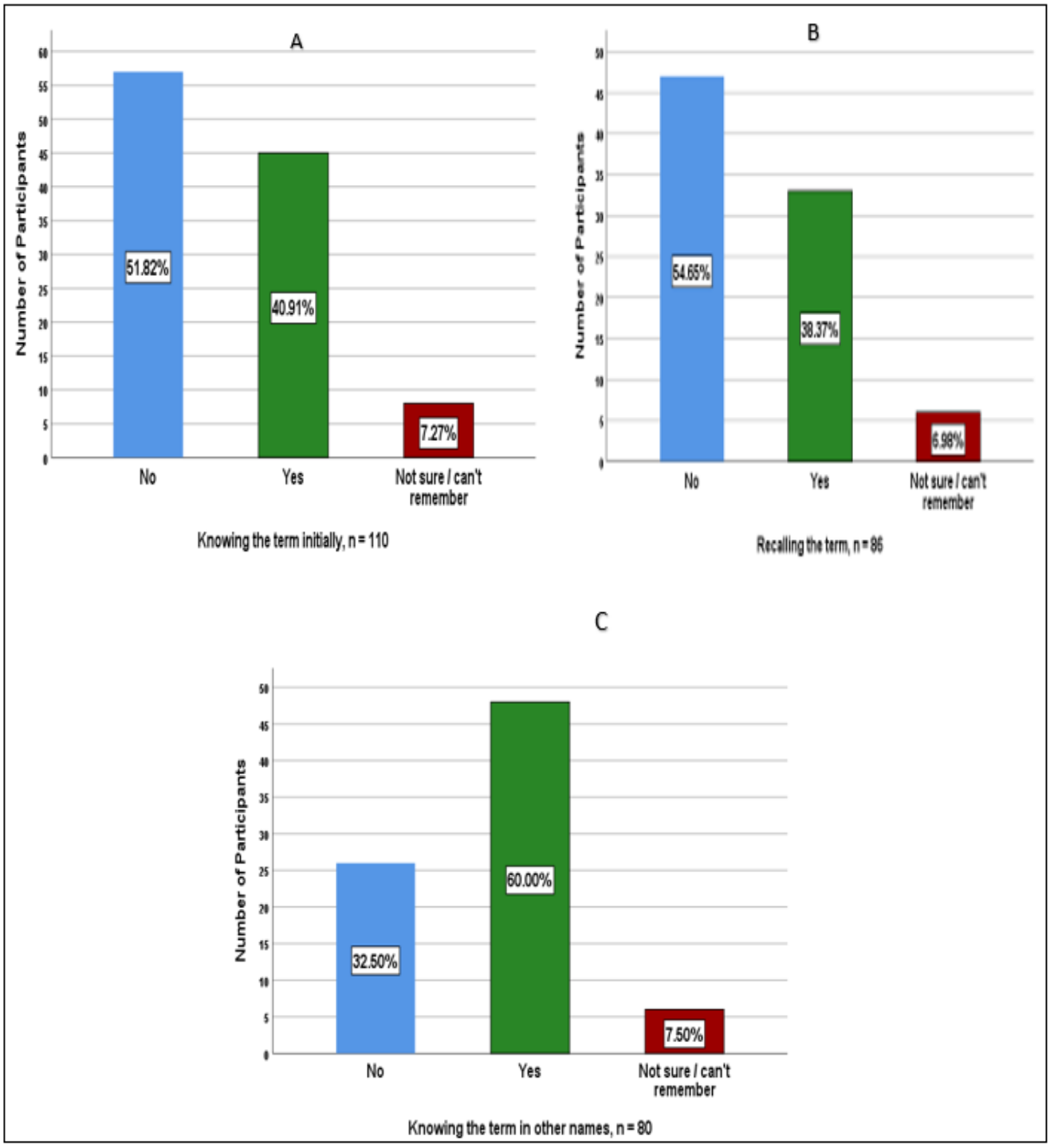

Figure 4.10. Percentage of participants on familiarity with concept of citizen science based on the three measures: **A**. knowing it by seeing or hearing the term; **B.** recalling seeing or hearing the term after being provided with a definition; **C**. familiarity with other similar terms.

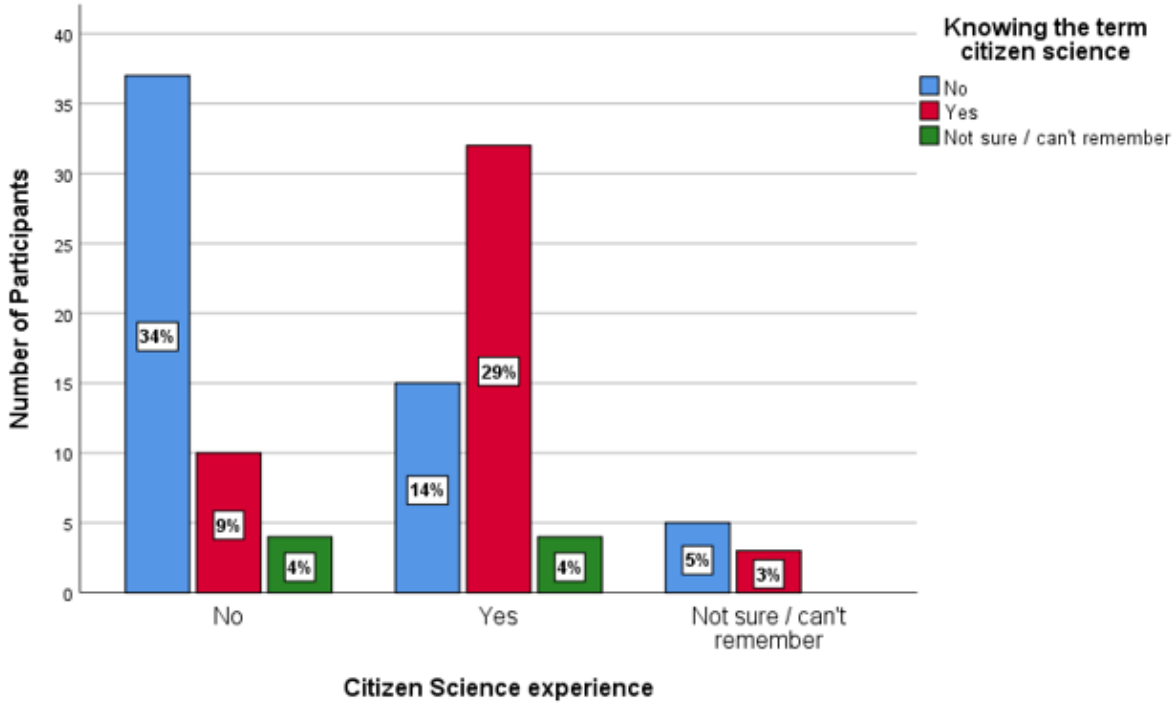

Figure 4.11. Participants familiarity with the term citizen science by experience. N = 110.

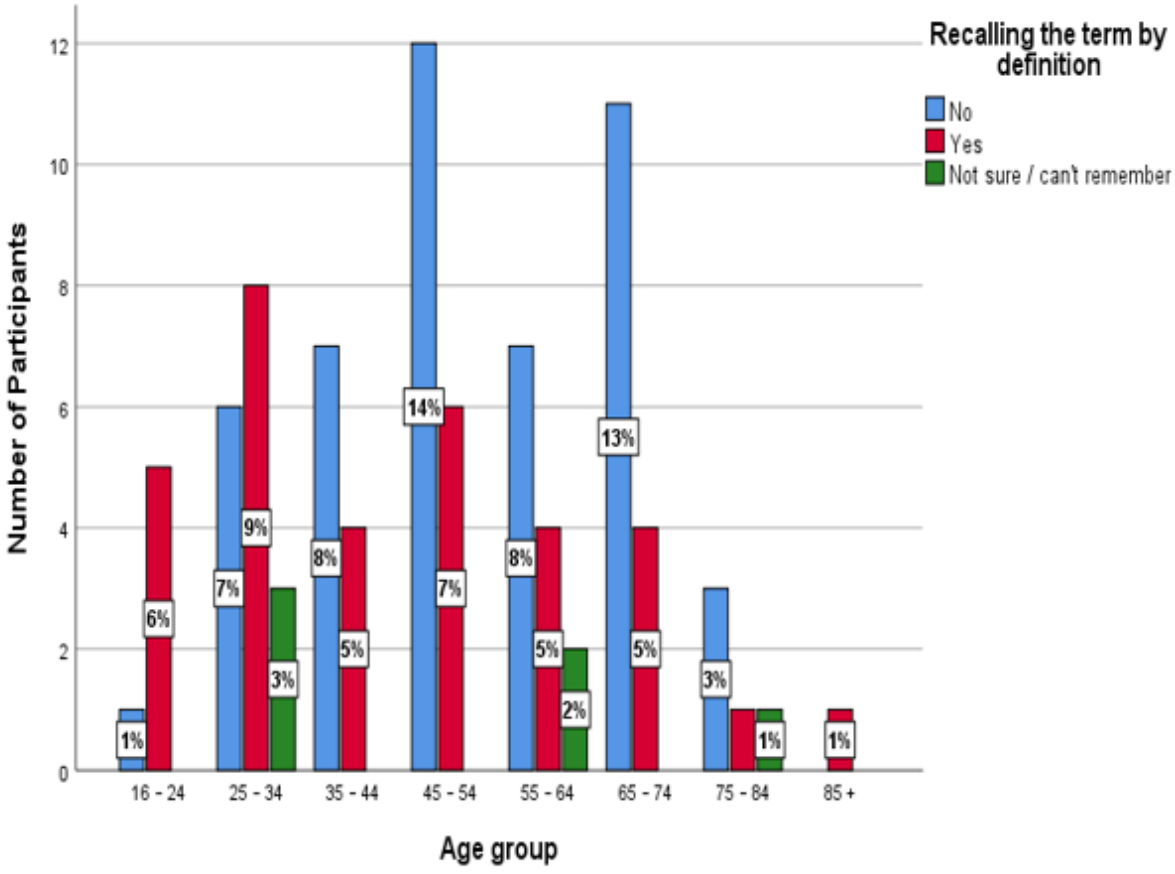

Figure 4.12. Participants recalling the term citizen science by age group. N = 86.

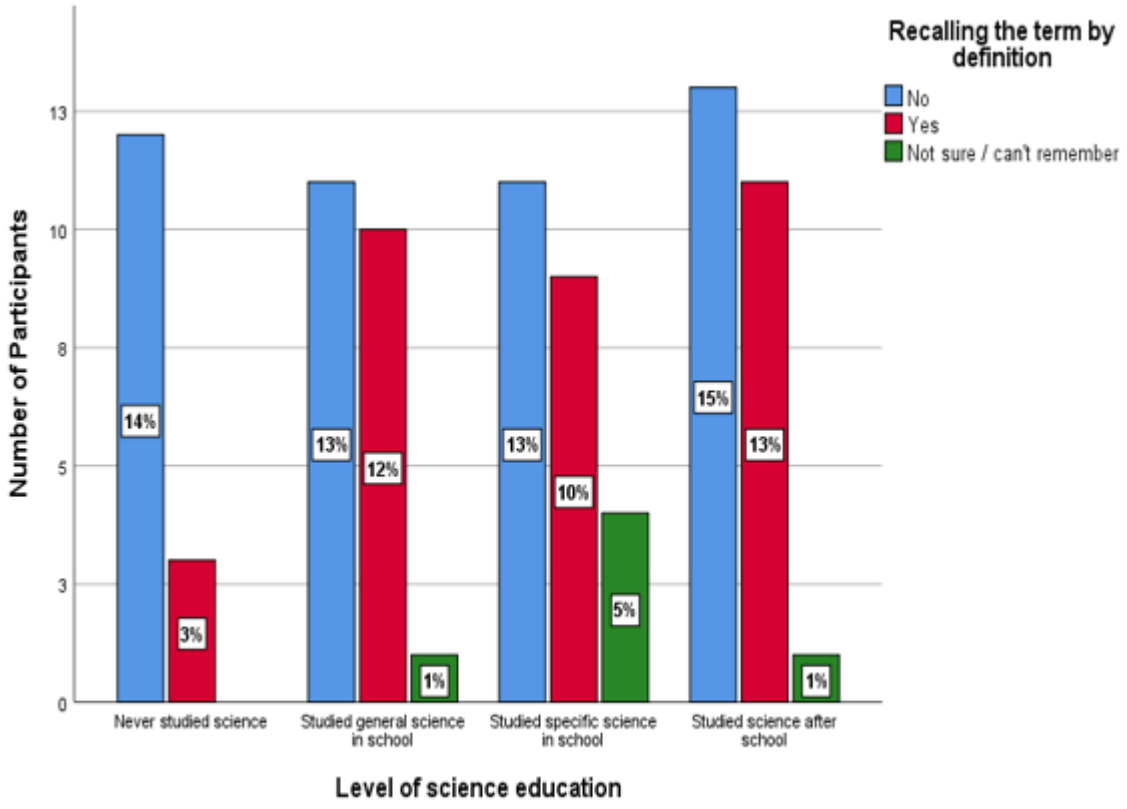

Figure 4.13. Participants recalling the term citizen science by science education. N = 86.

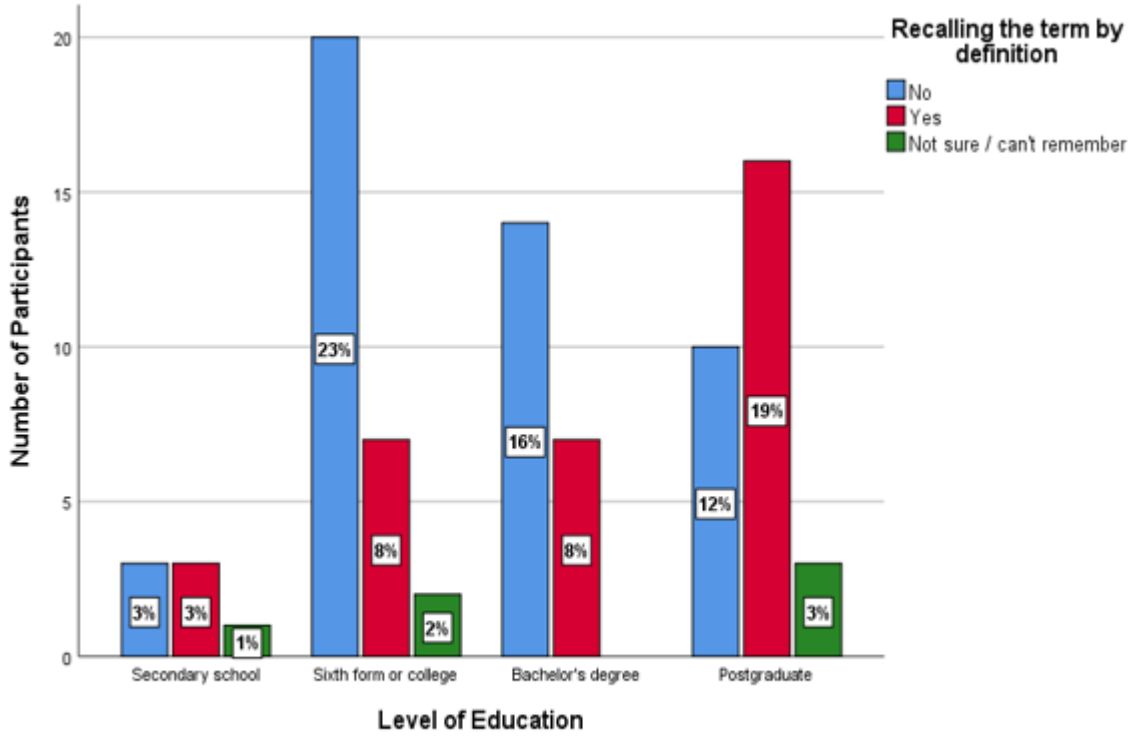

Figure 4.14. Participants recalling the term citizen science by level of education, N = 86.

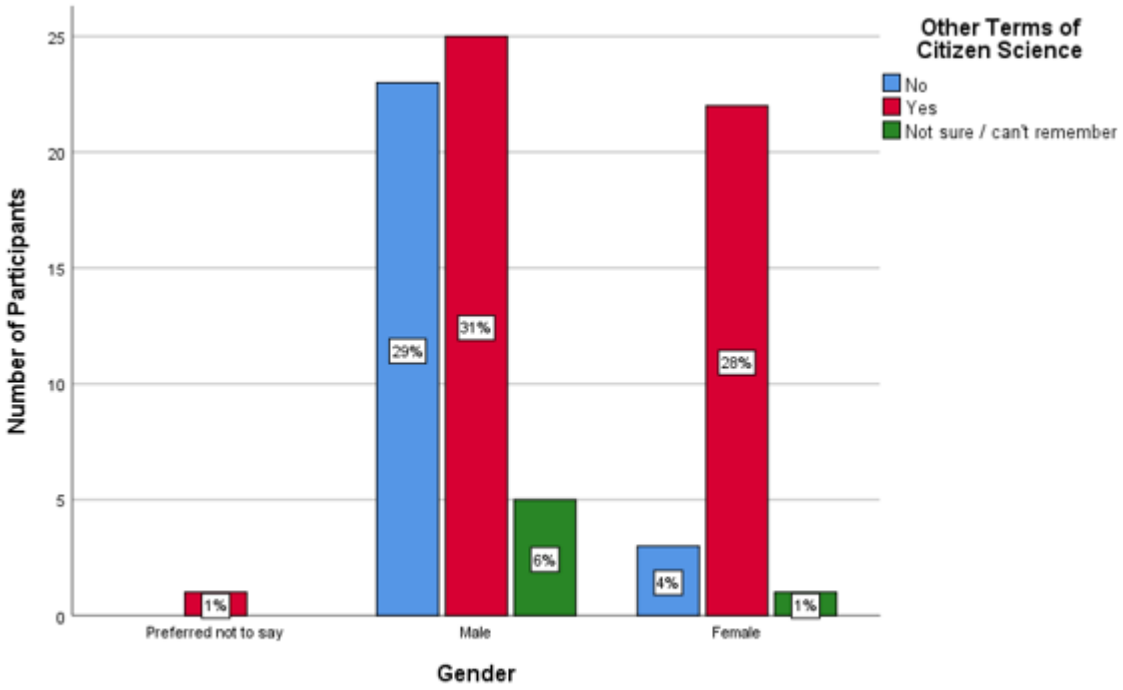

Figure 4.15. Participants knowing other terms of citizen science by gender. N = 80.

4.4 Public Interest in Assisting Coastal and Marine Citizen Science

Chi-square statistics explored the relationship between participants' interest in assisting coastal and marine citizen science research and their level of education. The respondents were asked to indicate how interested they were in assisting and the hours per year they were willing to dedicate in participating in coastal and marine research. They were presented with a 5-point scale (1, *not at all interested;* 5, *interested*) and different times of the year. Also, inferential statistics explored the different level of interests among groups of participants.

4.4.1 Relationship between Interest and Level of Education

For the relationship between interest and level of education, postgraduates were the keenest, as was shown by 38.5% selecting 5, *very interested* and 33.3% selecting 4, *somewhat interested.* Bachelor's degree and college holders were also enthusiastic, as shown by 32.3% selecting 5, *very interested* and 41.9% selecting 4, *somewhat interested*; and 31.3% selecting 5, *very interested* and 43.8% selecting 4, *somewhat interested*, respectively (Figure 4.16). This relationship between education levels and interest in participating revealed that highly educated participants were more likely to be potential volunteers but was not statistically significant (χ^2 = 20.827, df = 12, p = 0.053). However, when participants were asked to indicate their interests in conducting different citizen science tasks, the Chi-squared revealed statistically significant

relationships, where highly educated individuals were very likely to conduct some tasks (Table 4.2).

On the other hand, the relationship between participants' science education and interest in participating was statistically significant (χ^2 = 21.670, df = 12, p = 0.041), with those studied science after school (44.4%) were very interested in assisting (Figure 4.17). They were more likely interested in planning future citizen science and acting as a representative to explain society's conservation concerns (Table 4.3). These results were not unexpected because they concurred thoroughly with the volunteers' profiles in some citizen science projects, for example, Galaxy zoo (Raddick *et al.*, 2009 & 2013) and local parks stewardship activities in Portland (Dresner *et al.*, 2015). They are also in complete agreement with Martin *et al.* (2016b) and Lewandowski *et al.* (2017) findings, who conducted similar studies and found potential participants to be highly educated, particularly in the field of science.

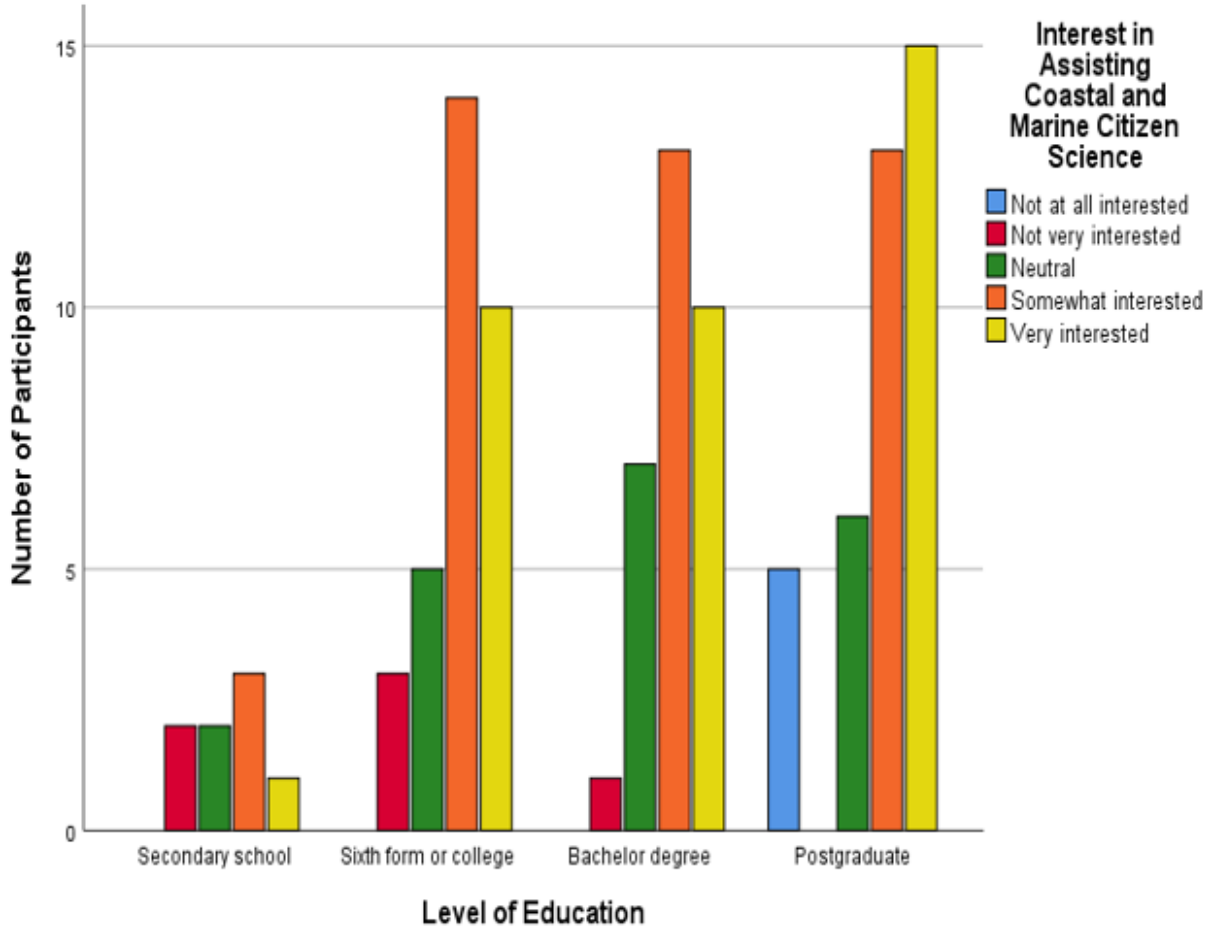

Figure 4.16. Relationship between participants' level of education and interest in participating in coastal and marine research. N = 110.

Table 4.2

Chi Squared (χ^2) Statistics Results for the Relationship Between Participants Interest Level in Conducting Citizen Science Tasks and Their Level of Education, n = 110

Citizen Science Tasks participants interested to get involved	***df***	***Chi square (χ^2)***	***P-value***
Helping to process information	12	8.940	0.708
Helping to communicate the findings	12	23.763	0.022*
Helping to plan coastal and marine CS	12	21.223	0.047*
Helping to decide where to spend fund	12	9.899	0.625
Collecting data for professional scientists	12	16.065	0.188
Helping to analyse the findings	12	11.611	0.477
Helping to decide CS future topic to focus	12	22.110	0.036*
Acting as a representative to explain society's concerns on coastal and marine CS	12	23.086	0.027*

*Note: The asterisks indicate significant p-values: ***p < 0.001, **p < 0.01, *p < 0.05, CS – Citizen science, df – degree of freedom*

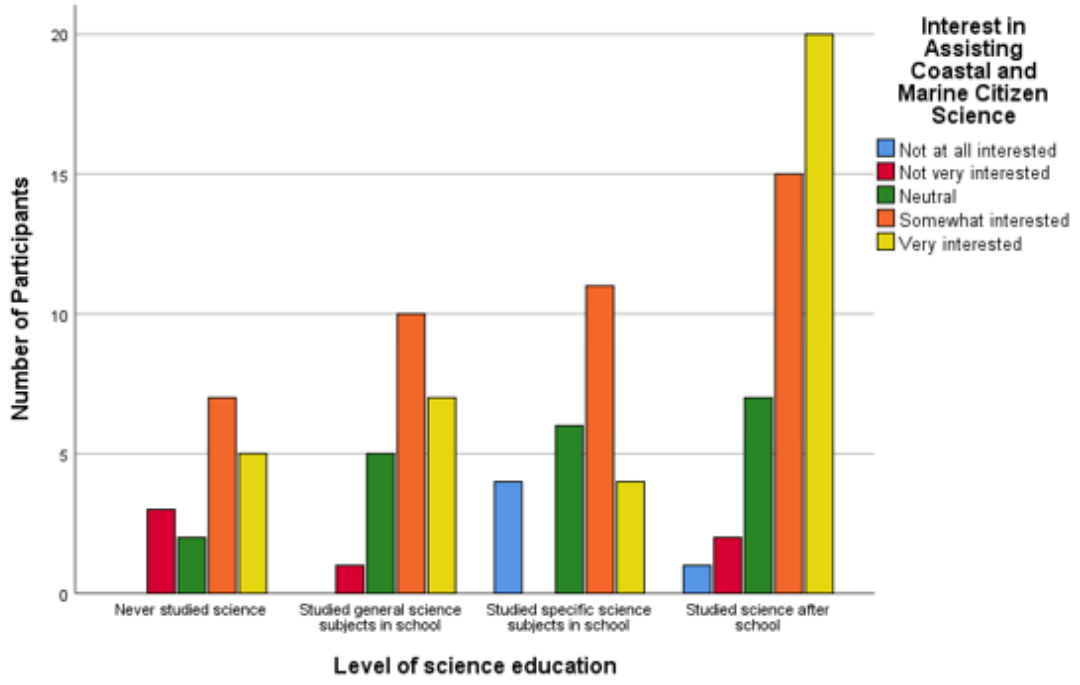

Figure 4.17. Relationship between participants' science education and interest in participating in coastal and marine research. N = 110.

Table 4.3

Chi Squared (χ^2) Statistics Results for the Relationship Between Participants Interest Level in Conducting Citizen Science Tasks and Their Level of Science Education, n = 110

Citizen Science Tasks participants interested to get involved	***df***	***Chi square (χ^2)***	***P-value***
Helping to process information	12	19.275	0.082
Helping to communicate the findings	12	18.029	0.115
Helping to plan coastal and marine CS	12	26.553	0.009**
Helping to decide where to spend fund	12	11.431	0.492
Collecting data for professional scientists	12	20.607	0.056
Helping to analyse the findings	12	16.057	0.189
Helping to decide CS future topic to focus	12	16.841	0.156
Acting as a representative to explain society's concerns on coastal and marine CS	12	27.485	0.007**

*Note: The asterisks indicate significant p-values: ***p < 0.001, **p < 0.01, *p < 0.05, CS – Citizen science, df – degree of freedom.*

4.4.2 Relationship between Hours Willing to Dedicate and Level of Education

Chi-square statistics revealed that the majority of the participants who were more likely to dedicate several days for assisting coastal and marine citizen science were highly educated (Figure 4.18), and those who studied science after school (Figure 4.19). These results share similarities with Brossard, Lewenstein and Bonney (2005) who reported that their participants have a positive attitude towards science due to their science background. The results also substantiate Straub (2016) claim that lack of science background is a limitation to volunteer participation and quality of data generated. However, the Chi-square revealed no significant relationship between number of hours to volunteer per annum and level of education (χ^2 = 19.531, df = 21, p = 0.551), as well as science education (χ^2 = 28.331, df = 21, p = 0.131).

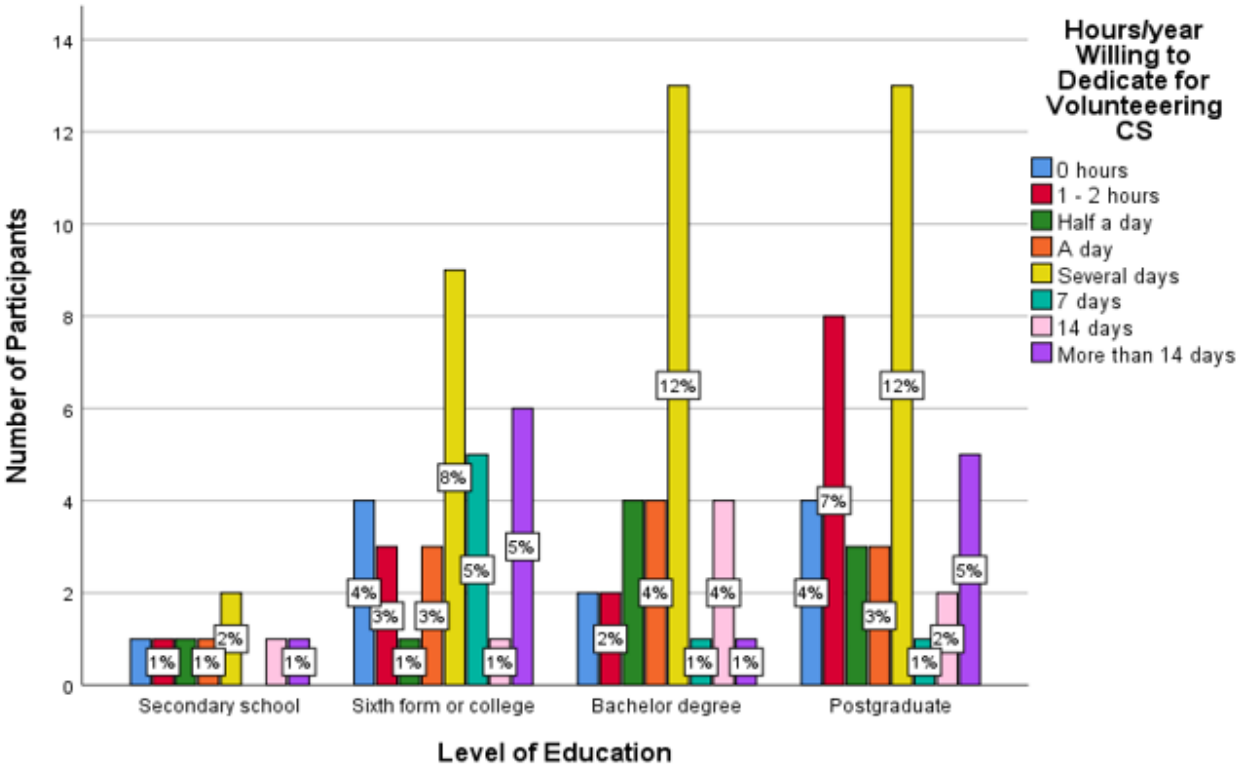

Figure 4.18. Relationship between participants' level of education and hours willing to dedicate for coastal and marine research. N = 110.

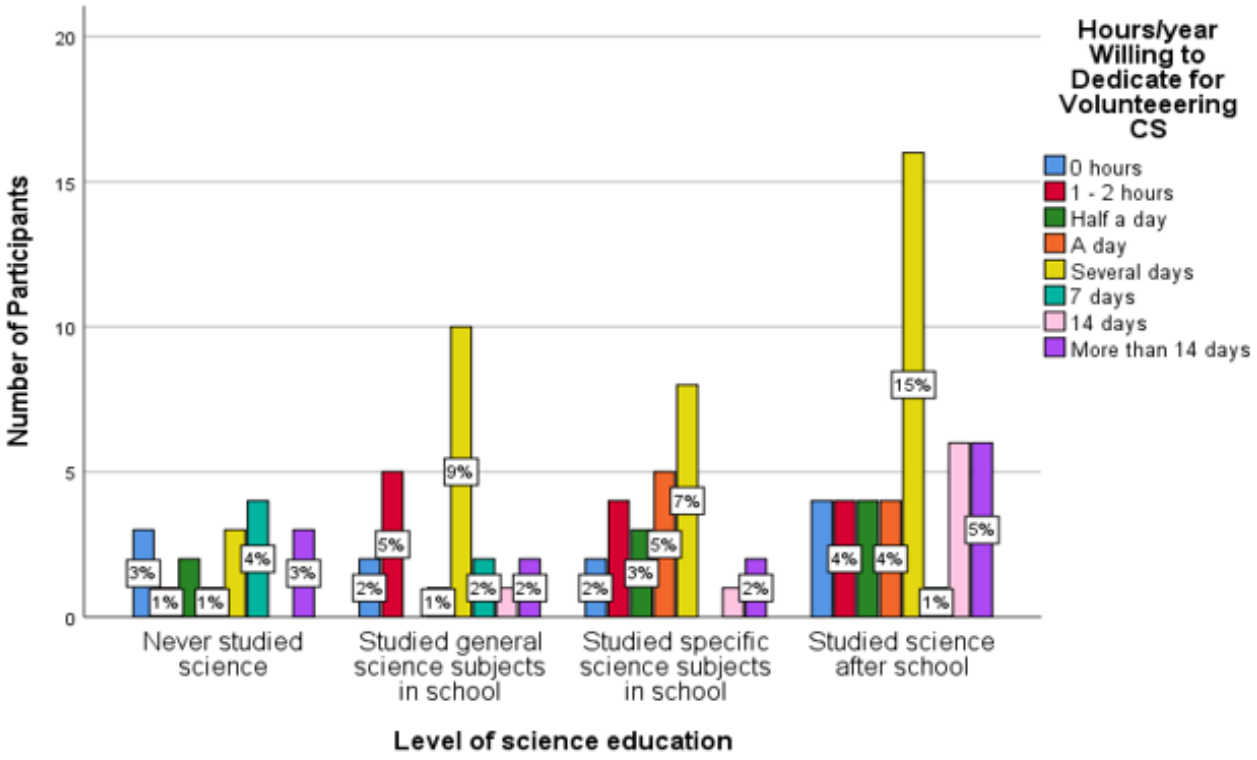

Figure 4.19. Relationship between participants' science education and hours willing to dedicate for coastal and marine research. N = 110.

4.4.3 Participant Groups' Interest in Participating in Citizen Science

The study used inferential statistics to explore the level of interest among participants' groups, using a 5-point scale (1, *not at all interested;* 5, *interested*). Although most responses were in the 4 and 5, Beach walkers were the keenest, followed by Sailors, Kayakers and Swimmers (Figure 4.20). The high level of interest among these groups was also reflected in the considerable time they were willing to dedicate for volunteering. The number of volunteer times among all the groups (except for windsurfers, snorkelers, and fishers) indicated a potentially significant contribution for volunteering. Sailors, Kayakers, Beach and Dog walkers were preferred to offer a significant amount of time per annum (Figure 4.21). The high level of interest and large number of hours willing to dedicate for volunteering among these groups were expected based on the dominance of their activities in Langstone Harbour (Foster (2013; LHB, 2019). However, these findings contradicted that of Martin *et al.* (2016b), who found Divers to be more interested in assisting coastal and marine research in Australian.

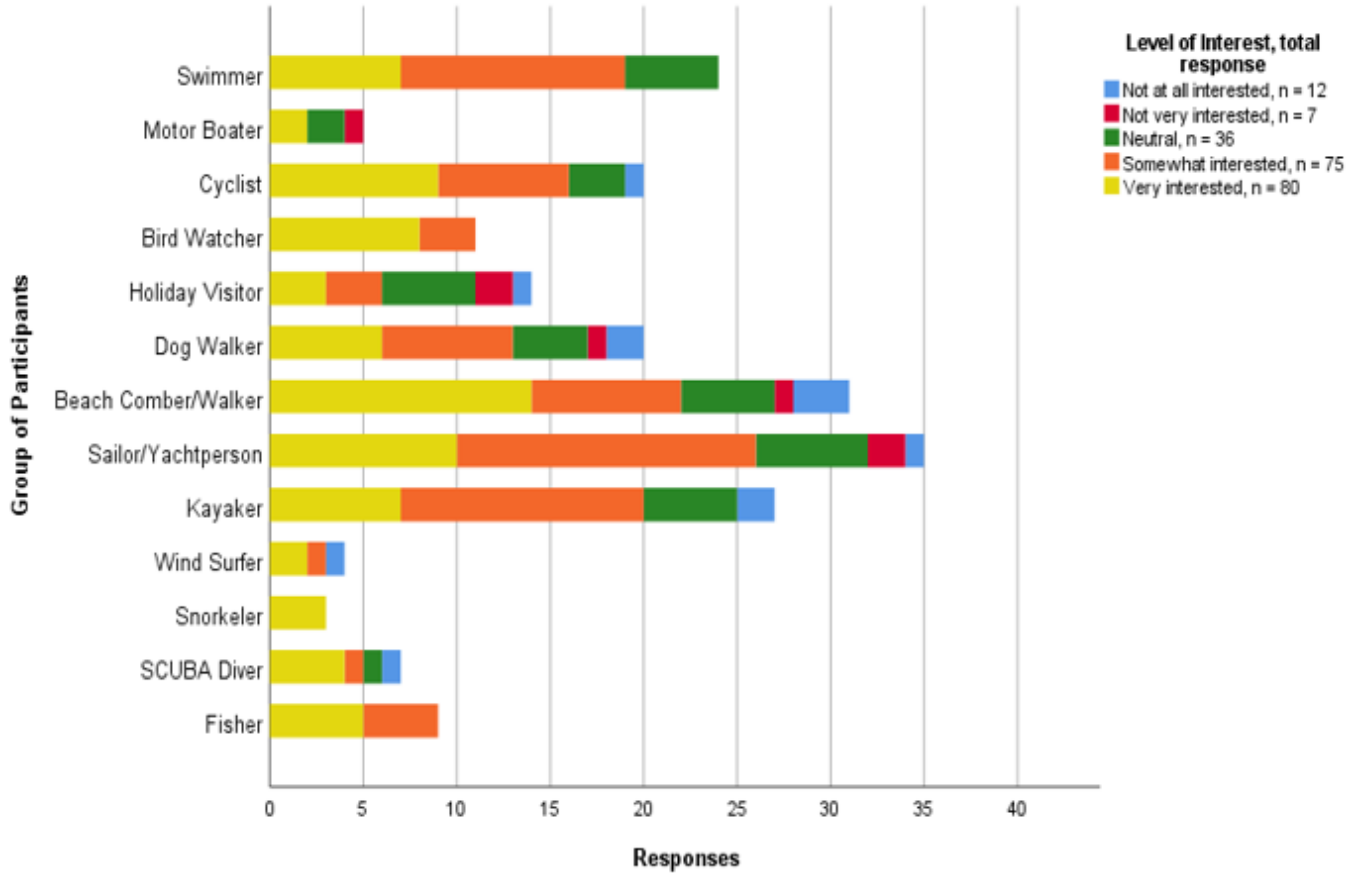

Figure 4.20. Group of participants and their level of interest for assisting coastal and marine research. N = 210.

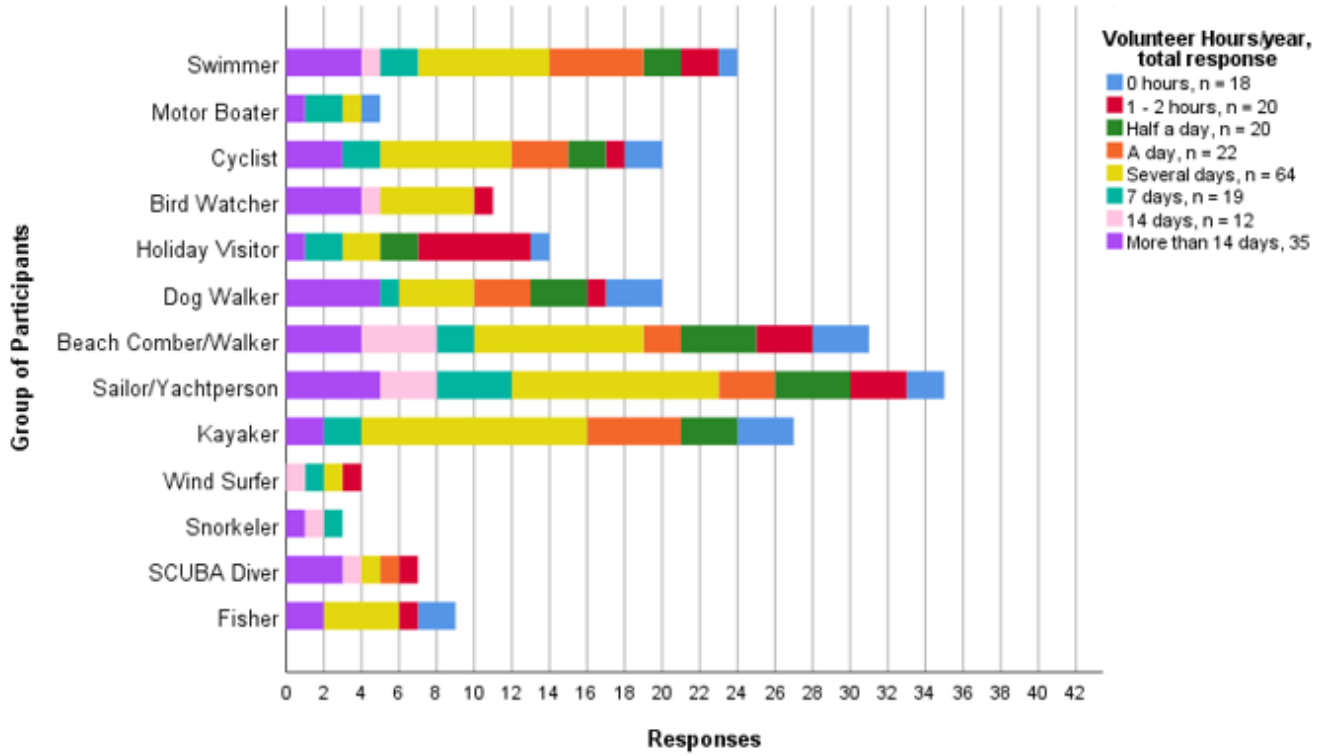

Figure 4.21. Group of participants and volunteer hours per annum willing to dedicate for assisting coastal and marine research. N = 210.

4.5 Public Interest in Conducting Different Citizen Science Tasks

Chi-square statistics (χ^2) explored the relationship between the public level of interest in conducting different citizen science tasks and their demographic status. The participants were presented with a 5-point scale (1, *very unlikely;* 5, *very likely*) to indicate how likely they were to get involved in doing any of the listed tasks.

4.5.1 Relationship between Interest in Conducting Tasks and Gender

The Participants were presented with different citizen science tasks and asked to indicate those interested them and how likely they were to get involved. The respondents were likely (40%) and very likely (25.5%) to get involved in collecting data for professional scientists. The least enthusiastic task was processing information, with 36.36% indicating unlikely to conduct it (Figure 4.22). The chi-square statistics revealed no any statistically significant relationship between the participants' gender and interest in participating in any of the tasks (Table 4.4), this confirms previous findings by Martin *et al.* (2016b). However, there was more enthusiasm among male participants than females in interest in conducting all the tasks. For example, in helping professional scientists to collect data (Figure 4.23), males were (25 and 17%, likely

and very likely respectively) than females (15 and 8%). The prevalence of more males to assist marine research was expected based on similar project findings in Foster (2013) and Allen (2015) within Langstone Harbour. It is also consistent with De la Torre-Castro *et al.* (2017), who found more men to participate in marine activities than women. However, the findings contradicted Lewandowski *et al.* (2017) who claimed that more women were more likely to volunteer in citizen science activities than men in the US. These findings, thus, need to be interpreted with caution because gender differences in conservation activities is subject to cultural, economic and social influences, alongside other variables within a society (Al-Azzawi, 2013).

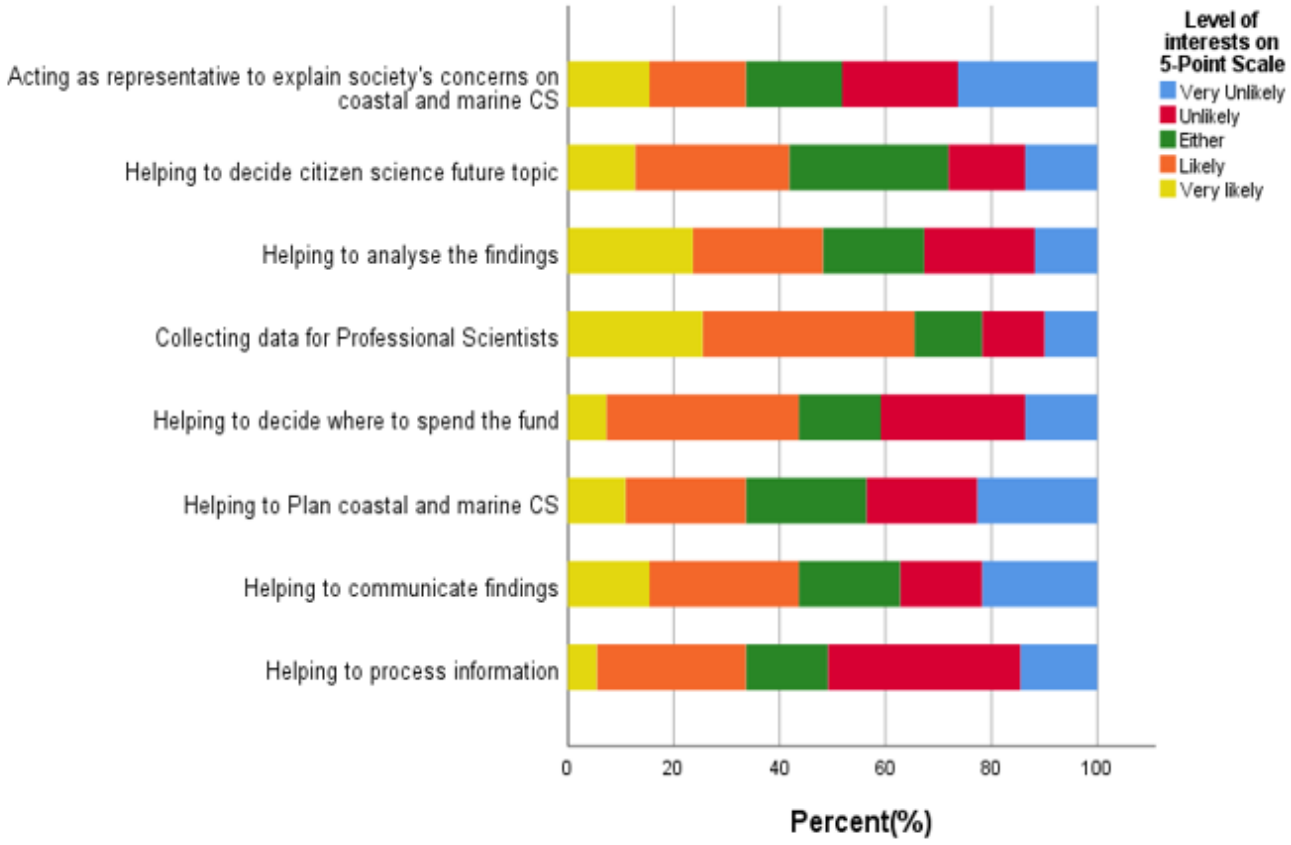

Figure 4.22. Percentages of participants level of interest in conducting coastal and marine citizen science tasks. N = 110.

Table 4.4

Chi Squared (χ^2) Statistics Results for the Relationship Between Participants Interest Level in Conducting Citizen Science Tasks and Their Gender, n = 110

Citizen Science Tasks participants interested to get involved	***df***	***Chi square (χ^2)***	***P-value***
Helping to process information	8	8.778	0.361
Helping to communicate the findings	8	7.961	0.437
Helping to plan coastal and marine CS	8	5.978	0.650
Helping to decide where to spend fund	8	8.081	0.426
Collecting data for professional scientists	8	10.014	0.264
Helping to analyse the findings	8	14.246	0.076
Helping to decide CS future topic to focus	8	6.275	0.616
Acting as a representative to explain society's concerns on coastal and marine CS	8	6.466	0.595

*Note: The asterisks indicate significant p-values: ***p < 0.001, **p < 0.01, *p < 0.05, CS – Citizen science, df – degree of freedom*

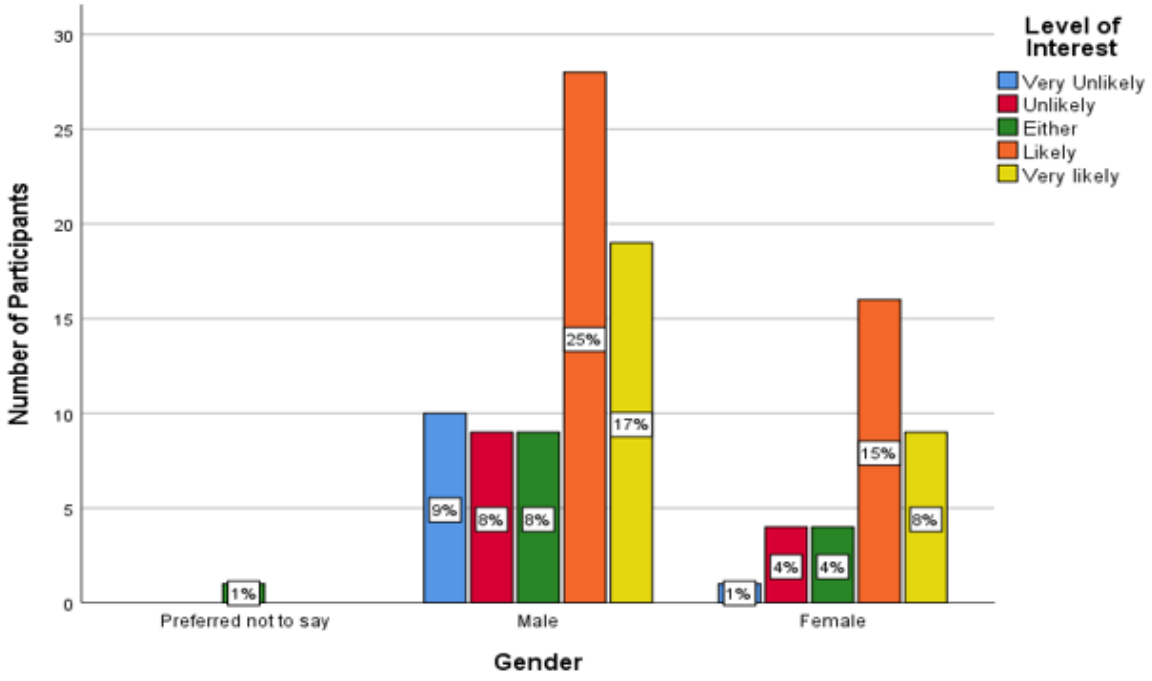

Figure 4.23. Relationship between participants gender and interest in collecting data for professional scientists. N = 110.

4.5.2 Relationship between Interest in Conducting Tasks and Age

In terms of the relationship between interest in conducting tasks and age-group, the result revealed no statistically significant relationship except in acting as representative to explain society's concerns about coastal and marine research (Table 4.5). Surprisingly, within this relationship and in helping to communicate citizen science findings, younger participants in the 25-34 age-group were more likely and very likely to conduct these tasks (Figure 4.24). These results contrasted earlier findings by Martin *et al.* (2016b) and Lewandowski *et al.* (2017) who found that interest in conducting citizen science tasks decreased with age. However, older individuals were more interested in collecting data for professional scientists and analysing findings (Figure 4.25).

Table 4.5

Chi Squared (χ^2) Statistics Results for the Relationship Between Participants Interest Level in Conducting Citizen Science Tasks and Their Age-group, n = 110

Citizen Science Tasks participants interested to get involved	***df***	***Chi square (χ^2)***	***P-value***
Helping to process information	28	35.405	0.158
Helping to communicate the findings	28	26.147	0.565
Helping to plan coastal and marine CS	28	35.165	0.165
Helping to decide where to spend fund	28	40.538	0.059
Collecting data for professional scientists	28	28.737	0.426
Helping to analyse the findings	28	38.944	0.082
Helping to decide CS future topic to focus	28	40.622	0.058
Acting as a representative to explain society's concerns on coastal and marine CS	28	42.846	0.036*

*Note: The asterisks indicate significant p-values: ***p < 0.001, **p < 0.01, *p < 0.05, CS – Citizen science, df – degree of freedom*

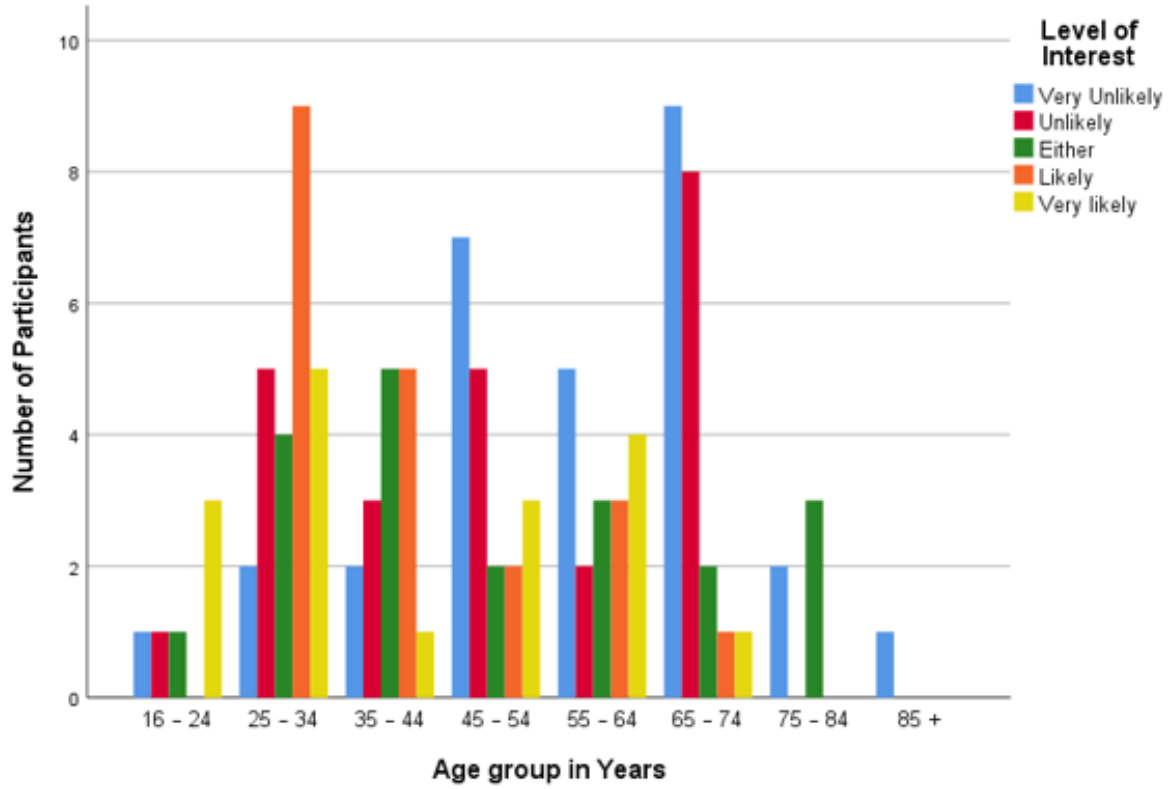

Figure 4.24. Prevalence of younger participants to help act as representative to explain citizen science. N = 110.

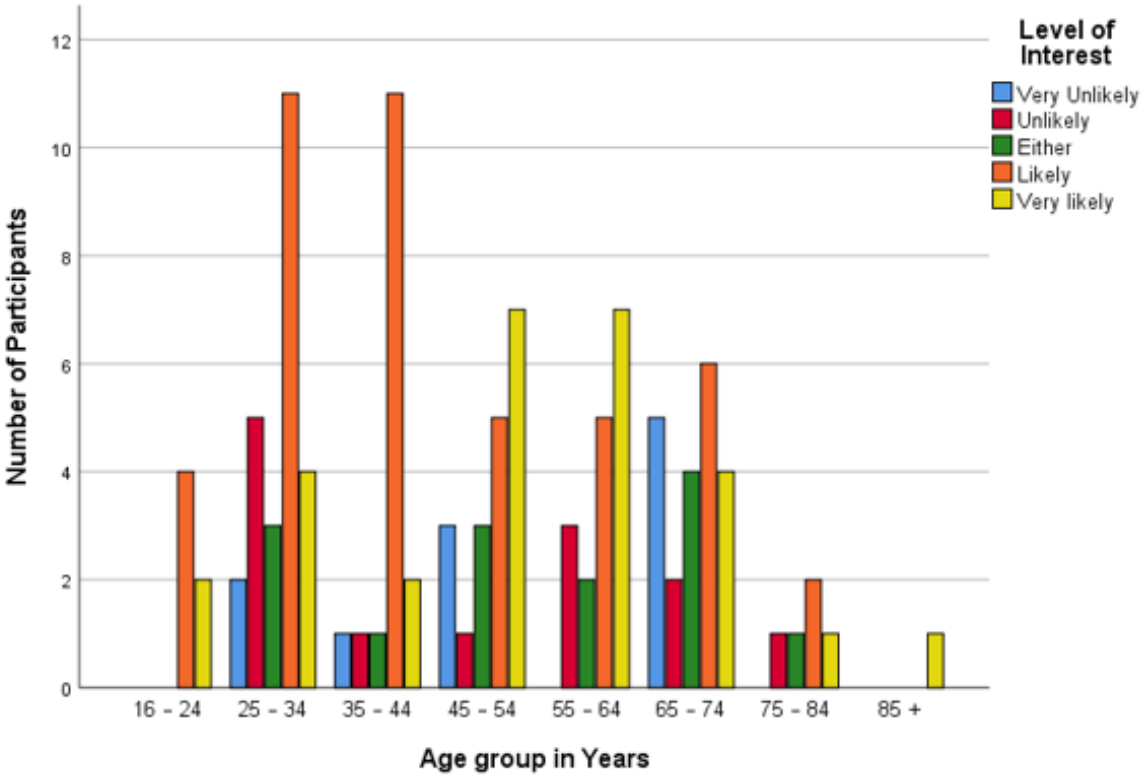

Figure 4.25. Prevalence of older participants to help in collecting data. N = 110.

4.6 Public Confidence in Doing Different Citizen Science Tasks

Chi-square statistics (χ^2) explored the relationship between public confidence in doing citizen science tasks and their demographic status. The participants were presented with a 5-point scale (1, *not confident at all;* 5, *completely confident*), and asked to indicate how confident they would be in doing any of the tasks after receiving instructions about it.

The respondents of this study felt utterly confident in collecting litter (28.2%), recording of incidental sighting at sea (27.3%), and reporting stranded organisms (25.5%). They also felt reasonably confident in monitoring endangered species (40.0%), monitoring water quality (34.5%). The tasks with high response of not confident at all were: monitoring reef (45.5%), identifying organisms (38.2%), and biodiversity survey at night (36.4%, Figure 4.26).

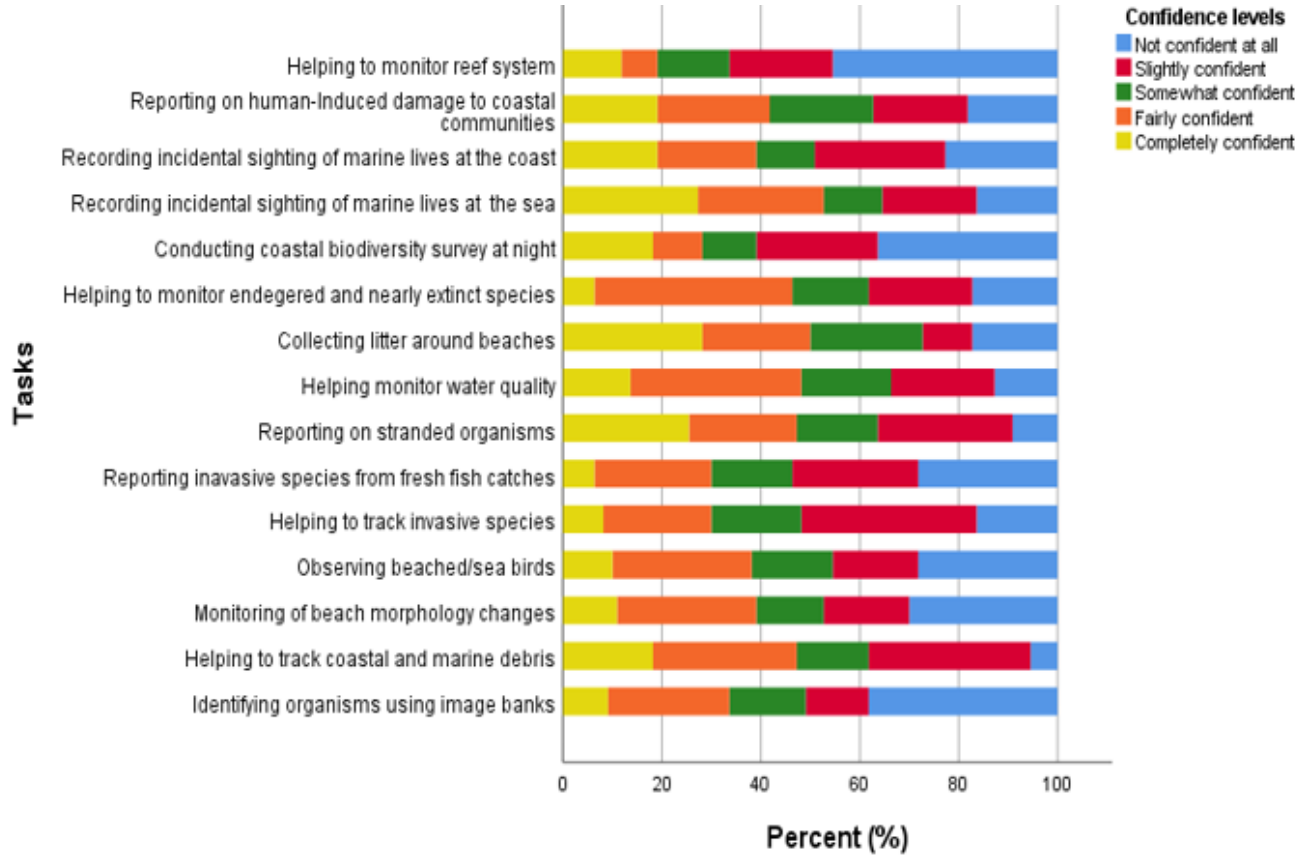

Figure 4.26. Percentages of participants level of confidence in volunteering in coastal and marine citizen science tasks. N = 110.

The chi-square statistics revealed no statistically significant relationship between the participants' gender and confidence in doing any of the tasks (Table 4.6). This result confirms the previous findings by Martin *et al.* (2016b). However, there were more males than females in confidence in doing all the tasks. The prevalence of more males to assist marine research

was expected based on similar projects findings in Foster (2013) and Allen (2015) within Langstone Harbour. It is also consistent with De la Torre-Castro *et al.* (2017) but contradicted Lewandowski *et al.* (2017). However, due care need be paid to interpret these findings because gender difference in conservation activities is subject to cultural, economic and social influences, alongside other variables within a society (Al-Azzawi, 2013).

Table 4.6

Chi Squared (χ^2) Statistics Results for the Relationship Between Participants Confidence Level in Doing Tasks and Their Gender, n = 110

Citizen Science Tasks participants interested to get involved	***df***	***Chi square (χ^2)***	***P-value***
Helping to monitor reef system	8	5.932	0.655
Reporting on human-induced damage to coastal communities	8	5.219	0.734
Recording incidental sighting of marine lives at the coast	8	7.077	0.528
Recording incidental sighting of marine lives at the sea	8	8.848	0.355
Conducting coastal biodiversity survey at night	8	6.055	0.641
Helping to monitor endangered and nearly extinct species	8	6.141	0.631
Collecting litter around beaches	8	9.624	0.292
Helping monitor water quality	8	7.415	0.493
Reporting on stranded organisms	8	4.017	0.856
Reporting invasive species from fresh fish catches	8	9.254	0.321
Helping to tract invasive species	8	4.138	0.844
Observing beached/sea birds	8	7.550	0.479
Monitoring of beach morphology changes	8	9.783	0.281
Helping to track coastal and marine debris	8	6.042	0.643
Identifying organisms using image banks	8	15.505	0.050

*Note: The asterisks indicate significant p-values: ***p < 0.001, **p < 0.01, *p < 0.05, CS – Citizen science, df – degree of freedom.*

In terms of the relationship of participants age-group with confidence in doing any task, chi-square statistics revealed statistically significant relationship only in collecting litter around beaches and monitoring beach morphology changes tasks (Table 4.7). Confidence in

monitoring beach morphology increased with age (Figure 4.27). This finding is consistent with the findings of Foster (2013) and Allen (2015), who reported that older individuals were more likely to show concern for marine conservation within Langstone Harbour. It is also in complete agreement with earlier findings by Martin *et al.* (2016b) and Lewandowski *et al.* (2017) who found that interest in conducting citizen science tasks decreased with age. However, in contrast to earlier findings, younger individuals were utterly confident in collecting litter around beaches than older people (Figure 4.28).

Table 4.7

Chi Squared (χ^2) Statistics Results for the Relationship Between Participants Confidence Level in Doing Tasks and Their Age group, n = 110

Citizen Science Tasks participants interested to get involved	***df***	***Chi square (χ^2)***	***P-value***
Helping to monitor reef system	28	26.977	0.520
Reporting on human-induced damage to coastal communities	28	35.648	0.152
Recording incidental sighting of marine lives at the coast	28	33.953	0.202
Recording incidental sighting of marine lives at the sea	28	36.964	0.120
Conducting coastal biodiversity survey at night	28	39.112	0.079
Helping to monitor endangered and nearly extinct species	28	30.727	0.329
Collecting litter around beaches	28	45.131	0.021*
Helping monitor water quality	28	31.773	0.284
Reporting on stranded organisms	28	26.409	0.551
Reporting invasive species from fresh fish catches	28	30.820	0.325
Helping to tract invasive species	28	36.317	0.135
Observing beached/sea birds	28	29.016	0.412
Monitoring of beach morphology changes	28	42.946	0.035*
Helping to track coastal and marine debris	28	29.910	0.368
Identifying organisms using image banks	28	18.307	0.918

*Note: The asterisks indicate significant p-values: ***p < 0.001, **p < 0.01, *p < 0.05, CS – Citizen science, df – degree of freedom*

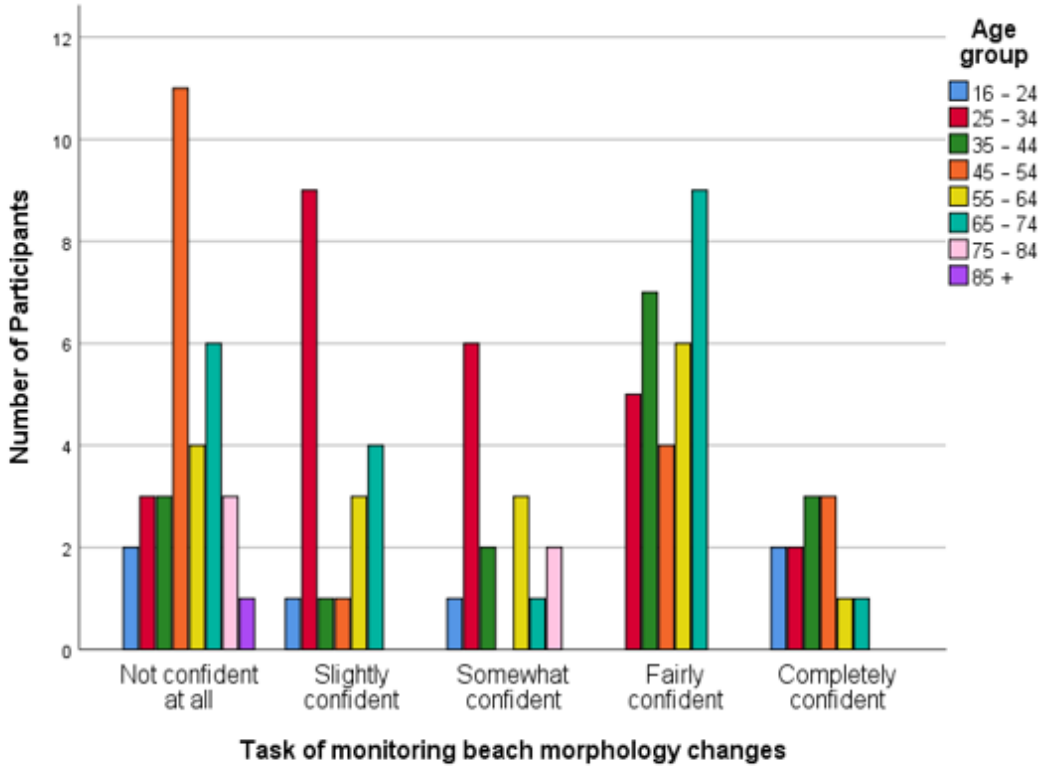

Figure 4.27. Confidence of older participants in monitoring beach morphology data. N = 110.

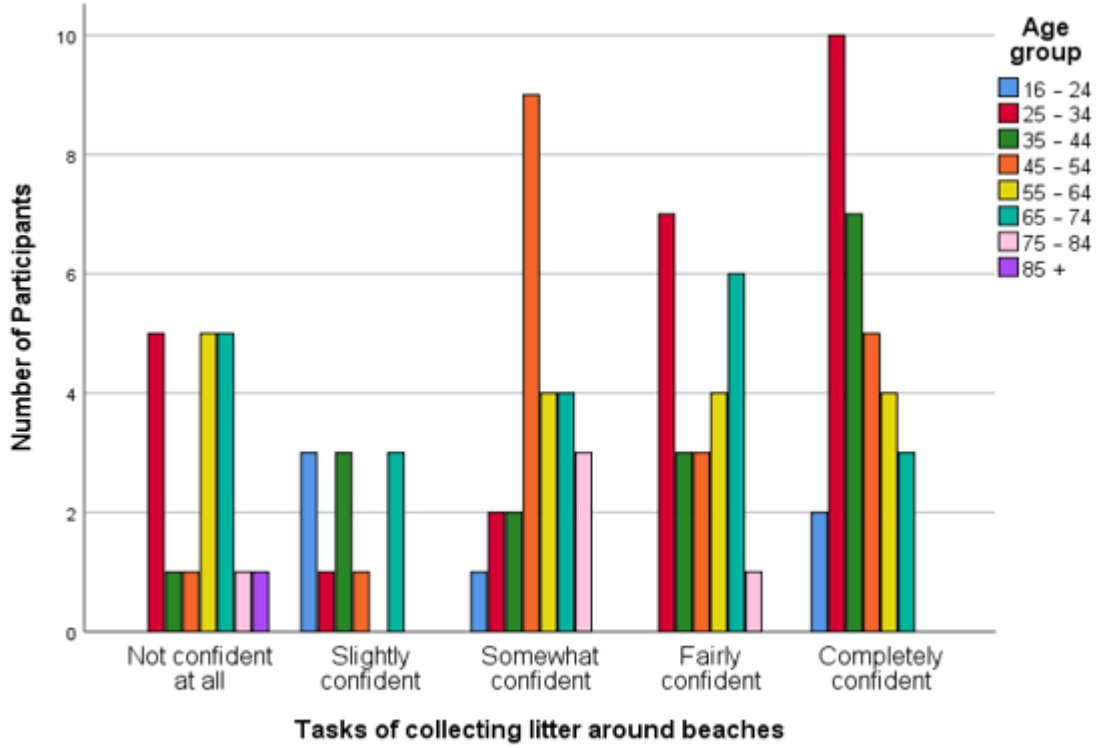

Figure 4.28. Confidence of younger participants in collecting litter around beaches. N = 110.

4.7 Importance of Coastal and Marine Environment

The remarkable result that emerged from this study was that all the group of participants, especially Sailors, Beachcombers and Kayakers, indicated that the coastal and marine environment was essential in their lives (Figure 4.29). When asked to what extent conserving the environment will improve their quality of life, these groups were the highest to report that 'to a very great extent' (Figure, 4.30).

Similarly, when asked whether '*decline in the health of coastal and marine environment would personally affect them*', agree and strongly agree responses were very high among all the participants, notably those groups (Figure 4.31). As was expected, the participants' experience and uses of this environment will influence their pro-environmental behaviour towards it (Miller, 2005; Bögeholz, 2006; Jefferson *et al.*, 2015). The findings are barely distinguishable from Martin *et al.* (2016b) who found similar pro-environmental behaviours among their participants in Australia, likewise, those found in the UK by Jefferson *et al.*, (2014), Spence, Pidgeon and Pearson (2018), and Easman *et al.*, (2018).

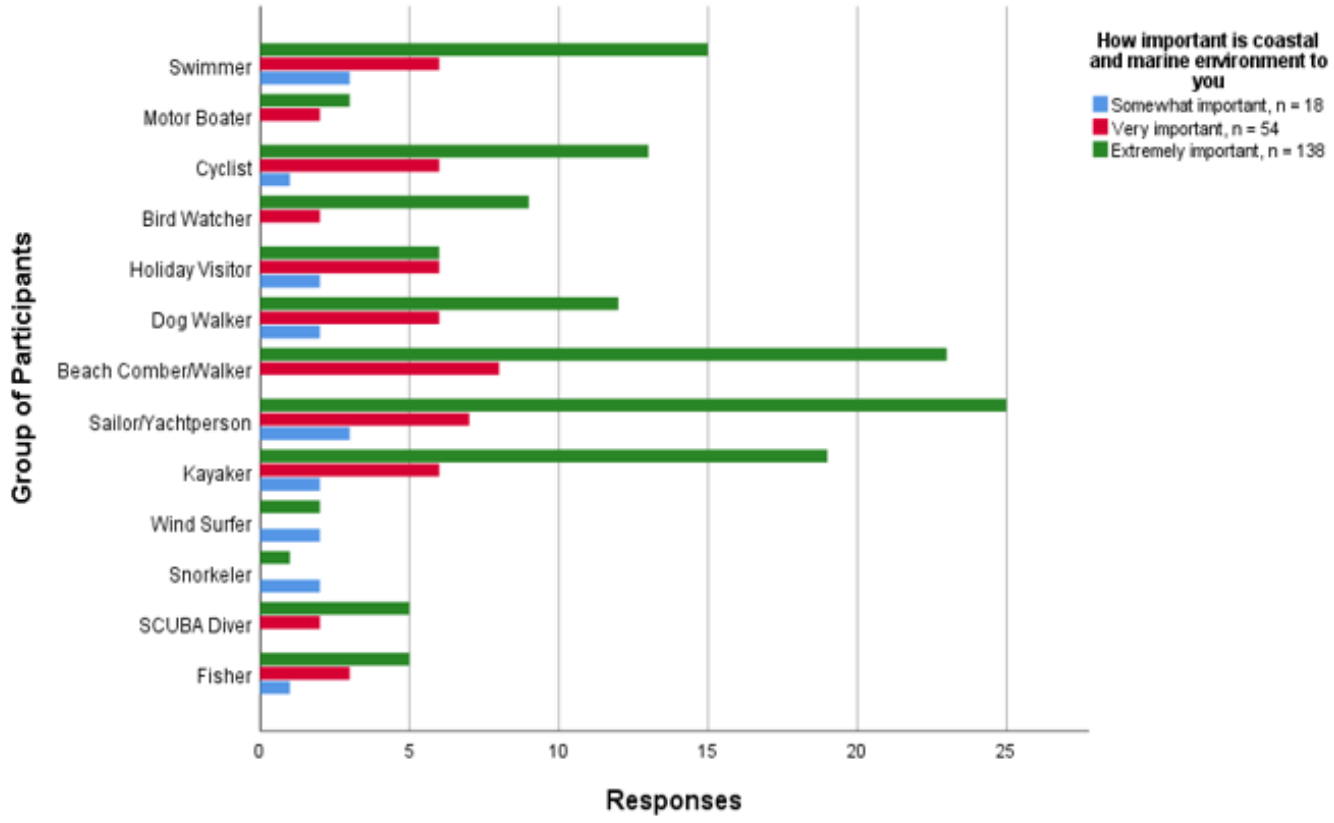

Figure 4.29. Importance of coastal and marine environment to participant group. N = 210.

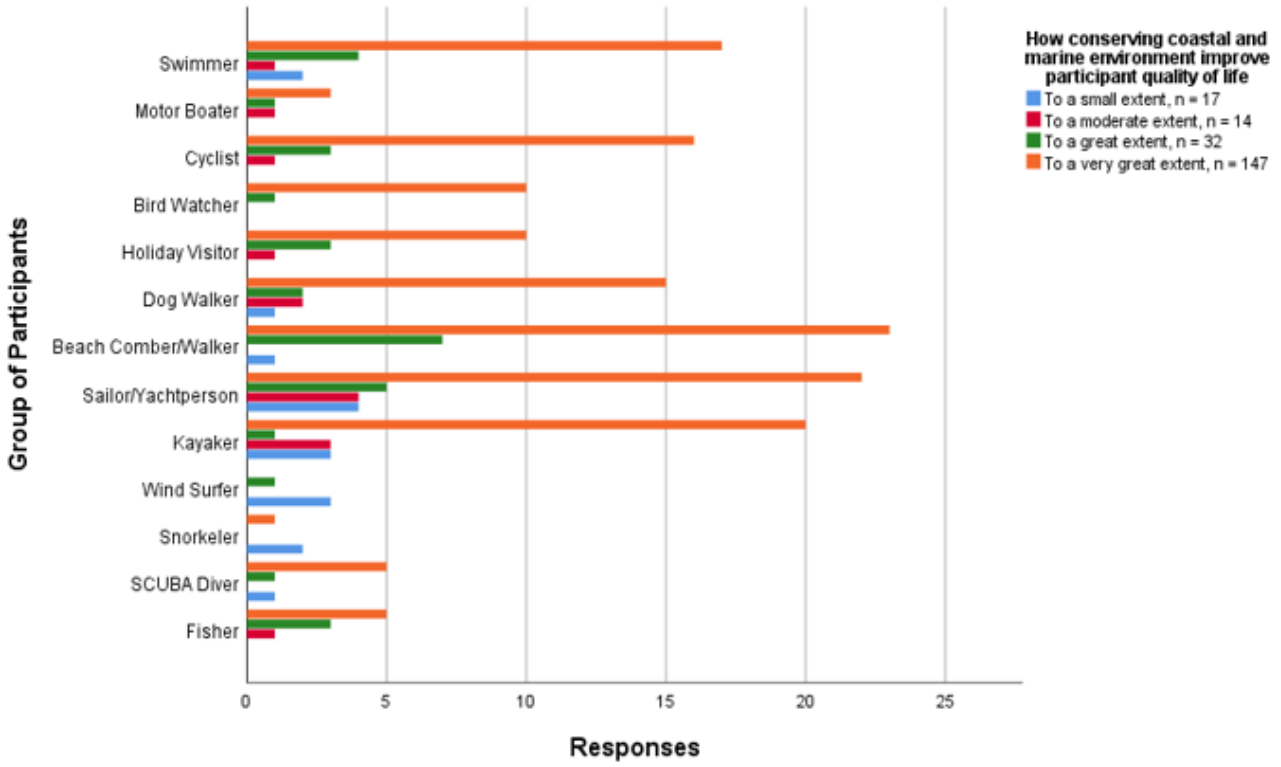

Figure 4.30. Participant perceptions on conserving coastal and marine environment. N = 210.

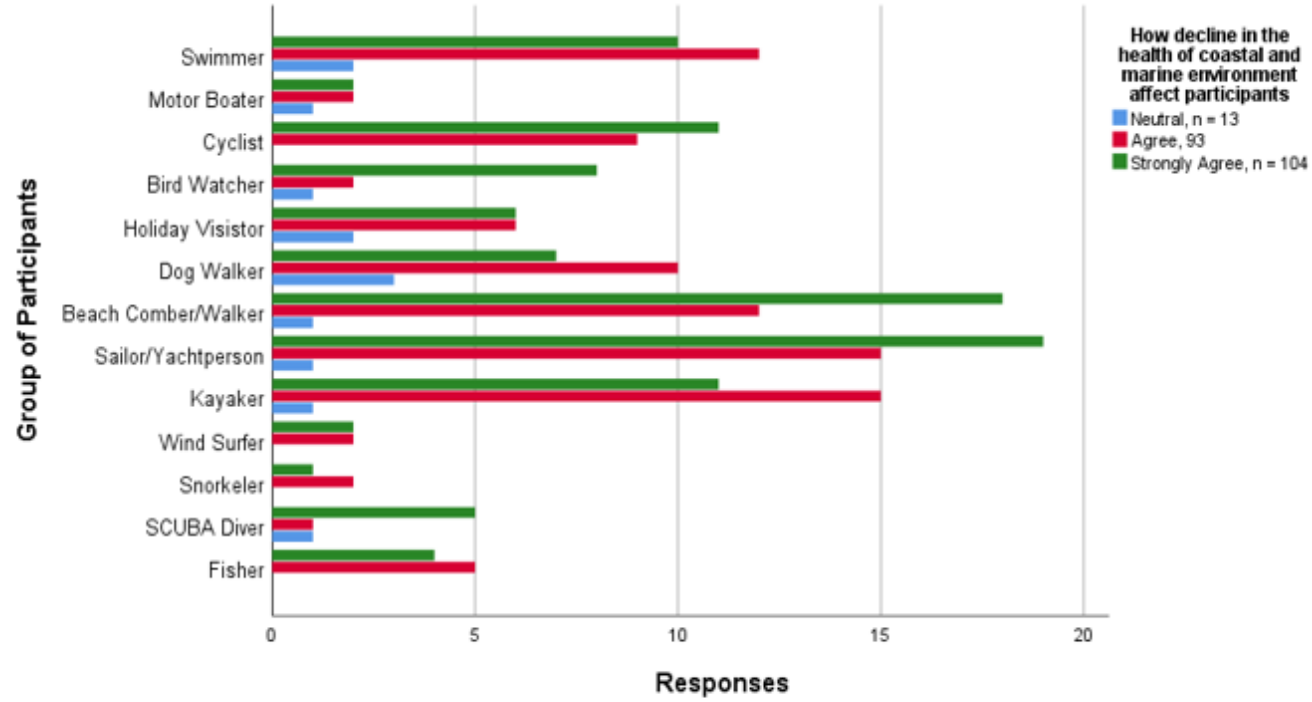

Figure 4.31. Participant perceptions on the decline in the health of coastal and marine environment. N = 210.

4.8 Importance of Feedback as Motivation

In response to the question about the importance of getting feedback from professional scientists after participating in a citizen science project, most participant groups reported a high importance on this. On a 5-point scale options (1, *not at all important*, and 5, *very important*), 4 and 5 responses were very high among Beach walkers, Sailors and Kayakers, followed by Swimmers and Cyclists (Figure 4.32). This potential volunteers' longing for feedback from scientists was not unexpected because it was identified as an effective motivator for repeat participation (Singh *et al.*, 2014), and a means of sharing science outcomes and justifying why volunteers spent their times (Segal *et al.*, 2015). Martin *et al.* (2016b) found similar results with Divers showing more desire to get feedback.

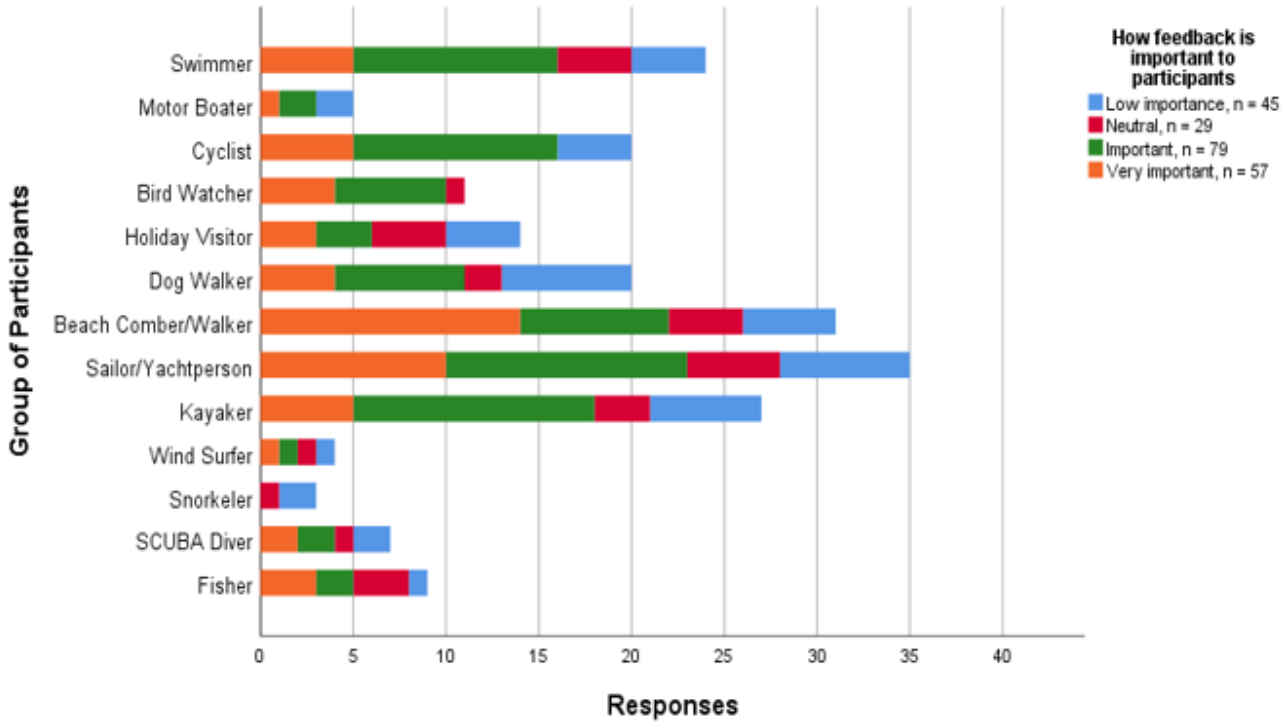

Figure 4.32. Importance of getting feedback after participation in a project. N = 210.

4.9 Willingness to Share Findings

The majority of potential volunteers placed a high interest on willingness to share citizen science information and persuade others to get involved. On a 5-point scale options (1, *not at all interested*, and 5, *very interested*), approximately one-third of the participants (35%) selected *4 – somewhat interested* and 20% selected *very interested* and *neutral* each (Figure 4.33). When they were given the names of different organizations and asked to select with

which they would be more confident and happier to share findings, government agencies and university-based scientists were with the highest response rate. While private research companies and NGOs were the least selected by the participants (Figure 4.34). These results match well with the finding of Martin *et al.* (2016b). This high confidence to share findings with these organizations was not unexpected based on the 'Public Trust Doctrine' that instilled into people's mind that a State holds the management of its natural resources for the benefits of all (Fletcher, 2005), and the high trust people have in scientists (Critchley, 2008). It might also be due to coastal and marine pro-environmental behaviours among UK populations and increased campaign to force the government to act on the declining sea health (Hawkins *et al.*, 2016).

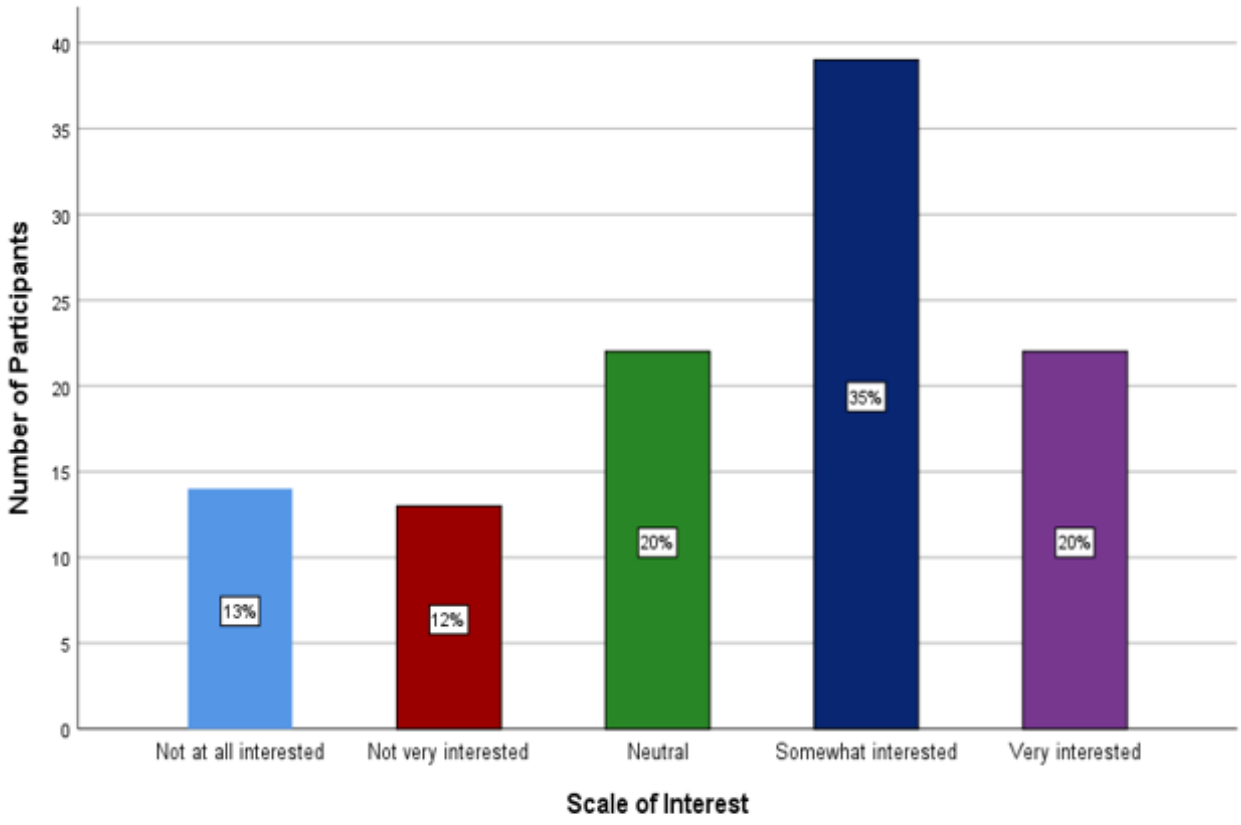

Figure 4.33. Participants level of interest on sharing citizen science information. N = 110.

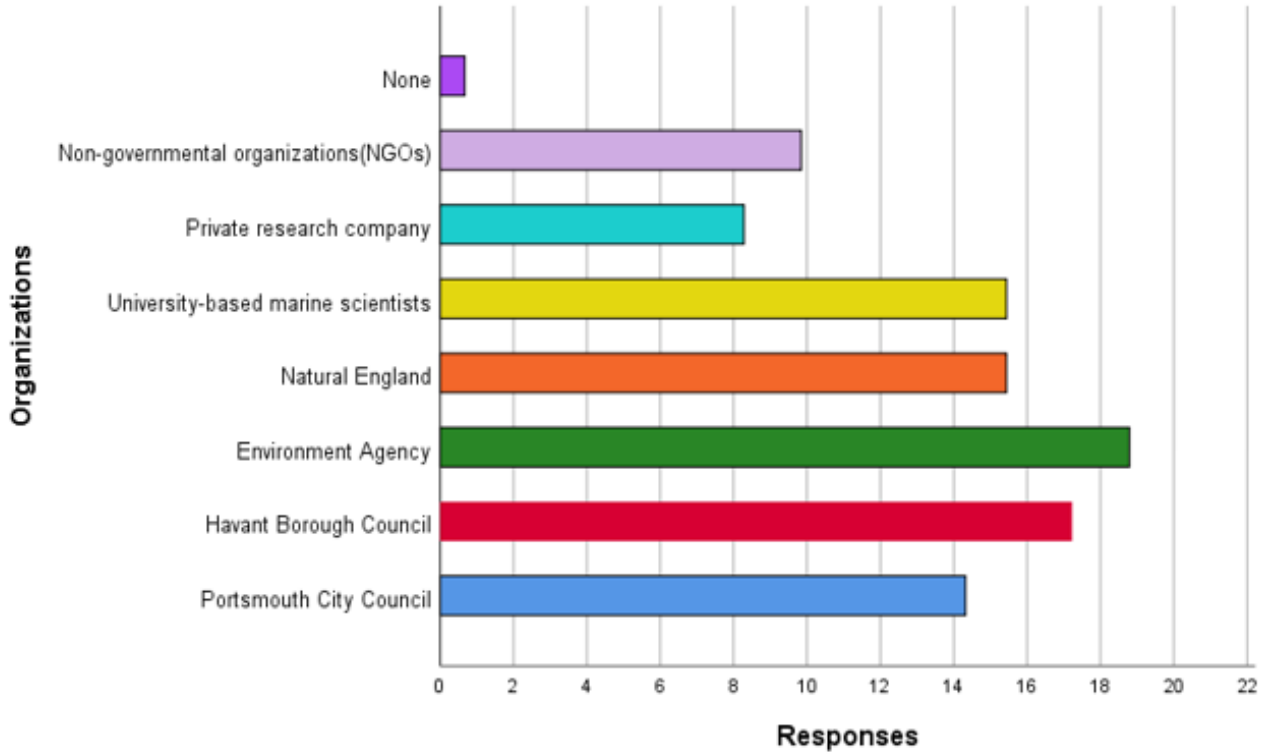

Figure 4.34. Organizations participants willing to share research findings with.

4.10 Chapter Conclusion

In conclusion, the chapter used both the descriptive and inferential statistics to describe the web survey results. The chapter presented prevalence of more males, highly educated and younger participants. The participants were with varying degree of interest, confidence, and motives concerning their demographic status and types of coastal and marine activities. Chapter six discussed the key findings in detail.

CHAPTER FIVE:

INTERVIEW RESULTS AND ANALYSIS

5.1 Introduction

This chapter presents and analyses the interview responses. The purpose of the interview is to evaluate how different citizen science projects are having an impact on public interests, and environmental understanding, influence on management and policy in the coastal and marine environment for conservation purpose. The research question is that do the citizen science projects have the potential to influence interests, literacy, management, and policy of the environment towards conservation? Therefore, this study used the phenomenological approach to identify interviewees' experiences on the potential of their citizen science projects to answer the research question. Also, four out of the five interviews were conducted over the phone while one was face-to-face.

5.2 Participants' Characteristics

The detail background information of five key players in citizen science projects from different organizations that participated in the interview is presented in Table 5.1. The participants were coded with a letter 'P' to ensure their anonymity.

Table 5.1

Interviewees' Characteristics and the Detail of Their Respective Citizen Science Projects

Participant	Gender	Project Focus	Size (Volunteer)	Funding Source	Participant Role	Year Established
P1	Male	Impact of Microplastics in Coastal Environment	≤ 50	Charitable donations, Fund raising activities, Corporate sponsorship	Project founder Coordinating participants and project activities	2018
P2	Male	Wildlife conservation & amenity	≤ 40	Membership subscriptions	Organization chairman Organizing work parties Editing newsletter	1970
P3	Male	Wetland birds survey	≤ 100	Membership subscriptions and donations	Project facilitator	>Decades
P4	Male	Marine mammals survey	≤ 800 across UK	Memberships and donations Charitable trusts grant	Data management and analysis Work publications	1998
P5	Female	Collecting species presence and occurrence data	≤ 200	National lottery heritage fund	Coordinate participants and project activities Engage with participants on outreach and education Teaching/Organizing project science	2018

5.3 Thematic Analysis

Citizen science project design affects its potentials to engage public, collect data and inform policy and management (Shirk *et al.,* 2012). This study identified that the interviewees' projects varied in terms of focus, scope and size in Langstone Harbour and the entire Solent area (Table 5.1). Thus, interviewees' responses signify a diversity among them. The interview conducted assessed their projects potentials, but do not formally report or document any project achievements or objectives. Therefore, thematic analysis results were the participants' responses and views on the capacity of their projects to achieve these potentials.

The generated interview transcripts in Microsoft word were cleaned to remove the misinterpreted words, then sent back to each participant to ensure the clarity of their own words (Adu, 2019). These transcripts were organised into paragraph headings based on the questions on the interview schedule, then uploaded into NVivo 12 for thematic analysis. The uploaded transcripts were reorganised and coded by themeing data (Saldaña, 2016). The 'Query command' was used to understand and explore the codes and produced themes (Figures 5.1 & 5.2). Therefore, the codes were categorised, sorted, and themes generated based on the relationship between the codes and frequencies (Koch *et al.,* 2014; Adu, 2019).

Figure 5.1. Word Cloud: indicating the most frequent words from the interview transcripts

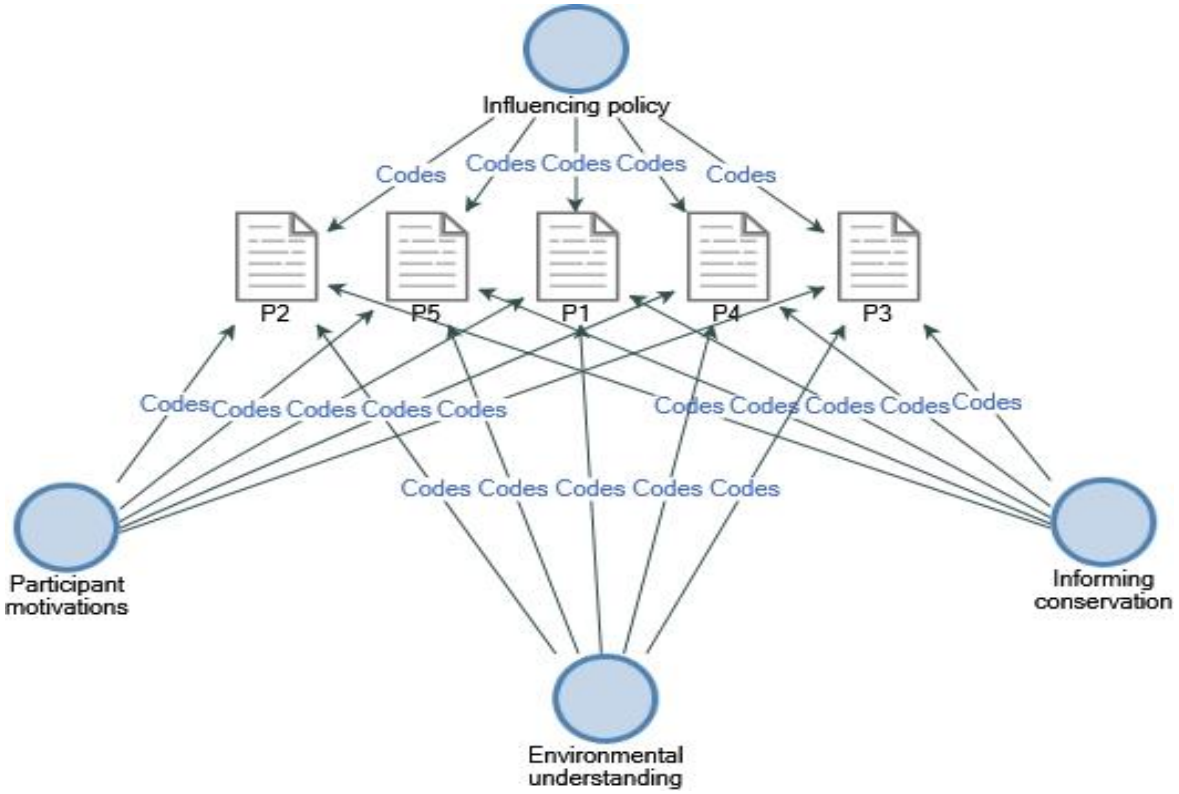

Figure 5.2. Project Map: showing interrelatedness of the themes to interviewees.

The coding process generated four key themes: (1) Environmental understanding, (2) influencing policy, (3) informing conservation, and (4) participant motivations (Table 5.2). The most commonly identified of all the themes was the participant motivations (42 references across all five interviewees), and the least mentioned was influencing policy (16 references, Table 5.3 and Figure 5.3). To identify the themes' roles and interplay in answering the research question, they were discussed and linked with the existing works of literature.

Table 5.2

Themes Generated and their References Across all the Sources

Participant	Environmental understanding	Influencing policy	Informing conservation	Participant motivations
P1	7	2	3	6
P2	5	4	1	5
P3	4	1	5	13
P4	6	7	3	7
P5	12	2	5	11
Total references	34	16	17	42

Table 5.3

Summary of the Generated Themes, Their Meanings and Evidence from the Transcripts

Theme	Frequency	Meaning	Evidence
Participant motivations	42	Volunteers who participated in citizen science projects are more likely to be motivated through either feedback, mode of interactions with organizers or their desire to help	"Talking to volunteers before and after surveys. Often hearing them say 'I never knew that' them asking for more information and where to find further information and certain issues. Seeing they go out and buy literature on the marine environment to bring on the next surveys," (P5)
Environmental understanding	34	Volunteers increase pro-environmental behaviours and better environmental understanding for participation. Citizen science projects have the potential to increase these.	"Collecting environmental data can make volunteers to care more about the environment and develop a sense of place," (P3). "They can actually understand the threats, learn about it. Be impassioned and fall in love with their local area and kindle a desire to protect it," (P5). "So, we reduced the gap to their knowledge by finding out something they don't know but getting it out at first," (P1).
Informing conservation	17	Volunteers' action in citizen science projects inform management of coastal and marine environment for conservation purpose.	"I can say citizen science influence management, *because* the data on what we collect is fed back to marine conservation society and to our members and particularly used by the marine conservation society, a national organization, to inform government and companies about the amount of litter that occurs on our coasts all around the UK" (P2)
Influencing policy	16	Citizen science projects have potential to influence or inform policy changes for coastal and marine environment conservation concerns.	"I am involved in somehow a project in Langstone Harbour which I rather more directly citizen scientist in recording birds and wildlife generally that goes back to national records that go to national organizations who are involved in formulating conservation policies for biodiversity across the country" (P2).

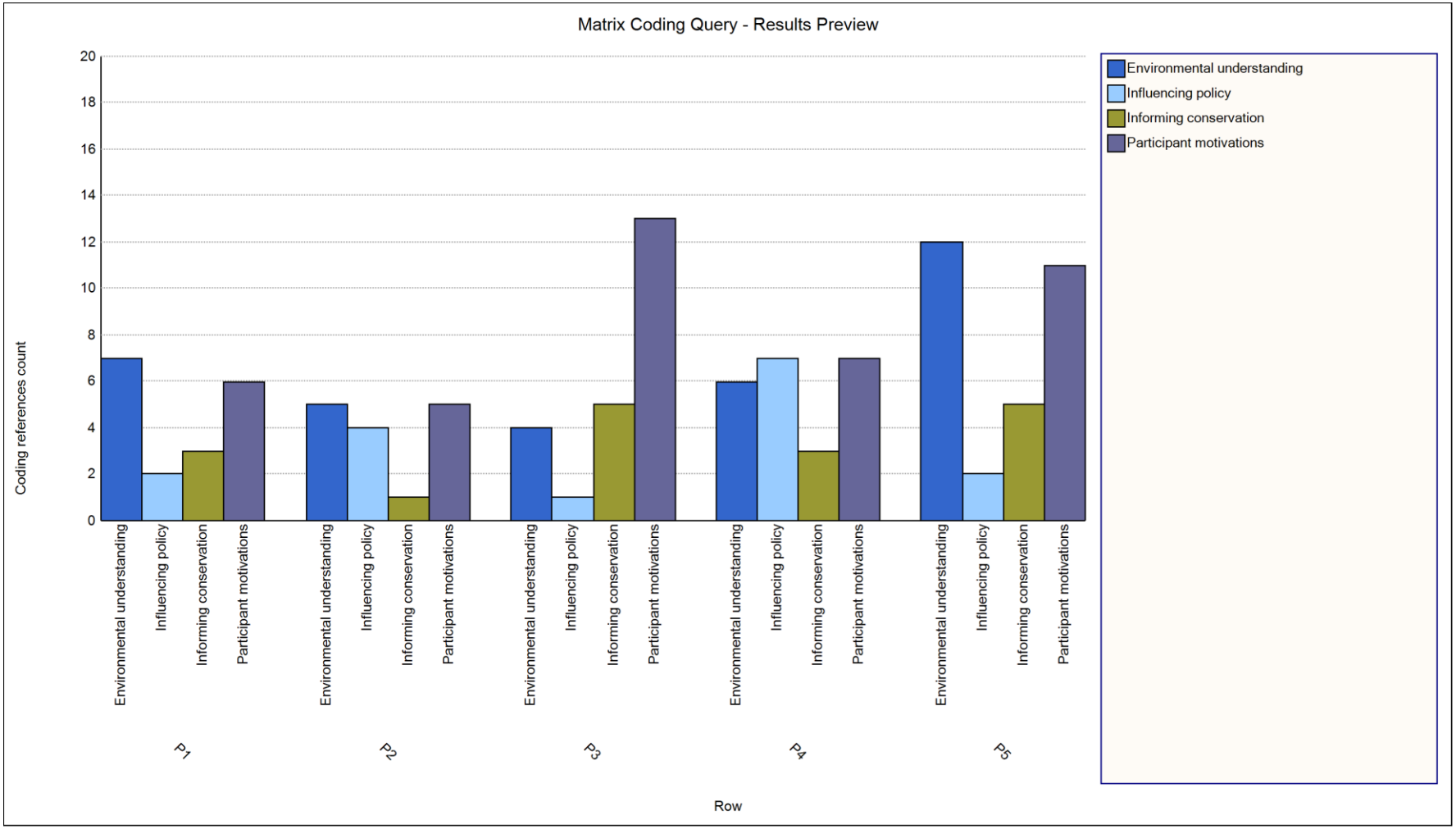

Figure 5.3. Matrix coding query, showing generated themes and reference

5.3.1 Participant Motivations

Citizen science project volunteers are not free workers, but individuals who will continue participating if their desires are satisfied (Ryan *et al.*, 2001). This theme of participant motivations reviews that volunteers in citizen science projects are more likely to be motivated through enough feedback, interactions with projects organisers and building partnership with working parties. Sending feedback to volunteers was a means to motivate and make them stay (Pecl *et al.*, 2019). Volunteers feel valued when they receive thanks and feedbacks, have ownership of the outcomes or consulted about the methods (Lawrence, 2006; Silvertown, 2009). Therefore, P5 stated that "our citizen science always makes the public feel they are part of something and not an outsider". The interviewees' responses about sending feedback to motivate volunteers is consistent with other studies (e.g. McKinley *et al.*, 2015; Kelly *et al.*, 2019; Pecl *et al.*, 2019), for example, "we say thank you when they do" (P1). Also, sharing information through feedback was agreed as a significant motivator, for example, "feedback kept them on the projects because we normally meet-up each other in the day, posts by emails, and sharing the data within the participants, so they get to see the results". Interviewee P1, who is a project founder and responsible for coordinating participants, indicated that thousands of people continue to show interest through "the meet-ups, mainly newsletters. A lot on social media; we got 28,000 people look at our post, we got 15,000 people on our Facebook page and 6,000 on our Instagram". Therefore, feedback is essential because keeping respectful, informative and continual communication is necessary to maintaining committed individuals in the projects (Hind-Ozan, Pecl, & Ward-Paige, 2017).

Effective interaction between all working parties received strong support in favour of motivating volunteers. Interviewees highlighted that "we always teach our participants about marine conservation during surveys and training and engage them in an open discourse based on generated knowledge that they can understand, access and trust (P5). This claim is in complete agreement with Thiel *et al.* (2014), who indicated that interaction provides a social platform for knowledge sharing about conservation issues, facilitate effective collaboration and build trust. Another example is "citizen science through engaging locals, can promote trust and understanding among decision-makers, regulators, scientists, managers, volunteers and others of the social dimensions of the natural environment where people live," (P3). However, "interactions with participants have to be transparent so that to create social dimensions" (P5).

5.3.2 Environmental Understanding

This theme focused on increased in volunteers' pro-environmental behaviours and understanding due to participation in citizen science projects. Interviewee P2 stressed that "participation in our project increases participant's general understanding about coastal and marine environment and its conservation". Likewise, P4 explained that their project is "informing ocean literacy to educate public about challenges/issues in coastal and marine environment through creating pro-environmental behaviour". This is "because the more one person knows, shares those ideas and society the whole have a better understanding of the coasts" (P3). For example, "our project provided that experience and community feeling of doing good and positive things. Likeminded people end up helping create movements that can spread to other people. So, citizen science project very much helps empower, educate and bring people together over a common cause" (P5). Another example is that "I have spoken to my volunteers, I have seen the changes, especially on few people when they start asking questions more. Again, I wanted to impart knowledge more because the curiosity is there" (P5). These substantiate previous studies by Dutcher *et al.* (2007), Rogers and Bragg (2012), Toomey and Domroese (2013), who show that citizen science project by its potential to connect volunteers with nature has led to changes in their pro-environmental behaviours, understandings and intentions.

Moreover, in agreement with another study by Martin et al. (2016a), it was agreed that trust must exist between projects organisers and volunteers for effective changes in attitudes to occur. Interviewee P5, who is a training and education manager explained that "because you are creating a trust and relationship with the volunteers, you are taking them, educating them and becoming their teacher, you have that relationship with trust. They trust that you are providing them with the correct information and informing them about what is actually going on", thus, leads to attitudinal changes. Therefore, it is undeniably that citizen science foster stewardship of the environment because participants most at times demonstrate positive attitudes through increased pro-environmental behaviours for conservation of natural resources (Danielsen *et al.*, 2009; Lawrence, 2010).

5.3.3 Informing Conservation

The theme of informing conservation focused on how volunteer actions in citizen science projects inform management of the coastal and marine environment for conservation purpose. It was agreed that citizen science has the potential to serve as a valuable tool for conservation

by increasing public awareness and knowledge of biodiversity (McKinley *et al.*, 2017). "For example, in our survey, citizen science has improved and sped up environmental changes detection and identifying invasive species" (P5). Interviewee P2, who is an organization chairman explained that "our citizen science informed the public about coastal and marine environment conservation by advertising the information that is gained. Also, for potentially lobbying government and local authorities on what needs to be done to benefit biodiversity and public amenity". For example, "the data on what we collect is fed back to marine conservation society and to our members and particularly used by the marine conservation society, a national organization, to inform government and companies about the amount of litter that occurs on our coasts all around the UK," (P2). Despite these volunteer actions to inform conservation and management, interviewee P3, stressed that citizen science could only be used "when volunteers can collect high-quality data, and their participation makes it possible to address unanswerable research questions or reaching inaccessible environment in any other way". However, it "can often operate at a greater spatial and temporal scales than conventional science due to its cost-effective nature for collecting some types of data. For example, observation of biological and physical phenomena and breeding birds over long temporal and in enough spatial scales that is meaningful and scientifically reliable" (P3). Therefore, extreme caution must be paid in "before conducting citizen science, and there is a need to weigh its strengths and weaknesses", (P5).

5.3.4 Influencing Policy

This theme primarily focused on the potential of citizen science to inform policy. Policy change in the coastal and marine environment due to citizen science projects' influence was a big issue in this theme. Consistent with other studies by Garcia-Soto *et al.* (2017), Hyder *et al.*, (2015), and Townhill and Hyder, (2017), interviewees in this study agreed that the coastal and marine citizen science remains a viable option for effective implementation of policies. This is because "the citizen science got the opportunity to gather many data. Also, policymakers tend to respond quite positively when they are faced with many numbers" (P1). Also, interviewee P2 stated that "we collect invaluable litter data during our surveys, reporting it back to MCS then to UK governments and the global annual International Coastal Clean-up programme. Providing this data has helped to change policy and behaviours, including the introduction of the 5p carrier bag charge". Besides, interviewee P4 explained that "we collect data and analyse that to give us a sort of evidence-based conservation benefits and knowledge to policy managers. We also use our data to inform marine policy and developed MPAs, and we are trying to get an important marine mammal area".

Science is an essential component of informing policy (Fletcher, 2007). Therefore, “the shift in management recently, with emphasis on adaptive management and ecosystem-level protection has necessitated the use of scientific data to inform decisions and policy implementation. This will be well suited using citizen science approaches” (P4). Also, it can be done “well obviously through education in collecting data. That is where citizen science is quite important because you need public opinion behind that data, forcing those in government actually to act on it” (P5). Again, “citizen science has the power to enhance two-way flow of information between the environmental policymakers, natural resources managers and the general public. With this, the public can engage in decision-making processes” (P4). Although, policies developed by involving all relevant stakeholders from both civil and scientific societies are more powerful than those developed by either the society or science community alone (Townhill & Hyder, 2017), yet the power of citizen science to influence policy is often overlooked (Evans *et al.*, 2000). Therefore, “the more people who know about it, the more people who feel connected to that, so the strongly this data is correct and need to be acted upon then you going to get the policy changes that you need” (P5).

5.8 Chapter Conclusion

In conclusion, the interviewees’ experiences and views on their different projects indicated the potential of citizen science to influence interests, literacy, management, and policy of the coastal and marine environment towards conservation. The chapter presented that citizen science has a direct benefit on conservation by informing policy and management, increasing stewardship and understanding of coastal and marine environment through public participation and influences. However, due care must be paid in to ensure volunteer safety and rapport, data quality and transparency to be able to achieve the benefit.

CHAPTER SIX: OVERALL DISCUSSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter presents the overall discussions of the key analysed questionnaire results and interview responses presented in chapters four and five. It also suggests thoughtful recommendations for both new and ongoing coastal and marine citizen science project organisers for ease volunteer identification, recruitment, engagement, and retention. It is divided into five main sections: 6.2 Familiarity with citizen science, 6.3 Interest, and confidence in citizen science tasks, 6.4 Volunteer motivations, and 6.5 Potential of citizen science to influence environment management, then 6.6 Chapter conclusions.

6.2 Familiarity with Citizen Science

The different coastal and marine users are both beneficiaries and potential volunteers of citizen science. Recruiting, engaging and retaining them in citizen science projects would be affected by their level of familiarity, interest, and confidence in participating in it (Lewandowski *et al.*, 2017).

Given that only 41% of the participants were familiar with the term 'citizen-science' initially, yet a lot more recognized it by its definition and under different names. This was not surprising because even though the name is getting popularity (Follett and Strezov, 2015), yet many authors do not use it in their published papers (Cooper *et al.*, 2014). This shows that using the name 'citizen-science' only during recruitment might be unattractive or unclear for many potential volunteers. Although there is growing consensus among practitioners and scientists for this term, for example the emergent of citizen science organizations (e.g. ECSA, CSA, and ACSA), websites content (e.g. www.citizensciencetoday.org), popular books (e.g. Janis & Bonney, 2012; Toth, 2015; and Cigliano & Ballard, 2017) as well as 'Citizen Science: *Theory and Practice'* journal, the meaning of the term to potential participants should be considered carefully (Geoghegan *et al.*, 2016). Therefore, project organizers should consider whether using the term will attract or dissuade potential volunteers (Geoghegan *et al.*, 2016) because different names were used to describe 'citizen-science' across disciplines (Shirk *et al.*, 2012; Comber *et al.*, 2014) beyond the ones provided in this study. Also, to effectively recruit volunteers for coastal and marine citizen science, project coordinators might benefit from using both 'citizen-science' and synonymous names in addition to its clear definition (Lewandowski *et al.*, 2017).

6.3 Interest, and Confidence in Citizen Science Tasks

Members of the public differ widely in terms of interest, confidence, and motivation towards doing activities because what works for particular potential volunteers might be less viable for another (Tweddle *et al.*, 2012). This section has provided the characteristics of coastal and marine users that are interested and confident in different tasks of citizen science. The respondents were interested and confident in their capability to perform specific tasks. The findings in the present study revealed that there were more male, highly educated and younger potential participants in terms of interest and confidence in performing citizen science tasks. In general, they were likely (40%) and very likely (25.5%) interested in collecting data as a task. These findings suggest that assigning data-collection task may be an essential way of recruiting new volunteers. The findings are in complete agreement with Martin *et al.*, (2016b) and Lewandowski *et al., (*2017). The higher level of interest and confidence among men are consistent with many other studies that reported men demonstrated more confidence, for example in areas such as marine activities (De la Torre-Castro *et al.*, 2017), science of computing (Irani, 2004), and medical science (Blanch *et al.*, 2008).

The second preference task, especially among younger potential participants, was helping to communicate project findings. This was not surprising given that volunteers found it difficult to disseminate results of monitoring forest to their broader community in Fernandez-Gimenez *et al.* (2008). These types of potential volunteers need to be provided with communication support. However, this result is in contrast with Martin *et al.*, (2016b) and Lewandowski *et al., (*2017) who found that interest decreased with age. In terms of marine user profession, sailors, kayakers and beachcombers were keenest and willing to dedicate a large number of hours for volunteering citizen science. Although this might be due to the prevalence of their activities in Langstone Harbour, yet they appeared to be more enthusiastic in this study.

Differences between education, genders, ages and professional activities might influence volunteer recruitments in a project. Younger male and Highly educated individuals might be more inclined to participate in citizen science due to their higher levels of interest, confidence, and science background. Project organizers should be thoughtful and targeted about who to recruit so that many participant groups may be involved and have a stake in the project in question (Cigliano *et al.*, 2015). Therefore, increasing age and gender representation is encouraged during volunteer recruitment in citizen science projects. Also, the high level of interest and confidence among the educated potential volunteers was not entirely contrary to

expectations. These findings concurred thoroughly with the volunteer profiles in some citizen science projects (e.g. Galaxy zoo and local parks stewardship activities, Raddick *et al.* 2009 & Dresner *et al.* 2015), and are also consistent with Martin *et al.* (2016b) and Lewandowski *et al.* (2017). Therefore, considering potential volunteers' both general and science educations is encouraged to identify suitable volunteers for specific tasks that require skills and science background.

Moreover, the respondents of this study indicated increased interest and confidence in performing more difficult citizen science tasks (except for monitoring reef system) after receiving instructions on how to conduct them. This was expected because other studies (e.g. Savan *et al.*, 2003; Finn *et al.*, 2010) have reported increased volunteer confidence after repeated training, monitoring opportunities, and overtime. Therefore, targeted recruitment should consider both volunteer and research staff training as indispensable before assigning any task, thus, to increase the quality of data collected and participants well-being (Cigliano *et al.*, 2015). This is because "there is a sort of thing which is very difficult to ask or get public involve in unless they are very specialist, or they involved in such elements in some ways" (P3). Besides, the bottom-up management approach should be adopted by citizen science projects through providing training to locals not only to participate but also to impact resource management and project sustainability because of the acquired skills (Cigliano *et al.*, 2015).

6.4 Volunteer Motivations

This section has provided insights into various factors that might motivate potential volunteers to participate in coastal and marine citizen science projects. Understanding these factors of why and how people prefer to involve in a project is essential to provide desired results and benefits to both community and science (Geoghegan *et al.*, 2016). All groups of participants in this study, especially Sailors, Beachcombers, Kayakers, and Swimmer, indicated that the coastal and marine environment is critical to their lives and conserving it will improve their quality of life. Likewise, they strongly agreed that a decline in the health of this environment would personally affect them. These findings indicated extreme environmental, emotional intensity and sense of place among the potential volunteers. These are considered essential factors for facilitating and motivating volunteers in conservation-based projects (Haywood, 2014; Hartley, Thompson & Pahl, 2015). These findings are consistent with West, Pateman, and Dyke (2015) who found wanting to protect the environment and helping nature as strong motivators. Therefore, environment-centred projects are encouraged to target these individuals,

who already exhibit pro-environmental behaviours, powerful emotional connections, experiences, and actions to protect the environment (Cigliano *et al.,* 2015). They are also encouraged to build the capacity of these potential volunteers through partnering with their organisations and defining the project's objectives collaboratively because these might significantly create capacity and sense of ownership that would help in addressing conservation issues as suggested in Cigliano *et al.* (2015).

Another identified motivator is feedback (Tweddle *et al.*, 2012). All participant groups indicated a significant importance of having feedback from coordinators if they were to be involved in any project's aspect. This finding matches well with Geoghegan *et al.* (2016), whose participants reported that they feel motivated and consider their participation worthwhile because of how the project organizers value communication and feedback. Sending feedback is considered as a means of sharing science outcomes and justifying why volunteers spent their time so that to encourage repeat participation (Singh *et al.,* 2014; Segal *et al.,* 2015). Therefore, coordinators of citizen science projects in coastal and marine environment should consider sending rapid feedback through either website, automated phone text message, email or simply saying thank-you. Thanking volunteers for participation not only encourages continued engagement but gives them a sense of accomplishment and shows them they are valued (Tweddle *et al.,* 2012).

The majority of potential volunteers indicated a high interest in willingness to share project findings and motivate others to get involved. Also, the results clearly show that participants placed high trust in government agencies and university-based scientists as to whom to share their citizen-science findings. These results need to be discussed with caution, considering the conflict of interest in science that commonly happens in the media (Leiserowitz *et al.,* 2013). Therefore, this high trust might be due to increased campaign to force the UK government act on ocean health (Hawkins *et al.,* 2016), or public perceptions that science is conducted in laboratories and universities (Gauchat, 2011), and that the resource management is held by a State (Fletcher, 2005). To this end, coordinators need to partner with universities or government agencies to win public trust in their projects, and thereby increase recruitment.

6.5 Potential of Citizen Science to Influence Environment Management

All interviewees showed great support on the potential of their projects to influence environmental management inform of environmental policy changing and informing conservation. To support their claim, McKinley *et al.* (2017) emphasised that citizen science

has the potential to serve as a constructive platform for conservation by increasing public awareness and knowledge of biodiversity. This potential of citizen science needs collective action because coastal and marine policies developed constructively by involving all relevant stakeholders from both civil and scientific societies are more powerful than those developed by either the society or science community alone (Townhill & Hyder, 2017). Therefore, projects targeted on informing conservation and influencing policy should get enough public support and scientific data through active volunteer engagement and training to ensure the data quality so that to stimulate natural resource management or policy-making (McKinley *et al.*, 2015, Figure 6.1).

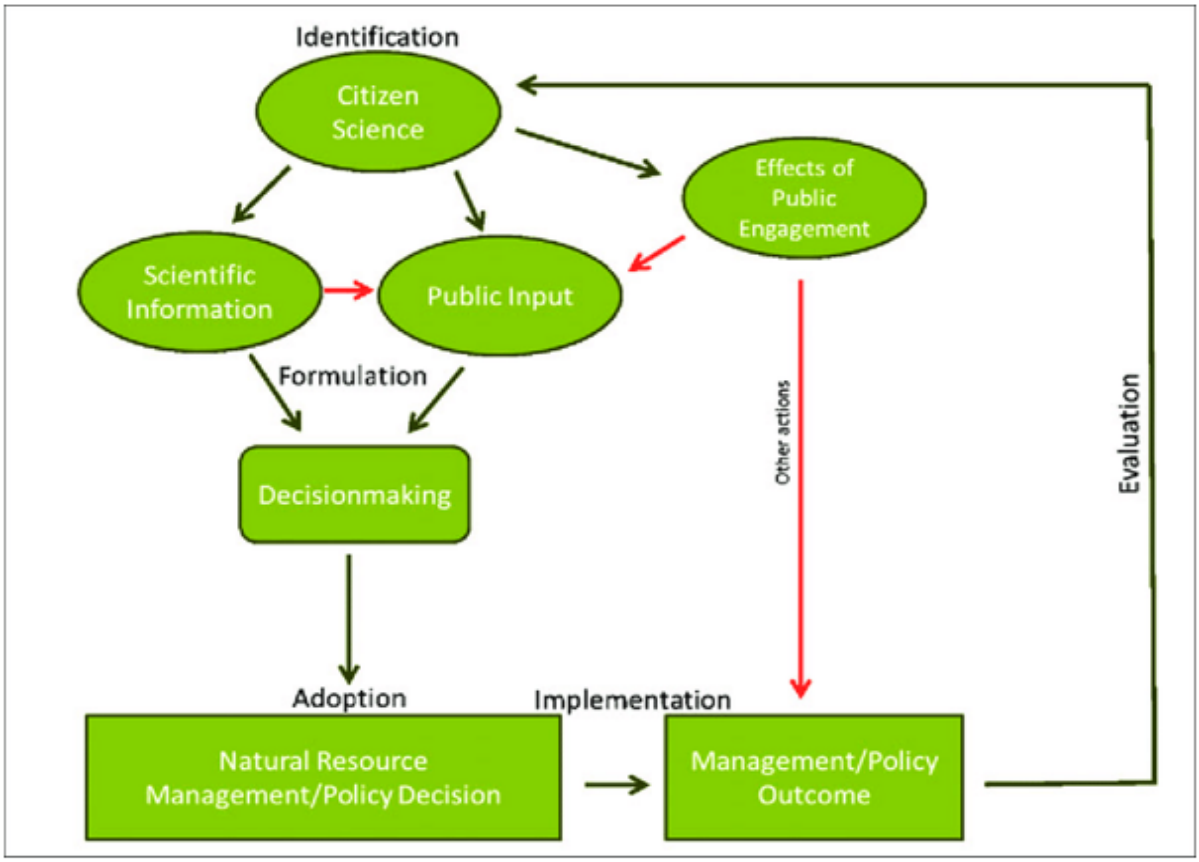

Figure 6.1. Pathways that citizen science can take to influence natural resource management and environmental protection by (1) generating scientific information, and (2) facilitating direct (green arrows) and indirect (red arrows) public input and engagement. Direct public input and engagement include, for example, comments on proposed government actions; indirect input and engagement include communication with peers that might stimulate community engagement in natural resource management, environmental protection, and policy decisions. Text in black refers to the policy cycle: problem or issue identification produces a need; option formulation addresses the issue; policy adoption points to a way of resolving the issue; policy implementation entails taking action; and outcome evaluation assesses policy effectiveness, initiating the next policy cycle. **Source: (Adapted from McKinley *et al.*, 2015)**

6.6 Chapter Conclusions

In conclusion, this chapter has provided general discussions and recommendations based on the analysed quantitative and qualitative results presented in chapters four and five and linked with the broader literature. The chapter has also provided an insight into how both potential and ongoing citizen science project organisers will understand the characteristics of potential volunteers for their projects in Langstone Harbour for effective recruitment and retention. However, due care must be taken before implementing these recommendations because the potential volunteers exhibit varying levels of interest and confidence in conducting different citizen science tasks.

CHAPTER SEVEN: CONCLUSIONS

7.1 Introduction

This chapter concludes the whole project by summarising the overall study settings, outlining the significant findings and making a conclusion, and lastly highlighting some limitations from the study.

7.2 Study Summary

As stated in the introduction, the main aim of this study was to critically evaluate public interest in citizen science for coastal and marine conservation in Langstone Harbour. This study was expected to determine potential ways of promoting recruitment, increasing engagement and enhancing retention of the general public as citizen scientists for projects that enhance Langstone Harbour for the benefit of all its users. The harbour was selected as a case study because of its designation as both the UK and international Special Area of Conservation, and other Nature Reserve designations due to its biodiversity especially birdlife (Langstone Harbour, N.D). Besides, it is known for the myriad of substantial recreational and commercial activities whose impacts pose issues that call for conservation measures in the area (Foster *et al.,* 2014; LHB, 2019). Therefore, the study used mixed research method by combining an in-depth quantitative survey of various coastal and marine users and qualitative interviews of different key players in citizen science projects. The web-based survey was distributed using snowballing to recruit hard-to-reach coastal and marine users and was completed by 110 respondents. Also, five interviewees from different organizations in the harbour area participated in the interview. Four interviews were conducted over the phone and one face-to-face.

7.3 Final Conclusion

Citizen science can be an avenue for providing people with the opportunity to participate in scientific research projects (Shirk *et al.,* 2012). Although understanding the interests and needs of the public in a citizen science project is a vital element for its deliberate design (Shirk *et al.,* 2012), yet project coordinators often overlooked it. Therefore, this study critically evaluated public interest in coastal and marine citizen science in Langstone Harbour area to try to reveal its potentials to engage more extensive volunteers. Individuals who had varying interests in the coastal and marine citizen-science participated in both the web-based survey and interviews and covered a range of broad activities in the coastal and marine environment. The results of this study revealed an informative and exciting characteristic of people who may

volunteer for citizen-science in this environment. The findings are also relevant information for coordinators of both ongoing and new citizen science projects in Langstone Harbour.

Although it indeed appeared that less than half of the participants were familiar with the term citizen-science, many more recognised it by its definition and under different names. This report has significant implications for the use of only the term citizen-science during volunteer recruitment for a project. Therefore, different names could be used to associate citizen-science with (Comber *et al.*, 2014) because the name used tends to persuade or dissuade potential volunteers for a project (Geoghegan *et al.*, 2016).

Moreover, the evidence from this study indicates that respondents were interested and confident in their capabilities to perform specific tasks. Interest and confidence in performing citizen science tasks tended to increase among men, highly educated and both younger and older participants. Also, highly educated people with science background tended to devote a considerable time to citizen science. It is more likely, therefore, citizen science to engage educated young people who already have an interest in science. Citizen science appears to afford individuals with valuable opportunity to increase their friendships, skills, and most importantly, knowledge (Martin *et al.*, 2016c). However, it has hurdles of attracting people that are distanced from science or low level of education through lack of opportunity, trust or interest (Martin *et al.*, 2016c).

The study has identified a considerable interest amongst different coastal and marine users. Sailors, Kayakers, and Beachcombers appeared to be more interested and confident in assisting and devoting a significant amount of time for volunteering coastal and marine research, especially in helping to collect data for scientists. This claim shows that starting with the task of data collection before assigning more difficult tasks would be a good strategy for increasing volunteer numbers in coastal and marine citizen science as suggested by Martin *et al., (*2016c) and Liu and Falk (2014). Therefore, this will provide an excellent opportunity for projects, especially contributory citizen-science, because it certainly indicates there is room for project growth.

Besides, the analysis also demonstrated strong evidence that all groups of participants in this study, especially Sailors, Beachcombers, Kayakers, and Swimmers reported a high sense of place to conserve the environment and feedback from professional scientists as motivators that will keep them in a project. These findings present good news for the conservation-based

project organisers because understanding the factors that influence volunteers to participate in a project and why they continue to be involved are indispensable to the success of that project (West & Pateman, 2016). It is worth noting that volunteers are also not free workers, but individuals who will continue participating if their desires are satisfied (Ryan, Kaplan & Grese, 2001).

Lastly, the interview analysis identified how citizen science projects, influence management, policy, and foster synergistic roles in improving engagement and ocean literacy for coastal and marine conservation. The interview findings support growing conservation calls by the European Marine Board (EMB) that suggested investment in coastal and marine citizen science as an essential tool to promote society's engagement and ocean literacy for the conservation of its seas.

7.4 Limitations

This study has gone some way towards enhancing understanding of public interest in citizen science for coastal and marine conservation. However, some limitations need to be considered. For instance, the results of the study are likely not wholly representative of all coastal and marine users in Langstone Harbour. Although attempts were made to promote the survey to attract responses from all coastal and marine users, some organisations were not convinced or chose not to participate. This might be responsible for the low response rate from members of such organisations. Therefore, the findings might not be representative of the interest and confidence of all coastal and marine users. Thus, future research could try to gain more in-depth responses from all user groups by creating a good rapport with their leaders.

Other identified limitations in this study are the nature of the questions and data collection tool used. The consent question (*I agree to conduct this survey of citizen science?*) asked potential participants at the beginning of the survey might have excluded those that feel citizen science does not appeal to them. Also, the Likert scales type questions (5-point scale) attracted varying levels of confidence and interest. There were many responses in the neutral scales which fail to measure the actual level of interest or confidence of the participants, and this might have provided useful information. These moderately confidence and interest levels may be where the public engagement interest lies. Excluding these participants indicated a leap in the interest and confidence levels of potential volunteers. It is also worth noting that the expression of participants' confidence and interest does not always turns to action due to behavioural changes in human nature (Fishbein & Ajzen, 2011). Therefore, future research should consider

restructuring the Likert-type questions to generate actual level of interest and considerable high response rate. Besides, the nature of the data collection tool, web-survey, might have also excluded some potential participants that are technophobic or not frequent users of the internet. Future studies are therefore recommended in order to cover all user groups to combine both web-survey and drop-off/pick-up methods of administering the questionnaire. However, despite these limitations, the study believed to be a springboard for evaluating public interest in citizen science in Langstone Harbour.

REFERENCES

Aceves-Bueno, E., Adeleye, A. S., Bradley, D., Brandt, W. T., Callery, P., Feraud, M., ... & Pearlman, I. (2015). Citizen science as an approach for overcoming insufficient monitoring and inadequate stakeholder buy-in in adaptive management: criteria and evidence. *Ecosystems*, *18*(3), 493-506.

Adu, P. (2019). A Step-by-Step Guide to Qualitative Data Coding. Routledge

Al-Azzawi, R. (2013). Gender in conservation: Does a gender aware approach lead to an improvement in the achievement of conservation outcomes. *Final Report: WWF-UK*.

Allen, K. (2015). User and stakeholder attitudes and perceptions towards coastal and marine conservation designations at Langstone Harbour, UK (Unpublished Master's dissertation). University of Portsmouth, Portsmouth, UK.

American Psychological Association. (2010). Publication manual of the American.

Au, J., Bagchi, P., Chen, B., Martinez, R., Dudley, S. A., & Sorger, G. J. (2000). Methodology for public monitoring of total coliforms, Escherichia coli and toxicity in waterways by Canadian high school students. *Journal of Environmental Management*, *58*(3), 213 230.

Australian Citizen Science Association (ACSA). (2019). *Discover another side of scientific research*. Available at: https://citizenscience.org.au/wp-content/uploads/2018/01/Australian-Citizen-Science-Association-brochure.pdf

Bain, R. (2016). Citizen science and statistics: Playing a part. *Significance*, *13*(1), 16-21.

Baily, B., & Pearson, A. W. (2007). Change detection mapping and analysis of salt marsh areas of central southern England from Hurst Castle Spit to Pagham Harbour. *Journal of Coastal Research*, 1549-1564.

Ballard, H. L., Trettevick, J. A., & Collins, D. (2012). Comparing participatory ecological research in two contexts: an immigrant community and a Native American community on Olympic Peninsula, Washington. In *Partnerships for Empowerment* (pp. 211-240). Routledge.

Ballinger, R. (n.d.). FINAL REPORT, The COREPOINT Partner Survey Evaluation of local ICZM efforts.

Beeharry, Y., Makoondlall-Chadee, T. & Bokhoree, C. (2014). Policy Analysis for Performance Assessment of Integrated Coastal Zone Management Initiatives for CoastalSustainability. *APCBEE Procedia*, 9, 30 – 35.

Blanch, D. C., Hall, J. A., Roter, D. L., & Frankel, R. M. (2008). Medical student gender and issues of confidence. *Patient Education and Counselling*, *72*(3), 374-381.

Blossom, T. (2012). *Fishing for Data: Potential for Citizen Science to Conserve Freshwater Ecosystems* (Doctoral dissertation, Department of Life Sciences, Silwood Park, Imperial College London).

Bonney, R., Cooper, C., & Ballard, H. (2016). The theory and practice of citizen science: Launching a new journal. *Citizen Science: Theory and Practice*, *1*(1).

Bonney, R., Cooper, C. B., Dickinson, J., Kelling, S., Phillips, T., Rosenberg, K. V., & Shirk, J. (2009). Citizen science: a developing tool for expanding science knowledge and scientific literacy. *BioScience*, *59*(11), 977-984.

Bögeholz, S. (2006). Nature experience and its importance for environmental knowledge, values and action: Recent German empirical contributions. *Environmental Education Research*, *12*(1), 65-84.

Borja, Á., Elliott, M., Carstensen, J., Heiskanen, A. S., & van de Bund, W. (2010). Marine management–towards an integrated implementation of the European Marine Strategy Framework and the Water Framework Directives. *Marine Pollution Bulletin*, *60*(12), 2175-2186.

Boyes, S. J., & Elliott, M. (2003). Effectiveness, efficiency & weakness of enforcement in the UK marine environment responses to questionnaire. *Unpublished Report. Institute of Estuarine & Coastal Studies, University of Hull, Hull HU6 7RX. Report to JNCC. Available from:< http://www. jncc. gov. uk/page-2819*.

Brenna, B. (2011). Clergymen abiding in the fields: The making of the naturalist observer in eighteenth-century norwegian natural history. *Science in Context*, *24*(2), 143-166.

Brennan, J., Fitzsimmons, C., Gray, T., & Raggatt, L. (2014). EU marine strategy framework directive (MSFD) and marine spatial planning (MSP): Which is the more dominant and practicable contributor to maritime policy in the UK?. *Marine Policy*, *43*, 359-366.

Brossard, D., Lewenstein, B., & Bonney, R. (2005). Scientific knowledge and attitude change: The impact of a citizen science project. *International Journal of Science Education*, *27*(9), 1099-1121.

Bryman, A. (2016). *Social research methods*. Oxford university press.

Cheng, C. A. S., Bond, K., Lockwood, C., & Hansen, S. (2012). Calibrating collaboration: monitoring and adaptive management of the Landscape Working Group process on the Grand Mesa, Uncompahgre and Gunnison National Forests in Western Colorado. In *Partnerships for Empowerment* (pp. 171-190). Routledge.

Christie, P., Bennett, N. J., Gray, N. J., Wilhelm, T. A., Lewis, N. A., Parks, J., ... & Taei, S. (2017). Why people matter in ocean governance: Incorporating human dimensions into large-scale marine protected areas. *Marine Policy*, *84*, 273-284.

Churchill, R., & Owen, D. (2010). *The EC common fisheries policy*. Oxford University Press.

Cicin-Sain, B., Knecht, R. W. (1998). *Integrated coastal and ocean management: concepts and practices*. Island press.

Cigliano, J. A., & Ballard, H. L. (Eds.). (2017). *Citizen science for coastal and marine conservation*. Routledge.

Cigliano, J. A., Meyer, R., Ballard, H. L., Freitag, A., Phillips, T. B., & Wasser, A. (2015). Making marine and coastal citizen science matter. *Ocean & Coastal Management, 115*, 77-87

Cigliano, J. A. & Ridlon, A. D. (2017). Uniquely Marine: Snorkelers and divers as citizen scientists. In J.A. Cigliano & H.L. Ballard (Eds), *Citizen science for coastal and marine conservation (pp. 237 –257).* Routledge

Collie, J. S., Beck, M. W., Craig, B., Essington, T. E., Fluharty, D., Rice, J., & Sanchirico, J. N. (2013). Marine spatial planning in practice. *Estuarine, Coastal and Shelf Science*, *117*, 1-11.

Cormick, C. (2012). How do we gain the interest of people who are uninterested in science and technology. In *Little by little: Expansion of Nanoscience and Emerging Technologies* (pp. 77-88). IOS Press.

Costanza, R., Andrade, F., Antunes, P., Van Den Belt, M., Boersma, D., Boesch, D. F., ... & Molitor, M. (1998). Principles for sustainable governance of the oceans. *Science*, *281*(5374), 198-199.

Crall, A. W., Jordan, R., Holfelder, K., Newman, G. J., Graham, J., & Waller, D. M. (2013). The impacts of an invasive species citizen science training program on participant attitudes, behavior, and science literacy. *Public Understanding of Science*, *22*(6), 745 764.

Crane, N. L., Rulmal, J. B., Nelson, P. A., Paddock, M. J. and Bernardi, G. (2017). Collaborating with Indigenous Citizen Scientists towards Sustainable Coral Reef Management in a Changing World. In J.A. Cigliano & H.L. Ballard (Eds), *Citizen science for coastal and marine conservation (pp. 197 –216).* Routledge

Critchley, C. R. (2008). Public opinion and trust in scientists: The role of the research context, and the perceived motivation of stem cell researchers. *Public Understanding of Science*, *17*(3), 309-327.

Cohn, J. P. (2008). Citizen science: Can volunteers do real research?. *BioScience*, *58*(3), 192 197.

Conrad, C. C., & Hilchey, K. G. (2011). A review of citizen science and community-based environmental monitoring: issues and opportunities. *Environmental Monitoring and Assessment*, *176*(1-4), 273-291.

Cope, S. N., Bradbury, A. P., & Gorczynska, M. (2008). Solent dynamic coast project: Main report; a tool for SMP2. *New Forest District Council and the Channel Coastal Observatory, Southampton, UK*.

Cornwall, A. (2008). Unpacking 'Participation': models, meanings and practices. *Community Development Journal*, *43*(3), 269-283.

Cousins, J.A., Huxham, M. and Winton, D. (2017). Using Citizen Science to Address Conservation Issues Related to Climate Change and Coastal Systems. In J.A. Cigliano & H.L. Ballard (Eds), *Citizen science for coastal and marine conservation (pp. 39 –58).* Routledge

Creswell, J. W., & Poth, C. N. (2017). *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications.

Danielsen, F., Burgess, N. D., Balmford, A., Donald, P. F., Funder, M., Jones, J. P., ... & Child, B. (2009). Local participation in natural resource monitoring: a characterization of approaches. *Conservation Biology*, *23*(1), 31-42.

Danielsen, F., Burgess, N. D., Jensen, P. M., & Pirhofer-Walzl, K. (2010). Environmental monitoring: the scale and speed of implementation varies according to the degree of peoples involvement. *Journal of Applied Ecology*, *47*(6), 1166-1168.

De la Torre-Castro, M., Fröcklin, S., Börjesson, S., Okupnik, J., & Jiddawi, N. S. (2017). Gender analysis for better coastal management–Increasing our understanding of social ecological seascapes. *Marine Policy*, *83*, 62-74.

Dean, A. J., Church, E. K., Loder, J., Fielding, K. S., & Wilson, K. A. (2018). How do marine and coastal citizen science experiences foster environmental engagement?. *Journal of Environmental Management*, *213*, 409-416.

Dean, A. J., Fielding, K. S., Lindsay, J., Newton, F. J., & Ross, H. (2016). How social capital influences community support for alternative water sources. *Sustainable Cities and Society*, *27*, 457-466.

Defra. (2009). A strategy for promoting an integrated approach to the management of coastal areas in England. London: Defra.

Defra. (2011). Defra's Evidence Investment Strategy: 2010–2013 and beyond. 2011 Update. London, UK: Department of Environment, Food and Rural Affairs. Available at:

https://www.gov.uk/government/publications/defra-s-evidence-investment-strategy-2010-to-2013-and-beyond

Delaney, D. G., Sperling, C. D., Adams, C. S., & Leung, B. (2008). Marine invasive species: validation of citizen science and implications for national monitoring networks. *Biological Invasions*, *10*(1), 117-128.

Department for Education. (2017). Education and training statistics for the United Kingdom. SFR64/2017, 9 November 2017

Dickinson, J. L., Shirk, J., Bonter, D., Bonney, R., Crain, R. L., Martin, J., ... & Purcell, K. (2012). The current state of citizen science as a tool for ecological research and public engagement. *Frontiers in Ecology and the Environment*, *10*(6), 291-297.

Dickinson, J. L., Zuckerberg, B., & Bonter, D. N. (2010). Citizen science as an ecological research tool: challenges and benefits. *Annual Review of Ecology, Evolution, and Systematics*, *41*, 149-172.

Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). *Internet, phone, mail, and mixed-mode surveys: the tailored design method*. John Wiley & Sons.

Dresner, M., Handelman, C., Braun, S., & Rollwagen-Bollens, G. (2015). Environmental identity, pro-environmental behaviours, and civic engagement of volunteer stewards in Portland area parks. *Environmental Education Research*, *21*(7), 991-1010.

Dutcher, D. D., Finley, J. C., Luloff, A. E., & Johnson, J. B. (2007). Connectivity with nature as a measure of environmental values. *Environment and Behavior*, *39*(4), 474-493.

Easman, E. S., Abernethy, K. E., & Godley, B. J. (2018). Assessing public awareness of marine environmental threats and conservation efforts. *Marine Policy*, *87*, 234-240.

Edwards, R., Kirn, S., Hillman, T., Kloetzer, L., Mathieson, K., McDonnell, D., & Phillips, T. (2018). Learning and developing science capital through citizen science. UCL Press.

European Citizen Science Association (ECSA) (2015). *Ten principles of citizen science.* Available at:
https://ecsa.citizen-science.net/sites/default/files/ecsa_ten_principles_of_citizen_science.pdf

European Commission (2013). *Science for Environment Policy In-depth Report: Environmental Citizen Science*. Report produced for the European Commission DG Environment, December 2013. Available at:

http://ec.europa.eu/environment/integration/research/newsalert/pdf/IR9_en.pdf

Evans, S. M., Birchenough, A. C., & Fletcher, H. (2000). The value and validity of community based research: TBT contamination of the North Sea. *Marine Pollution Bulletin*, *40*(3), 220-225.

Fernandez-Gimenez, M., Ballard, H., & Sturtevant, V. (2008). Adaptive management and social learning in collaborative and community-based monitoring: a study of five community-based forestry organizations in the western USA. *Ecology and Society*, *13*(2).

Field, A. (2018). *Discovering statistics using IBM SPSS statistics*. SAGE.

Finn, P. G., Udy, N. S., Baltais, S. J., PRICE, K., & Coles, L. (2010). Assessing the quality of seagrass data collected by community volunteers in Moreton Bay Marine Park, Australia. *Environmental Conservation*, *37*(1), 83-89.

Fishbein, M., & Ajzen, I. (2011). *Predicting and changing behavior: The reasoned action approach*. Psychology press.

Fletcher, K. M. (2005). Regional ocean governance: the role of the Public Trust Doctrine. *Duke Envtl. L. & Pol'y F.*, *16*, 187.

Fletcher, S. (2007). Converting science to policy through stakeholder involvement: an analysis of the European Marine Strategy Directive. *Marine Pollution Bulletin*, *54*(12), 1881 1886.

Fletcher, S., Jefferson, R., Glegg, G., Rodwell, L., & Dodds, W. (2014). England's evolving marine and coastal governance framework. *Marine Policy*, *45*, 261-268.

Fletcher, S., Johnson, D., & Hewett, T. (2007). Coastal management in the Solent: an introduction. *Marine Policy*, *31*(5), 585-590.

Fletcher, S., & Potts, J. (2007). Ocean citizenship: an emergent geographical concept. *Coastal Management*, *35*(4), 511-524.

Follett, R., & Strezov, V. (2015). An analysis of citizen science based research: usage and publication patterns. *PloS One*, *10*(11), e0143687.

Foster, T. (2013). A critical analysis of the attitudes and perceptions of recreational boaters based in Portsmouth Harbour and Langstone Harbour towards Marine Conservation Zones (Unpublished Master's dissertation). University of Portsmouth, Portsmouth, UK.

Foster, N. M., Hudson, M. D., Bray, S., & Nicholls, R. J. (2014). Research, policy and practice for the conservation and sustainable use of intertidal mudflats and saltmarshes in the Solent from 1800 to 2016. *Environmental Science & Policy*, *38*, 59-71.

Garcia-Soto, C., van der Meeren, G. I., Busch, J. A., Delany, J., Domegan, C., Dubsky, K., Fauville, G., Gorsky, G. von Juterzenka, K., Malfatti, F., Mannaerts, G., McHugh, P., Monestiez, P., Seys, J., Węsławski, J.M. & Zielinski, O. (2017). Advancing Citizen Science for Coastal and Ocean Research. French, V., Kellett, P., Delany, J., McDonough, N. [Eds.] *Position Paper 23 of the European Marine Board*, Ostend, Belgium. 112pp. ISBN: 978-94-92043-30-6

Gauchat, G. (2011). The cultural authority of science: Public trust and acceptance of organized science. *Public Understanding of Science*, *20*(6), 751-770.

Geoghegan, H., Dyke, A., Pateman, R., West, S. & Everett, G. (2016). *Understanding motivations for citizen science*. Final report on behalf of UKEOF, University of Reading, Stockholm Environment Institute (University of York) and University of the West of England.

Gollan, J. (2013). Citizen science can produce reliable data. *The Conversation*, from *http://theconversation.com/citizen-science-can-produce-reliabledata-10815*.

Gray, D. E. (2018). *Doing research in the real world*. Los Angeles: Sage.

Gray, D., Canessa, R., Rollins, R., Dearden, P and Keller, C. (2010). Understanding Recreational Boater Attitudes to Zoning in a Proposed Marine Protected Area. Coastal Management, 38, (6), pp.575-597. DOI: 10.1080/08920753.2010.523413

Habitat Directive (1992). Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. *Official Journal of the European Union*, *206*, 7-50.

Haklay, M. (2013). Citizen science and volunteered geographic information: Overview and typology of participation. In *Crowdsourcing geographic knowledge* (pp. 105-122). Springer, Dordrecht.

Haklay, M. (2015). Citizen science and policy: A European perspective. *Washington, DC: Woodrow Wilson International Center for Scholars*.

Haklay, M. (2018). Participatory citizen science. In: Hecker, S., Haklay, M., Bowser, A., Makuch, Z., Vogel, J. & Bonn, A. *Citizen Science: Innovation in Open Science, Society and Policy*. UCL Press, London. https://doi.org/10.14324/111.9781787352339

Halpern, B. S., Longo, C., Hardy, D., McLeod, K. L., Samhouri, J. F., Katona, S. K., ... & Rosenberg, A. A. (2012). An index to assess the health and benefits of the global ocean. *Nature*, *488*(7413), 615.

Hamilton, G. (2010, July). Statistical training for non-statistical staff at the office for national statistics. In *Data and context in statistics education: Towards an evidence-based society. Proceedings of the Eighth International Conference on Teaching Statistics (ICOTS8.*

Harbour Guide (2019). Langstone Harbour Board. *Harbour guide, 2019 guides, tides and charges.* Available here: http://www.langstoneharbour.org.uk/images/upload/files/about-publications-files_pdf_2403.pdf

Harding, S., Nelson, L., & Glover, T. (2016). Solent Oyster Restoration Project Management Plan. *Blue Marine Foundation (BLUE), London, UK*.

Hartley, B. L., Thompson, R. C., & Pahl, S. (2015). Marine litter education boosts children's understanding and self-reported actions. *Marine Pollution Bulletin*, *90*(1-2), 209-217.

Hawkins, J. P., O'Leary, B. C., Bassett, N., Peters, H., Rakowski, S., Reeve, G., & Roberts, C. M. (2016). Public awareness and attitudes towards marine protection in the United Kingdom. *Marine Pollution Bulletin*, *111*(1-2), 231-236.

Haywood, B. K. (2014). A "sense of place" in public participation in scientific research. *Science Education*, *98*(1), 64-83.

Hecker, S., Bonney, R., Haklay, M., Hölker, F., Hofer, H., Goebel, C., ... & Robinson, L. (2018). Innovation in citizen science–perspectives on science-policy advances. *Citizen Science: Theory and Practice*, *3*(1).

Hecker, S., Haklay, M., Bowser, A., Makuch, Z., & Vogel, J. (Eds.). (2018). *Citizen science: innovation in open science, society and policy*. UCL Press.

Hecker, S., Luckas, M., Brandt, M., Kikillus, H., Marenbach, I., Schiele, B., ... & Wende, W. (2018). Stories can change the world–citizen science communication in practice. UCL Press.

Henry, G. W., & Lyle, J. M. (2003). National recreational and indigenous fishing survey. Canberra, Australia: Australian Government Department of Agriculture, Fisheries and Forestry.

Hering, D., Borja, A., Carstensen, J., Carvalho, L., Elliott, M., Feld, C. K., ... & Solheim, A. L. (2010). The European Water Framework Directive at the age of 10: a critical review of the achievements with recommendations for the future. *Science of the Total Environment*, *408*(19), 4007-4019.

Heubach, K., & Lambini, C. K. (2018). Distribution and selection of experts in the intergovernmental science-policy platform on biodiversity and ecosystem services (IPBES): the case of the regional assessment for Africa. *Innovation: The European Journal of Social Science Research*, *31*(sup1), S61-S77.

Hind-Ozan, E. J., Pecl, G. T., & Ward-Paige, C. A. (2017). Communication and trust-building with the broader public through coastal and marine citizen science. In *Citizen Science for Coastal and Marine Conservation* (pp. 261-278). Routledge.

Hobbs, S. J., & White, P. C. (2012). Motivations and barriers in relation to community participation in biodiversity recording. *Journal for Nature Conservation*, *20*(6), 364 373.

Hochachka, W. M., Fink, D., Hutchinson, R. A., Sheldon, D., Wong, W. K., & Kelling, S. (2012). Data-intensive science applied to broad-scale citizen science. *Trends in Ecology & Evolution*, *27*(2), 130-137.

Howell, K. E. (2012). *An introduction to the philosophy of methodology*. Sage.

Hyder, K., Townhill, B., Anderson, L. G., Delany, J., & Pinnegar, J. K. (2015). Can citizen science contribute to the evidence-base that underpins marine policy?. *Marine Policy*, *59*, 112-120.

Inshore Fisheries and Conservation Authority (IFCA) (2019). *The Solent European Marine Site (EMS)*. Available at http://www.southern-ifca.gov.uk/the-solent-ems

Irani, L. (2004, March). Understanding gender and confidence in CS course culture. In *ACM SIGCSE Bulletin* (Vol. 36, No. 1, pp. 195-199). ACM.

Irwin, A. (2002). *Citizen science: A study of people, expertise and sustainable development*. Routledge.

IUCN/WWF (International Union for Conservation of Nature, & World Wildlife Fund). (1980). *World conservation strategy: Living resource conservation for sustainable development*. Gland, Switzerland: IUCN.

Jaine, F. R., Couturier, L. I., Weeks, S. J., Townsend, K. A., Bennett, M. B., Fiora, K., & Richardson, A. J. (2012). When giants turn up: sighting trends, environmental influences and habitat use of the manta ray Manta alfredi at a coral reef. *PloS One*, *7*(10), e46170.

Janis L.D. and Bonney R.E. (Eds.). (2012). Citizen Science: Public Participation in Environmental Research. Cornell University Press.

Jefferson, R. L., Bailey, I., Richards, J. P., & Attrill, M. J. (2014). Public perceptions of the UK marine environment. *Marine Policy*, *43*, 327-337.

Jefferson, R., McKinley, E., Capstick, S., Fletcher, S., Griffin, H., & Milanese, M. (2015). Understanding audiences: making public perceptions research matter to marine conservation. *Ocean & Coastal Management*, *115*, 61-70.

Jenkins, E. W. (1999). School science, citizenship and the public understanding of science. *International Journal of Science Education*, *21*(7), 703-710.

Jordan, R. C., Brooks, W. R., Howe, D. V., & Ehrenfeld, J. G. (2012). Evaluating the performance of volunteers in mapping invasive plants in public conservation lands. *Environmental Management*, *49*(2), 425-434.

Jordan, R. C., Gray, S. A., Howe, D. V., Brooks, W. R., & Ehrenfeld, J. G. (2011). Knowledge gain and behavioral change in citizen-science programs. *Conservation Biology*, *25*(6), 1148-1154.

Kelly, R., Fleming, A., Pecl, G., Richter, A., & Bonn, A. (2019). Social license through citizen science: a tool for marine conservation. *Ecology and Society*, *24*(1).

Kilubi, I. (2017). Research methodology and data collection. *Strategic Technology Partnering and Supply Chain Risk Management*, (April 2016), 79–89. https://doi.org/10.1007/978-3-658-19918-0_8

Koch, L. C., Niesz, T., & McCarthy, H. (2014). Understanding and reporting qualitative research: An analytical review and recommendations for submitting authors. *Rehabilitation Counseling Bulletin, 57*(3), 131-143.

Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Age International.

Kumar, R. (2019). *Research methodology: A step-by-step guide for beginners*. Sage Publications Limited.

Laffoley, D., Baxter, J. M., Day, J. C., Wenzel, L., Bueno, P., & Zischka, K. (2019). Marine Protected Areas. In *World Seas: An Environmental Evaluation* (pp. 549-569). Academic Press

Langstone Harbour (2009). Langstone Harbour Management Plan Environmental Revisions 2009.

Langstone Harbour (N.D). Retrieved from: http://www.havantnature.net/langstone_harbour.html [23/07/2019]

Langstone Harbour Board (LHB) (2019). *Maps. Welcome to Langstone Harbour* http://www.langstoneharbour.org.uk/about-harbour-maps.php

Lawrence, A. (2006). 'No personal motive?' Volunteers, biodiversity, and the false dichotomies of participation. *Ethics Place and Environment, 9*(3), 279-298.

Lawrence, A. (Ed.). (2010). *Taking stock of nature: Participatory biodiversity assessment for policy, planning and practice*. Cambridge University Press.

Leiserowitz, A. A., Maibach, E. W., Roser-Renouf, C., Smith, N., & Dawson, E. (2013). Climategate, public opinion, and the loss of trust. *American Behavioral Scientist*, *57*(6), 818-837.

Leonardi, S., Lamb, H., Howe, P., & Choudhoury, A. (2017). State of the nation report' of UK primary science education.

Lewandowski, E., Caldwell, W., Elmquist, D., & Oberhauser, K. (2017). Public perceptions of citizen science. *Citizen Science: Theory and Practice, 2*(1).

Lewandowski, E., & Specht, H. (2015). Influence of volunteer and project characteristics on data quality of biological surveys. *Conservation Biology*, *29*(3), 713-723.

Liu, C. C., & Falk, J. H. (2014). Serious fun: Viewing hobbyist activities through a learning lens. *International Journal of Science Education, Part B*, *4*(4), 343-355.

Louv, R., & Fitzpatrick, J. W. (2012). *Citizen science: Public participation in environmental research*. Cornell University Press.

Mackenzie, B., Celliers, L., de Freitas Assad, L. P., Heymans, J. J., Rome, N., Thomas, J. O., ... & DiGiacomo, P. (2019). The role of stakeholders and actors in creating societal value from coastal and ocean observations. *Frontiers in Marine Science*, *6*, 137.

Maguire, B. (2010). The role of stakeholders in the marine planning process: a critical analysis of potential stakeholder involvement within the Solent (Unpublished Master's dissertation). University of Portsmouth, Portsmouth, UK.

Maguire, B., Potts, J., & Fletcher, S. (2011). Who, when, and how? Marine planning stakeholder involvement preferences–A case study of the Solent, United Kingdom. *Marine Pollution Bulletin*, *62*(11), 2288-2292.

Makuch, K. E. & Aczel, M. R. (2018). Children and citizen science. In: Hecker, S., Haklay, M., Bowser, A., Makuch, Z., Vogel, J. & Bonn, A. *Citizen Science: Innovation in Open Science, Society and Policy*. UCL Press, London. https://doi.org/10.14324/111.9781787352339

Marine Conservation Society (MCS). (2019). the Marine Litter Action Network (MLAN). Viewed on 15/07/2019, Available at: https://www.mcsuk.org/clean-seas/mlan

Martin, V. Y. (2017). Citizen science as a means for increasing public engagement in science: presumption or possibility?. *Science Communication*, *39*(2), 142-168.

Martin, V., Christidis, L., Lloyd, D., & Pecl, G. (2016a). Understanding drivers, barriers and information sources for public participation in marine citizen science. *Journal of Science Communication*, *15*(2), A02.

Martin, V. Y., Christidis, L., & Pecl, G. T. (2016b). Public interest in marine citizen science: is there potential for growth?. *BioScience*, *66*(8), 683-692.

Martin, V., Smith, L., Bowling, A., Christidis, L., Lloyd, D., & Pecl, G. (2016c). Citizens as scientists: what influences public contributions to marine research?. *Science Communication*, *38*(4), 495-522.

McAuliffe, S. (2011). Establishing attitudes and perceptions of recreational boaters, based in the Hamble, towards Marine Conservation Zones (Unpublished Master's dissertation). University of Portsmouth, Portsmouth, UK.

McKinley, E., & Fletcher, S. (2012). Improving marine environmental health through marine citizenship: a call for debate. *Marine Policy*, *36*(3), 839-843.

McKinley, D. C., Miller-Rushing, A. J., Ballard, H. L., Bonney, R., Brown, H., Cook-Patton, S. C., ... & Ryan, S. F. (2017). Citizen science can improve conservation science, natural resource management, and environmental protection. *Biological Conservation*, *208*, 15-28.

McKinley, D. C., Miller-Rushing, A. J., Ballard, H. L., Bonney, R., Brown, H., Evans, D. M., ... & Shanley, L. A. (2015). Investing in citizen science can improve natural resource management and environmental protection. *Issues in Ecology*, *2015*(19), 1-27.

McLeod, S.A. (2018). Questionnaire. Retrieved from https://www.simplypsychology.org/questionnaires.html

Measham, T. G., & Barnett, G. B. (2008). Environmental volunteering: Motivations, modes and outcomes. *Australian Geographer*, *39*(4), 537-552.

Meiner, A. (2010). Integrated maritime policy for the European Union—consolidating coastal and marine information to support maritime spatial planning. *Journal of Coastal Conservation*, *14*(1), 1-11.

Mercer-Mapstone, L. D. (2018). *The role of dialogue in social licence to operate in the extractives sector*. PhD Thesis, Sustainable Minerals Institute, The University of Queensland. https://doi.org/10.14264/uql.2018.544

Miller, J. R. (2005). Biodiversity conservation and the extinction of experience. *Trends in Ecology & Evolution*, *20*(8), 430-434.

Miller-Rushing, A., Primack, R., & Bonney, R. (2012). The history of public participation in ecological research. *Frontiers in Ecology and the Environment*, *10*(6), 285-290.

Morais, A. M. M., Raddick, J., & dos Santos, R. D. C. (2013, May). Visualization and characterization of users in a citizen science project. In *Next-Generation Analyst* (Vol. 8758, p. 87580L). International Society for Optics and Photonics.

Nursey-Bray, M., Palmer, R., & Pecl, G. (2018). Spot, log, map: Assessing a marine virtual citizen science program against Reed's best practice for stakeholder participation in environmental management. *Ocean and Coastal Management*, *151*, 1-9.

Oppenheim, A. (1992). Questionnaire Design, Interviewing and Attitude Measurement, London, Pinter. Pp 303

Osborne, J. W. (2014). *Best practices in logistic regression*. Sage Publications.

Osborne, J. W. (2016). *Regression & linear modeling: Best practices and modern methods*. Sage Publications.

Pahl-Wostl, C., Mostert, E., & Tàbara, D. (2008). The growing importance of social learning in water resources management and sustainability science. *Ecology and Society*, *13*(1), 24.

Parrish, J. K., Little, K., Dolliver, J., Hass, T., Burgess, H. K., Frost, E., Wright, C. W. and Jones, T. (2017). Defining the Baseline and Tracking Change in Seabird Populations. In J.A. Cigliano & H.L. Ballard (Eds), *Citizen science for coastal and marine conservation (pp. 19 –38).* Routledge

Patton, M. Q. (1990). *Qualitative evaluation and research methods*. SAGE Publications, inc.

Pecl, G. T., Stuart-Smith, J., Walsh, P., Bray, D., Brians, M., Burgess, M., ... & Keane, J. (2019). Redmap Australia: challenges and successes with a large-scale citizen science based approach to ecological monitoring and community engagement on climate change. *Frontiers in Marine Science*, *6*, 349.

Potts, J. S. (1999). *The Information Needs and Resource Requirements of Coastal Defence Groups in England and Wales*.

Prager, K., Baggaley, N., Donnelly, D., Mckee, A., Lilly, A., & Cooksley, S. (2014). *How can we employ citizen science to determine the extent of soil erosion in Scotland?* Technical Report (DP02) (June, 2014).

Prior, S. (2011). Investigating the use of voluntary marine management in the protection of UK marine biodiversity. *Report to the RSPB, Sandy, UK [www document]. URL http://www.rspb.org.uk/Images/RSPB_Voluntary_Marine_Management_2011_tcm9–291744.pdf.*

Probert, P. K. (2017). *Marine Conservation*. Cambridge University Press.

Raddick, M. J., Bracey, G., Gay, P. L., Lintott, C. J., Murray, P., Schawinski, K., ... & Vandenberg, J. (2009). Galaxy zoo: Exploring the motivations of citizen science volunteers. *arXiv preprint arXiv:0909.2925*.

Raddick, M. J., Bracey, G., Gay, P. L., Lintott, C. J., Cardamone, C., Murray, P., ... & Vandenberg, J. (2013). Galaxy Zoo: Motivations of citizen scientists. *ArXiv Preprint arXiv:1303.6886*.

Rasmussen, L. M. and Cooper, C. (2019). Citizen Science Ethics. *Citizen Science: Theory and Practice*, 4(1): 5, pp. 1–3. DOI: https://doi.org/10.5334/cstp.235

Riesch, H., & Potter, C. (2014). Citizen science as seen by scientists: Methodological, epistemological and ethical dimensions. *Public Understanding of Science*, *23*(1), 107 - 120.

Rogers, Z., & Bragg, E. (2012). The power of connection: Sustainable lifestyles and sense of place. *Ecopsychology*, *4*(4), 307-318.

Roy, H. E., Pocock, M. J. O., Preston, C. D., Roy, D. B., Savage, J., Tweddle, J. C., & Robinson, L. D. (2012). Understanding citizen science and environmental monitoring. *Final Report on Behalf of UK-EOF. NERC Centre for Ecology & Hydrology and Natural History Museum*, 10-11.

Ryan, R. L., Kaplan, R., & Grese, R. E. (2001). Predicting volunteer commitment in environmental stewardship programmes. *Journal of Environmental Planning and Management*, *44*(5), 629-648.

Saldaña, J. (2016). *The coding manual for qualitative researchers*. London: Sage.

Santoro, F., Selvaggia, S., Scowcroft, G., Fauville, G., & Tuddenham, P. (2017). *Ocean literacy for all: a toolkit* (Vol. 80). UNESCO Publishing.

Sara, P., Elena, A., Rebecca, G. and Alex, A. (November 14th 2017). *UK's role in degradation of the marine environment*. House of Commons Library, Debate Pack. Number CDP 2017-225

Savan, B., Morgan, A. J., & Gore, C. (2003). Volunteer environmental monitoring and the role of the universities: the case of Citizens' Environment Watch. *Environmental Management*, *31*(5), 0561-0568.

Schläppy, M. L., Loder, J., Salmond, J., Lea, A., Dean, A. J., & Roelfsema, C. M. (2017). Making waves: marine citizen science for impact. *Frontiers in Marine Science*, *4*, 146.

Schlomer, G. L., Bauman, S., & Card, N. A. (2010). Best practices for missing data management in counseling psychology. *Journal of Counseling Psychology*, *57*(1), 1.

Segal, A., Gal, Y. A. K., Simpson, R. J., Victoria Homsy, V., Hartswood, M., Page, K. R., & Jirotka, M. (2015, May). Improving productivity in citizen science through controlled intervention. In *Proceedings of the 24th International Conference on World Wide Web* (pp. 331-337). ACM.

Shamir, L., Yerby, C., Simpson, R., von Benda-Beckmann, A. M., Tyack, P., Samarra, F., ... & Wallin, J. (2014). Classification of large acoustic datasets using machine learning and crowdsourcing: Application to whale calls. *The Journal of the Acoustical Society of America*, *135*(2), 953-962.

Shirk, J., Ballard, H., Wilderman, C., Phillips, T., Wiggins, A., Jordan, R., ... & Bonney, R. (2012). Public participation in scientific research: a framework for deliberate design. *Ecology and Society*, *17*(2).

Silvertown, J. (2009). A new dawn for citizen science. *Trends in Ecology & Evolution*, *24*(9), 467-471.

Singh, N., Danell, K., Edenius, L., & Ericsson, G. (2014). Tackling the motivation to monitor: success and sustainability of a participatory monitoring program. *Ecology and Society*, *19*(4).

Singh, Y. K. (2006). *Fundamental of research methodology and statistics*. New Age International.

Smith, S. D., & Edgar, R. J. (2014). Documenting the density of subtidal marine debris across multiple marine and coastal habitats. *PloS One*, *9*(4), e94593.

Smith, T.J., & McKenna, C.M. (2013). A comparison of logistic regression pseudo R^2. *Multiple Linear Regression Viewpoints, 39,* 17-26. Retrieved from http://www.glmj.org/archives/articles/Smith_v39n2.pdf (30/08/2019).

Spence, E., Pidgeon, N., & Pearson, P. (2018). UK public perceptions of Ocean Acidification The importance of place and environmental identity. *Marine Policy*, *97*, 287-293.

Soen, V., & Huyse, T. (2016). Citizen Science in Flanders: Can we count on you?

Soma, K., & Haggett, C. (2015). Enhancing social acceptance in marine governance in Europe. *Ocean & Coastal Management*, *117*, 61-69.

SPICOSA (Science and Policy Integration for Coastal System Assessment). (2018). System Approach Framework (SAF).
Retrieved 13/07/2019 http://www.coastal-saf.eu/introduction/index.shtml

Straub, M. (2016). Giving citizen scientists a chance: A study of volunteer-led scientific discovery. *Citizen Science: Theory and Practice*, *1*(1).

Team, H. (2012). Harmonised concepts and questions for social data sources, secondary standards: social capital. *Office for National Statistics*.

Teijligen, E. R., & Hundley, S. (2001). Social research update: The importance of pilot studies. *Guildford, UK: University of Surrey*.

Theobald, E. J., Ettinger, A. K., Burgess, H. K., DeBey, L. B., Schmidt, N. R., Froehlich, H. E., ... & Parrish, J. K. (2015). Global change and local solutions: Tapping the unrealized potential of citizen science for biodiversity research. *Biological Conservation*, *181*, 236-244.

Thiel, M., Hong, S., Jambeck, J. R., Gatta-Rosemary, M., Honorato-Zimmer, D., Kiessling, T., ... & Kruse, K. (2017). Marine litter–bringing together citizen scientists from around the world. In *Citizen Science for Coastal and Marine Conservation* (pp. 104-131). Routledge.

Thiel, M., Penna-Díaz, M. A., Luna-Jorquera, G., Salas, S., Sellanes, J., & Stotz, W. (2014). Citizen scientists and marine research: volunteer participants, their contributions, and projection for the future. *Oceanography and Marine Biology: An Annual Review*, *52*, 257-314.

Toomey, A. H., & Domroese, M. C. (2013). Can citizen science lead to positive conservation attitudes and behaviors. *Human Ecology Review*, *20*(1), 50-62.

Toth, B. D. (2015). Diary of a Citizen Scientist: Chasing Tiger Beetles and Other New Ways of Engaging the World Teresa of the New World.

Townhill, B. L., and Hyder, K. (2017). Citizen science and Marine Policy. In J.A. Cigliano & H.L. Ballard (Eds), *Citizen science for coastal and marine conservation (pp. 178 - 193).* Routledge

Tweddle, J. C., Robinson, L. D., Pocock, M. J. O., & Roy, H. E. (2012). *Guide to citizen science: developing, implementing and evaluating citizen science to study biodiversity and the environment in the UK*. Natural History Museum and NERC Centre for Ecology & Hydrology for UK-EOF. Available online: www.ukeof.org.uk

Tulloch, A. I., Possingham, H. P., Joseph, L. N., Szabo, J., & Martin, T. G. (2013). Realising the full potential of citizen science monitoring programs. *Biological Conservation, 165,* 128-138.

UK Harbours Directory (N.D). *Langstone*. Retrieved from: https://www.harbours.co.uk/langston/langston.html [23/07/2019]

UNEP (United Nations Environment Programme) (2006). *Marine and Coastal Ecosystems and Human Well-being*: A Synthesis Report Based on the Findings of the Millennium Ecosystems Assessment (Nairobi: UNEP).

van Broekhoven, W. (2010). *Perceptions driving local support for marine conservation* (Doctoral dissertation, Imperial College London).

van Ginkel, J. R., & van der Ark, L. A. (2005). SPSS syntax for missing value imputation in test and questionnaire data. *Applied Psychological Measurement*, *29*(2), 152-153.

Vann-Sander, S., Clifton, J., & Harvey, E. (2016). Can citizen science work? Perceptions of the role and utility of citizen science in a marine policy and management context. *Marine Policy*, *72*, 82-93.

Vetter, J. (2011). Introduction: lay participation in the history of scientific observation. *Science in Context*, *24*(2), 127-141.

Walliman, N. (2017). *Research methods: The basics*. Routledge.

Wasser, A. (2017). Engaging Youth and Schools in Coastal Citizen Science: Balancing both education and science goals. In J.A. Cigliano & H.L. Ballard (Eds), *Citizen science for coastal and marine conservation (pp. 217 –236).* Routledge

West, S. E., & Pateman, R. M. (2016). Recruiting and retaining participants in citizen science: What can be learned from the volunteering literature?. *Citizen Science: Theory and Practice*.

West, S. E., Pateman, R. M., & Dyke, A. J. (2015). Motivations and data submissions in citizen science. *Report to DEFRA.*

West, S. E, Pateman, R., & Dyke, A. (2016). *Data submission in citizen science projects report for DEFRA* (Project number PH0475). University of York

Wilmsen, C., & Krishnaswamy, A. (2012). Challenges to institutionalizing participatory research in community forestry in the US. In *Partnerships for Empowerment* (pp. 71 92). Routledge.

Wulfhorst, J. D., Eisenhauer, B. W., Gripne, S. L., & Ward, J. M. (2012). Core criteria and assessment of participatory research. In *Partnerships for Empowerment* (pp. 47-70). Routledge.

Yu, B., Cai, Y., Jin, L., & Du, B. (2018). Effects on Willingness to Pay for Marine Conservation: Evidence from Zhejiang Province, China. *Sustainability*, *10*(7), 2298.

ETHICS FORM

University of Portsmouth, Department of Geography
Ethics Review Checklist: MSc Version

To be completed by all MSc CMRM Students

- You are required to undertake an ethics review of your Independent Study Research Proposal. Before completing this checklist please read through the guidance documents on the Fieldwork and Research Methods Moodle site.
- When you have completed the checklist, submit it Dr M. Bray. This form must be submitted and approved BEFORE you start any data collection.

Student Name: Ibrahim LAWAN Student Number: UP915328
Preferred Supervisor (if known): Dr. Jonathan Potts
Independent Study Title: CRITICAL EVALUATION OF PUBLIC INTEREST IN CITIZEN SCIENCE FOR COASTAL AND MARINE CONSERVATION IN LANGSTONE HARBOUR.

Please indicate Yes or No (fill in a square use a tick etc.):-	Yes	No
[A] Is the study likely to involve human research subjects or participants?	☑	☐

*If **'Yes'**, please go to **Section [B]** on page 2*

*If **'No'**, please answer the following:-*

a) Are there risks of damage to physical and/or ecological environmental features – especially if within protected areas (nature reserves, SSSIs, national parks, EU designated habitats)?	☐	☐
b) Are there risks of damage to features of historical or cultural heritage?	☐	☐
c) Are there risks of harm to any animal?	☐	☐
d) Could the research outputs potentially be harmful to third parties?	☐	☐

If you have answered 'yes' to a), b), c) or d), then please provide details (in the space below) of how you plan to minimise any risks identified. You may attach additional information if necessary.

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Now go to page 4 and sign the Declaration (Section D)

1

[B] You intend to involve human research subjects. Will your data collection methods involve:-

TICK **ONE** BOX ONLY

1. Secondary sources (i.e. data that have already been collected and are in the public domain such as the UK Census of Population, data from web-resources such as ONS Neighbourhood Statistics or the various Government Departments' statistical pages) ☐
2. Primary sources (e.g. face-to-face interviews or questionnaires, focus groups or observational methods)? ☑
3. Both secondary and primary collection methods:- ☐

*If you ticked statement **number 2 or 3**, please go to **Section C** on the next page (page 3).*

*If you ticked **number 1** then please indicate whether there are any other potential problems relating to research ethics:-*

Please indicate Yes or No :-	Yes	No
4. Are there risks of damage to physical and/or ecological environmental features, especially if within protected areas (nature reserves, SSSIs, national parks, EU designated habitats)?	☐	☐
5. Are there risks of damage to features of historical or cultural heritage?	☐	☐
6. Are there risks of harm to any animal?	☐	☐
7. Could the research outputs potentially be harmful to third parties?	☐	☐

If you have answered 'yes' to 4), 5), 6) or 7), then please provide details (in the space below) of how you plan to minimise any risks identified. You may attach additional information if necessary.

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Now go to page 4 and sign the Declaration (Section D)

[C] In terms of the primary data collection methods on human subjects, please answer the following:-

Please indicate Yes or No:-	Yes	No
1. Will the study involve NHS patients, staff or premises?	☐	☑
2. Do human participants/subjects take part in studies without their knowledge/consent at the time or will deception of any form be used?	☐	☑
3. Does the study involve vulnerable or dependent participants (e.g. children or people with learning difficulties)	☐	☑
4. Are drugs, placebos or other substances (e.g. food, vitamins) to be administered to participants?	☐	☑
5. Will blood or tissue samples be obtained from participants?	☐	☑
6. Is pain or more than mild discomfort likely to result from the study?	☐	☑
7. Could the study induce psychological distress or anxiety in participants, or third parties?	☐	☑
8. Will the study involve prolonged or repetitive testing or participants?	☐	☑
9. Will financial inducements other than reasonable expenses be offered?	☐	☑

Please indicate whether there are any other general problems relating to research ethics:-

10. Are there risks of damage to physical and/or ecological environmental features (especially protected areas, nature reserves, SSSIs etc.)?	☐	☑
11. Are there risks of damage to features of historical or cultural heritage?	☐	☑
12. Are there risks of harm to any animal?	☐	☑
13. Could the research outputs potentially be harmful to third parties?	☐	☑

If you have answered 'yes' to 2, 3, 8, 9, 10, 11, 12 or 13 then you must provide additional details (in the space below) of how you plan to minimise any risks identified e.g. use of participant information sheets or consent forms. Please attach any additional materials if necessary.

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Now go to page 4 and sign the Declaration (Section D)

[D] Declaration

I confirm that the information provided is a complete and accurate record of my plans at present and that I shall resubmit an amended version of this form should my research alter significantly such that there is any significant variation of ethical risk. I confirm that I have read the University Ethics Policy (2017) and have read "Research Ethics Guidance, Geography Staff and Students" both available on the Fieldwork and Research Methods Moodle site.

If I need to construct a questionnaire or set of questions to use in an interview, then I will seek my supervisor's approval of the final wording and format. Where necessary, I will also provide a covering letter/information leaflet and consent form, which should be approved and countersigned by my Dissertation supervisor. NB Approved interview/questionnaire schedules will be eligible for letters of support, which can be obtained from your supervisors. By printing my name below and by submitting this form I understand that I am taking responsibility for this ethics review and for the conduct of the research.

Signed ..... IBRAHIM LAWAN ..... (Student)

Date 30/05/2019

[E] APPROVAL RECORD *(completed by Departmental Ethics Representative <u>after</u> you have submitted the checklist)*

Dr M. Bray will study your ethics checklist and will tick one of the boxes below. If there is a recommendation to undertake more work in terms of ethics (e.g. undertaking a more detailed ethics review) then instructions will be included with the returned form. If your proposal is <u>not</u> ethically viable then this will also be made clear and you will be asked to rethink your Independent Study proposal or topic. Please retain a copy of this form.

Favourable opinion : INSIGNIFICANT risk/issues arising ☑

Favourable opinion : INSIGNIFICANT risks subject to comments listed below ☐

Risks assessed as SIGNIFICANT referred for rethink/DETAILED Ethics Review ☐

Opinion not possible – reasons specified below ☐

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Signed..... (Departmental Ethics Officer)

Date 11/6/19

LIST OF APPENDICES

Appendix A: Web survey Questionnaire

Survey for Public Interests in Participating in Coastal and Marine Environment Citizen Science

Thank you for following the link to this survey.

Evaluation of key stakeholders and public interests for participating in citizen science projects is needed to effectively address coastal and marine environment issues for the benefit of all users. The citizen science is a means of engaging society in scientific research.

I am an MSc student from the University of Portsmouth, Department of Geography, interested in critically evaluating the perceptions and interests of various coastal and marine environment users in participating in citizen science projects in Langstone Harbour as my MSc dissertation.

This study is expected to determine ways of promoting recruitment, increasing engagement and enhancing retention of the general public as citizen scientists. The survey will take approximately 10 minutes to complete. It asks questions on your:

- Level of familiarity and confidence in citizen science
- Type of activities in Langstone Harbour
- Use of coastal and marine environment
- Level of interest in assisting coastal and marine citizen science projects
- Preferred involvement type in citizen science projects
- Willingness to share data or information, and
- Demographic information

The anonymised and summarised information collected will be made available to all participants if requested. It will also be made available to The Solent Forum because they have provided bursary support (Professor Mike Clark award). The data will not be passed onto other persons or groups.

Participation in this survey is voluntary, you are free to withdraw from this survey at any stage and your personal details will remain confidential.

Thank you very much in advance for taking part in this survey.

Ibrahim Lawan

up915328@myport.ac.uk

I agree to conduct this survey, that my answers will remain anonymous, and that the survey results may be published to inform understanding and development of Coastal and Marine Environment Citizen Science in the UK. This consent can be revoked at any time.

- ❑ Yes
- ❑ No (If No, end the survey)

Respondent's level of familiarity and confidence in citizen science

Q2. Have you ever seen or heard the term citizen science before?

- ❑ Yes (If yes, go to Question 5)
- ❑ No
- ❑ Not sure / can't remember

Citizen science is a means of engaging public in scientific research. It may be through partnership between the public and professional scientists or the public conduct the research on their own to address questions and issues. The public involved are called citizen scientists.

Q3. Now that you know the definition of citizen science, do you recall seeing or hearing the term before?

- ❑ Yes (If yes, go to Question 4)
- ❑ No
- ❑ Not sure / can't remember

These are the other terms to describe citizen science;

- Crowd science
- Community-based monitoring
- Crowd-sourced science
- Public participation in research

Q4. Have you heard or seen any of the above terms before?

- ❑ Yes
- ❑ No
- ❑ Not sure / can't remember

Q5. Have you ever helped any scientific research in the past? (E.g. volunteering for medical, environmental or other research in some way)

- ❑ Yes
- ❑ No
- ❑ Not sure / can't remember

Respondent's coastal and marine activity type

Q6. Which of the following activities do you like doing in the coastal and marine environment? (Select all that apply)

- ❑ Fishing
- ❑ SCUBA diving
- ❑ Snorkelling
- ❑ Water skiing
- ❑ Wind surfing
- ❑ Kayaking
- ❑ Sailing/Yachting
- ❑ Holiday visiting
- ❑ Beachcombing/beach walking
- ❑ Dog walking
- ❑ Birdwatching
- ❑ Cycling
- ❑ Motor boating
- ❑ Swimming
- ❑ Other (specify)

Q7. Which of the following would you describe yourself as? ("I am a . . .")

- ❑ Fisher
- ❑ SCUBA diver
- ❑ Snorkeler
- ❑ Water skier
- ❑ Wind surfer
- ❑ Kayaker
- ❑ Sailor / Yachtsperson
- ❑ Beach comber/beach walker
- ❑ Dog walker
- ❑ Holiday visitor
- ❑ Birdwatcher
- ❑ Cyclist
- ❑ Motor boater
- ❑ Swimmer

- ❑ Other (specify)

Q8. Do you belong to any club/clubs that specialise in your coastal and marine activities?

- ❑ No
- ❑ Yes: (If Yes, select all that apply)
    - Snorkelling
    - Fishing (recreational)
    - Water skiing
    - SCUBA Diving
    - Wind surfing
    - Kayaking
    - Sailing/Yachting
    - Beach combing/beach walking
    - Dog walking
    - Cycling
    - Birdwatching
    - Motor boating
    - Swimming
    - Other ……

Respondent's use of coastal and marine environment

Q9. How often do you undertake activity in the coastal and marine environment?

- ❑ Less than once a year
- ❑ About once a year
- ❑ Several times a year
- ❑ At least once a month
- ❑ At least once a week
- ❑ Daily

Q10. How important is the coastal and marine environment to you?

1	2	3	4	5
❑ Not at all important	❑ Not very important	❑ Somewhat important	❑ Very important	❑ Extremely important

Q11. To what extent do you think conserving the coastal and marine environment will improve your quality of life?

1	2	3	4	5
❑ To a small extent	❑ To some extent	❑ To a moderate extent	❑ To a great extent	❑ To a very great extent

Q12. In general, how would you agree with this statement: Decline in the health of coastal and marine environment would personally affect me?

1	2	3	4	5
❑ Strongly disagree	❑ disagree	❑ Neutral	❑ agree	❑ Strongly agree

Respondent's level of interest in assisting coastal and marine citizen science projects

Q13. How interested are you in participating in coastal and marine scientific research in some way?

1	2	3	4	5
❑ Not at all interested	❑ Not very interested	❑ Neutral	❑ Somewhat interested	❑ Very interested

Q14. How many hours or days in total per year would you be willing to dedicate for volunteering in coastal and marine scientific research?

- ❑ 0 hours
- ❑ 1 – 2 hours
- ❑ Half a day
- ❑ A day
- ❑ Several days
- ❑ 7 days
- ❑ 14 days
- ❑ More than 14 days

Respondent's preferred involvement type in coastal and marine citizen science projects

Q15. Public involve or participate in citizen science and most activities do not require a scientific qualification or specialist training. Which of the following citizen science tasks interest you and how likely are you to get involved? (Select all that apply)

	Very Unlikely	Unlikely	Either	Likely	Very likely
Helping to process information (data)	❑	❑	❑	❑	❑
Helping to communicate the findings	❑	❑	❑	❑	❑
Helping to plan individual coastal and marine research projects	❑	❑	❑	❑	❑
Helping to decide where funding and other resources should be spent	❑	❑	❑	❑	❑
Collecting data/information for professional scientists	❑	❑	❑	❑	❑
Helping to analyze the findings	❑	❑	❑	❑	❑
Helping to decide what topics coastal and marine research should focus on in the future	❑	❑	❑	❑	❑
Acting as a representative to explain the concerns that society has about coastal and marine research	❑	❑	❑	❑	❑

Citizen scientists collect coastal and marine environmental or biological data that are then used by professional scientists.

Q16. If you were to receive instructions about the following tasks, how confident would you be doing any of these?

	Not confident at all	Slightly confident	Somewhat confident	Fairly confident	Completely confident
Identifying organisms and features using image banks and archives	❑	❑	❑	❑	❑
Helping to track coastal and marine debris (e.g. plastic pollution)	❑	❑	❑	❑	❑
Monitoring of beach morphology changes (e.g. coast form, water level)	❑	❑	❑	❑	❑
Observing beached birds or shorebirds/seabirds	❑	❑	❑	❑	❑
Helping to track invasive species (non-native species)	❑	❑	❑	❑	❑
Reporting on invasive species from monitoring of fresh fish catches	❑	❑	❑	❑	❑
Reporting on stranded organisms (fish, turtle, bird, marine mammals)	❑	❑	❑	❑	❑
Helping to monitor water quality	❑	❑	❑	❑	❑
Collecting litter around beaches and recording the information for scientists	❑	❑	❑	❑	❑
Helping to monitor endangered and nearly extinct species (species not frequently seeing as before)	❑	❑	❑	❑	❑
Conducting coastal biodiversity surveys at night	❑	❑	❑	❑	❑
Recording incidental sighting of marine lives while at sea	❑	❑	❑	❑	❑
Recording incidental sighting of marine lives at the coast	❑	❑	❑	❑	❑
Reporting on human-induced damage to coastal communities	❑	❑	❑	❑	❑

Helping to monitor reef system community	❑	❑	❑	❑	❑

Q17. If you were to get involved in any of the above coastal and marine environment scientific tasks, how important is feedback (e.g. getting the results, having discussions with scientists or acknowledging/confirming your contribution etc.) from professional scientists to you?

1	**2**	**3**	**4**	**5**
❑ Not at all important	❑ Low importance	❑ Neutral	❑ Important	❑ Very important

Q18. How confident are you in the following forms of citizen science projects findings?

Finding of research	Not at all confident	Less confident	More confident
When the data have been collected by citizen scientists but the rest of the work is done by professional scientists	❑	❑	❑
When citizen scientists and professional scientists both contributed to the project design, data collection, and analysis of the data	❑	❑	❑
When citizen scientists asked professional scientists to conduct project design, data collection, and analysis of the data	❑	❑	❑
When citizen scientists are completely responsible for the project design, data collection, and analysis of the data	❑	❑	❑

Respondent's willingness to share data or information

Q19. How interested are you in helping to share information and persuade others to get involved in citizen science projects?

1	2	3	4	5
❑ Not at all interested	❑ Not very interested	❑ Neutral	❑ Somewhat interested	❑ Very interested

Q20. Which of the following organisations would you be happy to share your citizen science findings with?

- ❑ Portsmouth City Council
- ❑ Havant Borough Council
- ❑ Environment Agency
- ❑ Natural England
- ❑ University-based marine scientists
- ❑ Private research companies / consultants
- ❑ Non-Governmental Organizations
- ❑ Other (specify)
- ❑ None of the above

Respondent's demographic information

Q21. Which area around Langstone Harbour do you live in?

- ❑ Hayling Island
- ❑ Havant
- ❑ Purbrook
- ❑ Drayton
- ❑ Portsmouth
- ❑ Milton
- ❑ Copnor
- ❑ Baffins
- ❑ Eastney
- ❑ Anchorage Park
- ❑ South Hayling
- ❑ Langstone
- ❑ Farlington
- ❑ Other (specify)

Q22. What level of education have you completed?

- ❑ Secondary school education
- ❑ Sixth form or college
- ❑ Bachelor degree
- ❑ Postgraduate

Q23. Which statement describes your level of science education?

- ❑ I have never studied science before
- ❑ I have studied general science subjects in school
- ❑ I have studied specific science subjects in school
- ❑ I studied science after school

Q24. Do you currently work in the science industry or practice science?

- ❑ Yes, I practice or work in the science industry
- ❑ No, but I used to practice or work in the science industry
- ❑ No, I have never practiced science or worked in the science industry

Q25. What is your age group?

- ❑ 16 – 24
- ❑ 25 – 34
- ❑ 35 – 44
- ❑ 45 – 54
- ❑ 55 – 64
- ❑ 65 – 74
- ❑ 75 – 84
- ❑ 85 +

Q26. What is your gender?

- ❑ Male
- ❑ Female
- ❑ Preferred not to say
- ❑ Other (please specify)

Thank you for your participation

Appendix B: List of Recruited Organizations and Clubs in the Langstone Harbour

S/N	Organization name	Leader or president	Address	Email	Phone number
1.	Hayling Ferry Sailing Club (hfsc)	Commodore: Richard Golden	Hayling Ferry Sailing Club (HFSC) Hayling Island, UK PO11 0DG 07870367571	Commodore@hfsc.org.uk	07887 804291
2.	Havant Sea Angling Club		Havant Sea Angling Club 172 Botley Drive Leigh Park Hampshire PO9 4NP 07742 679596		07742 679596
3.	Langstone Cutters Rowing Club	Christine Ball – chairman	Nigel Amstrong (New contact)	nigelarmstrong44@yahoo.com chairman@langstonecutters.com	07790 392981

4.	Langstone Harbour Water Skiers Association (LHWSA)	Simon Baldry – chairman		webmaster@lhwsa.org.uk	02392 343512
5.	Personal Watercraft Partnership (PWP)	David Pougher – Executive director		info@pwp.org.uk	07831467416
6.	Eastney Cruising Association (ECA)	Jenny Hartman – Commodore	Eastney Cruising Association Ferry Road Portsmouth Hampshire PO4 9LY		023 92 734103
7.	Langstone Sailing Club	Tim Wilyman - Commodore	Langstone Road, Havant Hamshire PO9 1RD mail@langstone.org.uk	commodore@langstonesc.org.uk	02392484577

8.	Langstone Harbour Fishermen's Association (LHFA)		Langstone Harbour Fishermen's Association, Milton Locks, Southsea. PO4 8LT Telephone 02392 732906	secretary@lhfa.co.uk	02392 732906
9.	Locks Sailing Club	Chris Flewitt – Commodore	Locks Sailing Club 6 Longshore way, Milton Locks, Portsmouth, Hamshire PO4 8LS	commodore@lockssc.co.uk	
10.	Tudor Sailing Club	Richard Gunn – commodore	Eastern Road, Portsmouth Hants. PO3 5LY	commodore@tudorsailing.org.uk	07712 553095

11.	Portsmouth and District Canoe Club	Simon Ashburn – club secretary	47 Bedhampton Road Bedhampton Havant Hants PO9 3EU	secretary.portsmouthcanoe@gmail.com	Telephone: 023 9307 5013
12	Hampshire & Isle of Wight Wildlife Trust	Tim Ferrero		timf@hwt.org.uk, tim.ferrero@hiwwt.org.uk	
13	Friends of Langstone Harbour	John Goodspeed – membership secretary	22, Hilltop Crescent Cosham PO6 1BD	john@havantnature.net	02392221361
14	Portsmouth and Langstone Sailing Association	Adrian Saunders Paul Tansom – secretary		secretary@plsa.org.uk	
15.	RSPB Langstone Harbour		RSPB, Basepoint, Harts Farm Way, Havant PO9 1HS	langstone.harbour@rspb.org.uk	01273775333

Appendix C: List of Interviewees Organisations

Just one ocean
Hampshire & Isle of Wight Wildlife Trust
Friends of Langstone Harbour
ORCA
RSPB Langstone Harbour

Appendix D: Interview Schedule

Questions on interviewee coastal and marine environment citizen science project(s)

Q1. Can you tell me a bit about your project(s)? *Size, research, history, who runs it, funding?*

Q2. What are your roles in the project(s)?

Q3. What is the key purpose (benefit/ focus) of your project(s)?

Q*4.* How does your project interact with its participants*?*

Q5. Does your project(s) normally send feedback to participants? How?

Questions on interviewee opinions on participants' engagement and interests

Q6. Do you think citizen science has a role to inform the public about coastal and marine environment conservation?

Q7. Do you think that public participation in your coastal and marine citizen science project(s) increases participant's general understanding about:

a. The coastal and marine environment?
   Can you provide any evidence for this from your project?
b. Coastal and marine conservation?

Q8. Do you think citizen science can influence coastal and marine conservation, management and policy in Langstone Harbour? *How? At what scale (temporal, spatial)?*

Q9. Do you think the awareness that citizen science creates about marine issues can promote greater trust in marine conservation and management? *(Clarify) Compared to those who don't participate in citizen science? How? Can you give any examples?*

Q10. Would you recommend the use of citizen science as a tool in other ways for coastal and marine conservation?

Appendix E: Interview Cover Letter

I am an MSc student from the Department of Geography, University of Portsmouth, interested in critically evaluating the perceptions and interests of various coastal and marine environment users in participating in citizen science projects in Langstone Harbour as my MSc dissertation.

The citizen science can be a means of engaging society in scientific research. Therefore, evaluating the perceptions and opinions of citizen science project coordinators is necessary to effectively address challenges of volunteer participation and engagement.

This study is expected to determine ways of promoting recruitment, increasing engagement and enhancing retention of the general public as citizen scientists.

Therefore, I would like you as a coordinator of coastal and marine citizen science projects to spare me some minutes out of your tight schedules to have a very short interview with you. If you are amenable, I will send my structured interview schedule to your email then you arrange the time at your own convenience. The interview will take approximately 15 – 20 minutes. It will ask questions on your;

- Coastal and marine environment citizen science projects
- Opinions on participants' engagement and interests

The anonymised and summarised information collected will be made available to all participants if requested. It will also be made available to The Solent Forum because they have provided bursary support (Professor Mike Clark award). The data will not be passed onto other persons or groups.

Participation in this interview is voluntary, you are free to withdraw from it at any stage and your personal details will remain confidential.

Thank you very much in advance for taking part in this interview.

Looking forward to hearing from you.

Kind regards

Ibrahim Lawan
MSc Student: Coastal and Marine Resource Management
up915328@myport.ac.uk

Appendix F: Interview Transcripts

Participant 1

INTERVIEWEE COASTAL AND MARINE ENVIRONMENT CITIZEN SCIENCE PROJECT(s)

Q.1. Citizen Science Project(s) Overview

Researcher

Tell me a bit about your project(s)? Size, research, history, who runs it, funding?

P1

The research is called The Big Microplastic Survey. It's looking at the impact of microplastics in coastal environment and also to sites of rivers and lakes around the world. The project was started in July 2018 following what effectively was a trial in Chichester harbour which is connected by water to Langstone harbour. From the first project we did which had about hundred volunteers, now we got several thousand volunteers around the world got involved. That is not necessarily Langstone Harbour but we are still doing some research in Langstone.

Very difficult to know the exact number of volunteers that are actively participating. There is a written rule for participation in citizen science that is ninety to ninety-one rule. That means, basically ninety percent of people who will registered for your project do not do anything, they just stay in the background. They will be commonly termed locals. Then you got nine percent also called dabblers and they may have one goal putting down but actually one percent is quite active. So, if you are looking at it, we got more than 500 different organizations individually signed up but that one percent we will expect 50 people be participating actively. That is alright, we currently have about two to three hundred samples that people sent to us. These figures are very much accurate.

Volunteers do not fund the projects and we do not fund them. What we did with this project is to look at what makes volunteer project work, that is citizen science. So, we look at recruitment, engagement and continuing motivation because these are issues govern within the idea of citizen science. So, we don't fund volunteers but we have made it easily accessible and cost-effective, it does not cost them many things. The materials they need are available and the time it takes is not very high because the time is money. The funding we gained have been used to develop the digital online database. The organization is a charity foundation, so the source of funding is from lots of charitable donations and we have fund raising activities that people do, people go on marathons as well as corporate sponsorship.

Q.2. Role in the Project(s)

Researcher

What are your roles in the project(s)?

P1

I run the whole organization, I am the CEO as well as the founder. I coordinate participants and project activities, manage the data we collect in the project, engage with the participants on outreach and education, as well as teach/organise science for the project. I also have a social media person who help me with sending newsletters and getting people more involved. Summarily, I am not too much engaging with people in this project for couple of reasons. First, I wanted to see what happened if I didn't and what happened if I do because I am trying to analyse some motivations behind people's actions. Second, we started marketing this project manually but now we're trying to digitize it to see how people will be more involved.

Q.3. Purpose/Focus of the Project(s)

Researcher

What is the key purpose (benefit/ focus) of your project(s)?

P1

Our project does all of these in some respects: Collecting data and producing new knowledge for science. Providing data to policy-makers and marine managers for conservation purpose. Informing ocean literacy to educate public about challenges/issues in coastal and marine environment (creating pro-environmental behaviour). Benefiting natural environment, by learning about and protecting it.

The main purpose is to evaluate the impact of microplastics and meso-plastics up to 25mm in size in coastal environment. How we do that is by getting people to analyse the various characteristics that are used to categorise microplastics, meso-plastics basically. Is it the primary plastic, the secondary plastic microplastics? What colour is it? What shape is it? What particular sources is it primarily from? To have some ideas, we used GIS to have an indication of scales and distributions and therefore make deductions about central impacts in the past on the coastal region. A recent research we did which that is very interesting is coming up, for example in Indonesia where the problem was not pre-production pellets which would be in Langstone Harbour where there is massive problem of polystyrene because they use it in fishing industry for production of fishing boxes and then they get destroyed and then they get thrown away. We do some analyses here to provide people with data to do further research if they want within Langstone Harbour and make it in an open access format.

Q.4. Interaction with Participants

Researcher

How does your project interact with its participants?

P1

We don't do training. One of the reasons for that is because when we looked at the preliminary studies there were conflicts about something that go against what we are trying to achieve. So, we look at the consistency and accuracy of the data. How did we do that? We make it very simple, we then support it by good materials so we produced very good online resources pack. We made videos that support these as well. We do all these by using crowdsourcing technique of citizen science using a lot of people and taking care of accuracy and consistency of the data to not take it completely wrong. We are also using the samples people are sending to us, to then see if we can trust what they said they got when we go through it later. So that is giving us indications on certain amount of data people they got and they make some assessment to whether it works or not. The meet-ups is mainly newsletters. A lot on social media; we got 28,000 people look at our post, we got 15,000 people on our facebook page and 6,000 on our Instagram. This is a hot topic, is not very difficult to get people interested on what we done.

Q.5. Feedback to Participant

Researcher

Does your project(s) normally send feedback to participants? How?

P1

We say thank you when they do and we are going to start doing that. Feedback is one thing we have not got it right. Like I say initially, I know there is feedback thing so I want to see what is going to happen if I didn't give feedback now because this is long term projects. Then when we start giving feedback we get some information.

INTERVIEWEE OPINIONS ON INTEREST AND ENGAGEMENT OF THE PARTICIPANTS

Q.6. Role of Citizen Science to Inform Coastal and Marine Conservation

Researcher

Do you think citizen science has a role to inform the public about coastal and marine environment conservation?

P1

Is not so much that going to be used to promote. It does promote because the whole thing about citizen science is, it should have a couple of things to come out of it. The first thing is to get scientific knowledge. So, we reduced the gap to their knowledge by finding out something they don't know but getting it out at first. The second is citizen scientists should learn something new, new skills or an understanding. The interesting thing is that, they're expanding their own knowledge as well. So, in that case, we got the ability to change their behaviours and particularly perceptions. That could extend to drive a policy change. So, I think is very important part of the project. The biggest problem is there is lots of sceptic but I think if you do it right then there is no reason why issues will come up. People are getting into citizen science. Citizen science is growing industry, growing area of scientific research because people have got the time on their hand, they got a lot more leisure time. People have the availability to do this thing and they are interested. The education level has changed over the last two hundred and fifty years or so when science was really domain on somebody in whitecoat and glasses in the lab making research.

Q.7. Citizen science and increase public understanding of the environment

Researcher

Do you think that public participation in your coastal and marine citizen science project(s) increases participant's general understanding about:

The coastal and marine environment?

Coastal and marine conservation?

P1

I think so, but I push out questionnaire. I will tell you that when I found out that result.

I think they may be aware in any way that is why they signed up because they are interested in it. If not, they probably wouldn't signed it up anyway. If you don't care about butterflies, you are not going to sign up to count butterflies. So, there is massive interest in it. I think it increased their knowledge because there is probably something they haven't done before and that is a good. It is one of the key thing citizen science projects should do and that's to inform people.

Q.8. Citizen science to influence coastal and marine management

Researcher

Do you think citizen science can influence coastal and marine conservation, management and policy in Langstone Harbour? How? At what scale (temporal, spatial)?

P1

For the management, yes It can, because there are lots of stuff that need to be found out. I think, citizen science can address conservation issues by engaging public to help decision making in a better way and enabling science to cover large temporal and spatial scales. As an organization we did lots of talks and presentations to local community, local environmental groups, to schools, to charity groups. For example, friends of Langstone Harbour, we gave a talk to them about the issue and so it really increases their awareness a lot of the times especially on our subject. Our subject is the one people can very easily overlook because you can walk on the beach you think is clean and actually it's not. We are giving people very clear indications that there is something they are probably not aware of before they get involved.

I think it can influence policy. You only have to look at the way that charity organizations, conservations organizations and marine conservations society can gather data on say litter to then start to influence policy making. So, the citizen science got the opportunity to gather many data. And policy makers tend to respond quite positively when they are faced with a lot of numbers. So, I think there are very much an opportunity for citizen science projects to change policy and is not just only counting microplastics or counting shellfish but what citizen science do. For example, to actively orientated citizen science projects for example when people look at the number of cars passing down a small road or they count the number of lorries or they get monitor the gases coming out of exhaustible pipe from cars or measure toxic coming out, that sort of stuff can have a huge impact on policy. So, yes it can influence policy. The scale of the project depends on how much big or what period of time because the impacts of whatever is studying is also significant. So, for example if I was to proof that a certain microplastics are actually having an impact on wiping out a specific type shellfish in Langstone Harbour or certain pollutants have impacts, is not necessarily the temporal, spatial scale of the project would also be a driven force. So is not just how big the project is or how long it is going for that is important but is it environmentally, economically and socially.

Q.9. Citizen science to increase environmental stewardship

Researcher

Do you think the awareness that citizen science creates about marine issues can promote greater trust in marine conservation and management? (Clarify) Compared to those who don't participate in citizen science? How? Can you give any examples?

P1

Yes, people get involved in citizen science projects, they're going to be more aware than somebody who potentially doesn't get involved.

Q.10. Citizen science as a tool for coastal and marine conservation

Researcher

Would you recommend the use of citizen science as a tool in other ways for coastal and marine conservation?

P1

Absolutely yes, I think. This project I had no idea that I am going to have over 500 organizations and individuals signed up within the first 12 months. I have no idea I would have 25 universities registered to be part of this. The research we done, the process we developed in Chichester Harbour and we got a big project coming out of these as a result of what we have done. There is huge amount potential, the biggest problem we got is that we faced so many problems; there are not enough scientists to carry out the analyses. And citizen science provides us with opportunity to do that, we just got to get that process right so that it become accurate, trustworthy so we can actually say yes this is good research then use it.

Participant 2

INTERVIEWEE COASTAL AND MARINE ENVIRONMENT CITIZEN SCIENCE PROJECT(s)

Q.1. Citizen Science Project(s) Overview

Researcher

Tell me a bit about your project(s)? Size, research, history, who runs it, funding?

P2

The relevant title of our project is Friends of Langstone Harbour. The project we are interested in, is the general wildlife conservation and amenity value of the harbour. And the sort of what we do is mainly litter picking but also occasionally path clearing and any other sort of jobs that make the harbour better for wildlife, better for people. Funding? The project is entirely funded by membership subscriptions. Though, I am not sure but the project started in the mid-nineteen seventies (1970s). The membership is now quite low down to probably around thirty (30) but I have quite a few people who are not members who do voluntary work. And there will be twenty (20) of them but on work parties, when we do work, we sometimes get as many as thirty (30) or forty (40) because we advertised events on the marine conservation society (MCS) website which causes more people to come and help.

Q.2. Role in the Project(s)

Researcher

What are your roles in the project(s)?

P2

I am the chairman of the organization. I organize the work parties. And I edit the newsletter issue.

Q.3. Purpose/Focus of the Project(s)

Researcher

What is the key purpose (benefit/ focus) of your project(s)?

P2

Well, benefiting the natural environment certainly and educating the public, yes.

Q.4. Interaction with Participants

Researcher

How does your project interact with its participants?

P2

We interact with the participants through internet, newsletters and twice a year meeting.

Q.5. Feedback to Participant

Researcher

Does your project(s) normally send feedback to participants? How?

P2

Yes, the projects send feedback to participants through newsletters.

INTERVIEWEE OPINIONS ON INTEREST AND ENGAGEMENT OF THE PARTICIPANTS

Q.6. Role of Citizen Science to Inform Coastal and Marine Conservation

Researcher

Do you think citizen science has a role to inform the public about coastal and marine environment conservation?

P2

Yes, our citizen science informed the public about coastal and marine environment conservation by advertising the information that is gained. Also, for potentially lobbying government and local authorities on what needs to be done to benefit biodiversity and public amenity.

Yes, our project inform participant about marine conservation and increased their awareness through newsletters but whether it changes opinions that may be debatable but again we used our newsletters to tell people what is going on in the harbour, what is happening in the harbour and the results of what we do.

Q.7. Citizen science and increase public understanding of the environment

Researcher

Do you think that public participation in your coastal and marine citizen science project(s) increases participant's general understanding about:

The coastal and marine environment?

Coastal and marine conservation?

P2

Yes, participation in our project increases participant's general understanding about coastal and marine environment and its conservation. The information we gained, past citizen scientists concerned quite primarily through litter picking. The data on what we collect is fed back to marine conservation society and to our members. And particularly used by the marine

conservation society, a national organization, to inform government and companies about the amount of litter that occurs on our coasts all around the UK.

Q.8. Citizen science to influence coastal and marine management

Researcher

Do you think citizen science can influence coastal and marine conservation, management and policy in Langstone Harbour? How? At what scale (temporal, spatial)?

P2

Yes, I can say citizen science influence management, because the data on what we collect is fed back to marine conservation society and to our members and particularly used by the marine conservation society, a national organization, to inform government and companies about the amount of litter that occurs on our coasts all around the UK. For example, we collect invaluable litter data during our surveys, reporting it back to MCS then to UK governments and the global annual International Coastal Cleanup programme. Providing this data has helped to change policy and behaviours including the introduction of the 5p carrier bag charge.

Q.9. Citizen science to increase environmental stewardship

Researcher

Do you think the awareness that citizen science creates about marine issues can promote greater trust in marine conservation and management? (Clarify) Compared to those who don't participate in citizen science? How? Can you give any examples?

P2

Yes, I do. The evidence for that it would be the fact that nowadays we collect lot less litter than we used to in days back. Partly because some individual people not part of our organization pick up litter from the places that we do in between the times we do. I have seen it happening. And also, because I think the general amount of education that is going on to publicity on BBC television and the media is making people much more conscious of the risks and the dangers of leaving litter at the coast.

Q.10. Citizen science as a tool for coastal and marine conservation

Researcher

Would you recommend the use of citizen science as a tool in other ways for coastal and marine conservation?

P2

Absolutely yes, because it has promoted natural resource management and influenced environmental protection decisions and policies across the UK. For example, I am involved in somehow a project in Langstone Harbour which I rather more directly citizen scientist in recording birds and wildlife generally that goes back to national records that go to national organizations who are involved in formulating conservation policies for biodiversity across the country.

Participant 3

INTERVIEWEE COASTAL AND MARINE ENVIRONMENT CITIZEN SCIENCE PROJECT(s)

Q.1. Citizen Science Project(s) Overview

Researcher

Tell me a bit about your project(s)? Size, research, history, who runs it, funding?

P3

We are not actually running any citizen science project for the moment but we do get involved in a few things. So, perhaps the most relevant one to us in the local area is the Wetland Birds Survey which is all around the local area. That is a survey where the whole coasts of the harbour and the estuary part of them are potentially accounted once a month. So, covers all the wetland birds there, and that is delivered by a network of volunteers manage by usually local contacts from the British Trust for ornithology to get all involve there. So, in the Langstone area loneliness there could be five different kind of volunteers involved in sessions in every month usually at high tide to the middle of the month. And everything of the birds that are visible in the harbour like all the nesting, faeces would get counted and keep the record of the population. This project has been running for decades through Membership subscriptions and donations.

Q.2. Role in the Project(s)

Researcher

What are your roles in the project(s)?

P3

My role is facilitating part of it. So, to have volunteers basically getting them to a right place logistically. And also sort of a using the data that is generated to make sure it gets to the right channels that they review at the most super ways to make most use of the data that is generated.

Q.3. Purpose/Focus of the Project(s)

Researcher

What is the key purpose (benefit/ focus) of your project(s)?

P3

The key purpose of the project is to generate data. To gain a body of a data that would be a very hard to get by ourselves. You know, we can network people that will capture a wide geographical area within a small time period that a single or few of member of staff will not be able to be. So, when we do this, we will do the whole thing usually the whole counts done on

the same day and we close on the same day. If we did that without public participation it will be very, very expensive in terms of staff and you know it will be very hard to get that number involved to be honest.

Q.4. Interaction with Participants

Researcher

How does your project interact with its participants?

P3

We can mostly or normally meet up each other in the day each month and there are lot of exchanges then but there are also posts by emails and sharing the data within the participants so they get to see the results of that. And there are also annual reports that put together whether they are local, national or they are going into other bodily reports in all sort of things. That will be shared within as well so they can see exactly the impacts of that data.

Q.5. Feedback to Participant

Researcher

Does your project(s) normally send feedback to participants? How?

P3

The feedback is in term of data and exchange information about what is changing in any long term trends and impacts does that data they gathered could have. There is also a friendly situation that there would be a local coordinator who will have a certain number of people that will be talking to anyway in such a friendly manner. And the national feature will also get exchange back to local participants in a more formal sort of network.

INTERVIEWEE OPINIONS ON INTEREST AND ENGAGEMENT OF THE PARTICIPANTS

Q.6. Role of Citizen Science to Inform Coastal and Marine Conservation

Researcher

Do you think citizen science has a role to inform the public about coastal and marine environment conservation?

P3

Yes, I do. I think citizen science has a big potential to inform the public about coastal and marine environment conservation. I think is not fully use at the moment. The size change of the law especially like over the last twenty years in this regard. Simply, the laws have more time on their hands and maybe they used to and there is more an interest in coastal and marine

issue. And we are much more connected in terms of the communication stance too to exchange ideas and information much easier. So, getting involved would be the useful thing public can do on the coasts. I think there are number of things could get forwarded in the future that the citizen science would have a key component to all of that: getting budget very straight, there are conservational organizations at the moment and utilizing people's enthusiasms for the coasts and for science are somethings we can really, really find useful. The key thing at the moment is just finding a way to facilitate it properly and thinking big, thinking all those ideas and getting them into the pace than where we were before.

Q.7. Citizen science and increase public understanding of the environment

Researcher

Do you think that public participation in your coastal and marine citizen science project(s) increases participant's general understanding about:

The coastal and marine environment?

Coastal and marine conservation?

P3

Yes, I would say this. You know, one of the things about citizen science and data gathering is you are spending time looking and thinking about things. Then, the more time you are on the ground for or reading through data, the more you are seeing the nature of the marine and the coastal world. And there are most things that may be the general society might not be aware of what is happening in the coasts. Once they get involve and see the nature of what our coastline is like today and the nature of wildlife, shore and the threats that physically face them like plastics and erosions. And just the nature they actually being involve in it and has a very educational awareness that impart on people. And it is straight as well because the more one person knows, shares those ideas and society the whole have better understanding of the coasts. So, in term of example, probably not really from our project but there are lot of people who started doing say like in the marine conservation society, their beach clean, there are data gathering there. That means getting people involve has an impact in them as serving the message of what is going on the coasts. May be in term of the project we are involve with, just seeing the number of birds changed over the years and may be the habitats due to the coastline change really get people to think about how the world we are living and the coastal world we are using is changing and the impact that those have on the marine around us.

Q.8. Citizen science to influence coastal and marine management

Researcher

Do you think citizen science can influence coastal and marine conservation, management and policy in Langstone Harbour? How? At what scale (temporal, spatial)?

P3

I do. I think that has done limited ways so far. I think there are lot of potential for that in future, much greater potential. So, citizen science projects majority being limited to data gathering. I am being in few different projects: Wetland Birds Survey, beach clean, archaeological project, they are also having a data gathering inform and spreading to different management plan. The different organizations involved are looking on how to better manage the harbour using part of the data seem very useful. In term of the conservation side of it and the direct management, I think getting citizen science has a role there in future direct from the ground, regular monitoring and may be delivering of the conservation projects. I think there is great scope of it on how we manage our environment. Citizen science can often operate at a greater spatial and temporal scales than conventional science due to its cost-effective nature for collecting some types of data. For example, observation of biological and physical phenomena and breeding birds over long temporal and in enough spatial scales that is meaningful and scientifically reliable.

Q.9. Citizen science to increase environmental stewardship

Researcher

Do you think the awareness that citizen science creates about marine issues can promote greater trust in marine conservation and management? (Clarify) Compared to those who don't participate in citizen science? How? Can you give any examples?

P3

I think it does. I think that creates great awareness having society involve in the science does create a great awareness. And I think people trust that data as long as the project runs correctly. For example, citizen science through engaging locals, can promote trust and understanding among decision-makers, regulators, scientists, managers, volunteers and others of the social dimensions of the natural environment where people live. I very, very rarely seeing anything I won't trust in. I mean good citizen science project will have check the way to make sure that the data is properly gathered. Of course, those who participated will have much more awareness compare to those who do not because they have been part of it and seeing everything. And collecting environmental data can make volunteers to care more about the environment and develop a sense of place. Citizen science is not the only way to have a better awareness but is very useful way to gain a better awareness. Obviously, you get yourself awareness by taking your time to educate yourself. Citizen science does that in a very useful manner and actually

two way of exchange of information you are educating yourself and both actually collecting data or delivering information which is a part of wider science and management plan. And I think someone who is not involve will be much lesser and limited understanding of the nature of things, I do not have any example, I am afraid.

Q.10. Citizen science as a tool for coastal and marine conservation

Researcher

Would you recommend the use of citizen science as a tool in other ways for coastal and marine conservation?

P3

Yes, I would recommend the use of citizen science in any way that people can really speaking seeing it be beneficial. I mean, there are limits to citizen science because you are asking someone to do something. What I mean is that, it may be advantageous to use citizen science when volunteers can collect high quality data, and their participation makes it possible to address unanswerable research questions or reaching inaccessible environment in any other way. And there is a sort of thing which is very difficult to ask or get public involve in unless they are very specialist or they involved in such elements in some ways. Some of the survey example is, if you are surveying seagrass which actually some people can do, but in some of the areas where seagrass grows which is very muddy areas like on the estuaries. It will be very dangerous to actually ask people to survey that, but there are where it can be done. I think, it bases very useful as long as it did not pass certain limits. I think in anything to get involve in to some degree is to facilitate a right that the citizen science would have that ability to commend a citizen science project. I think in lot of the conservations we are involved in; the key thing is really the facilitation, the central to how, where the project is relating or where the information is coming to and going from. I think on how the things will be delivered and how the people who are doing the citizen science can be supported because is very important that the volunteers who want to get involved in it have devoid level of support. So, they can deliver the quality information and exactly what you want so the end goal is very trusted as well.

Participant 4

INTERVIEWEE COASTAL AND MARINE ENVIRONMENT CITIZEN SCIENCE PROJECT(s)

Q.1. Citizen Science Project(s) Overview

Researcher

Tell me a bit about your project(s)? Size, research, history, who runs it, funding?

P4

We don't do any work at Langstone Harbour but it covers Solent I guess.

Orca in generally is a citizen science project. It started in 2001 as registered charity but we have been involved in collecting data from about 1998. We started up primarily in the Bay of Biscay but we have extended that quite rapidly and we collect data all over the UK now. We work on a lot of ferries going from Portsmouth, so we do collect data up to the English Channel as well. We have got about 800 actors across the UK working on ferries, collecting data and some seasonal staff that do presentations to public on those ferries as well. We also do a lot of community engagement work in schools, and so we have got a member of staff that goes between lots of schools, southern Hampshire area educating children from T-stage one up to undergraduate levels as well. Funding wise, we do not get any government funding. We are purely funded by memberships and donations. And we also do get grant funding as well, so we apply for money from charitable trusts. And we also get money through running events or fair workshops in the Bay of Biscay, Harvadis and also from partnership as well.

Q.2. Role in the Project(s)

Researcher

What are your roles in the project(s)?

P4

I personally manage all of the data that comes in for the charity and also in charge of doing all the analysis and publication work as well.

Q.3. Purpose/Focus of the Project(s)

Researcher

What is the key purpose (benefit/ focus) of your project(s)?

P4

I suppose we can fit in to all the following to some degrees:

• Collecting data and producing new knowledge for science

• Providing data to policy-makers and marine managers for conservation purpose

• Informing ocean literacy to educate public about challenges/issues in coastal and marine environment (creating pro-environmental behaviour)

• Benefiting natural environment, by learning about and protecting it

The end goal is definitely to provide data to policy makers for conservation. To that, we collect data and analyse that to give us a sort of evidence based conservation benefits and knowledge to policy managers. We also do recognise the benefits of general public knowing about the marine environment on practical basis. So, we do get quite heavily involved in public engagement and education and above general public level but also for marine stakeholders as well. Helping partners to understand what they can do to help as well.

Q.4. Interaction with Participants

Researcher

How does your project interact with its participants?

P4

It started in an organised day long training course which is in person and then it develops into weekly event of the day via email normally and newsletters. And then the participants do their project work where they can actually go out and collect data, within team or in person. When collecting data, our members continue to provide close guidance and oversight to ensure accurate and complete records.

Q.5. Feedback to Participant

Researcher

Does your project(s) normally send feedback to participants? How?

P4

We generally feedback to a team leader which is the person leading the survey and then will distribute the information to their team on how survey was gone, how many animals have seen. We also do survey reports, which are also circulated to a team and it include a brief summary on what they have seen and the map of animals they collected data on as well. The feedback is sent via email.

INTERVIEWEE OPINIONS ON INTEREST AND ENGAGEMENT OF THE PARTICIPANTS

Q.6. Role of Citizen Science to Inform Coastal and Marine Conservation

Researcher

Do you think citizen science has a role to inform the public about coastal and marine environment conservation?

P4

I think, the citizen science has a role to inform the public. Results can be garnered through citizen science research and because you also actually get the public involved and worked and they learned a lot through such practical elements which are more memorable, attend dinner, a brief talk. Its practicality is a good way to learn. So, we teach everyone that gets involve with us on general trends about marine environment, how to identify and also marine conservation at basic level as well. We also use our data to inform marine policy and developed MPAs and we are trying to get an important marine mammal area. So we pass that knowledge onto people again.

Q.7. Citizen science and increase public understanding of the environment

Researcher

Do you think that public participation in your coastal and marine citizen science project(s) increases participant's general understanding about:

The coastal and marine environment?

Coastal and marine conservation?

P4

Yes, definitely. I think, they do get more about understanding and knowledge about marine environment and conservation. Evidence for that would be: whenever we run a ship track project especially in the Bay of Biscay, people interact in our vessels for correct collusions and behavioural changes. And whenever we go on a ship with passengers or surveyors who do work with us, we get a lot of questions about that and some issues that not many people think about that. And online we present a lot of presentations about that and people learnt quite a bit about that in a very interested way to learn more as well.

Q.8. Citizen science to influence coastal and marine management

Researcher

Do you think citizen science can influence coastal and marine conservation, management and policy in Langstone Harbour? How? At what scale (temporal, spatial)?

P4

My knowledge of Langstone Harbour itself is quite limited because we do not do specific work there. Yes, I think citizen science has the ability to inform conservation and management

anywhere, based on collecting data at fine scale of spatial and temporal scale. The shift in management recently, with emphasis on adaptive management and ecosystem-level protection has necessitated the use of scientific data to inform decisions and policy implementation. This will be well suited using citizen science approaches. Because if you do not have dedicated surveying fund, you going to have limited funds and you can necessarily go back every week to collect lots of data. Where with citizen science, you can use people living in the area and going for a dog work or hike and you can get them to collect data on animals and habitats around regularly. So you get an idea of seasonal changes and interactions where you can use too much money.

In terms of policy, citizen science has the power to enhance two-way flow of information between the environmental policy makers, natural resources managers and general public. With this, public can engage in decision-making processes.

Q.9. Citizen science to increase environmental stewardship

Researcher

Do you think the awareness that citizen science creates about marine issues can promote greater trust in marine conservation and management? (Clarify) Compared to those who don't participate in citizen science? How? Can you give any examples?

P4

Yes, I think that is tricky one because a lot of people think citizen science is less robust than normal science and traditional, professional science. I think to some degree that is correct, you need to understand the limitations and strengths. Yes, I think involvement in citizen science can create a better awareness of marine conservation issues. And also, to help with general trends which if you are less involve in that field you definitely going to be less informed and less engaged. And your trust in science will be less because you are less informed.

Q.10. Citizen science as a tool for coastal and marine conservation

Researcher

Would you recommend the use of citizen science as a tool in other ways for coastal and marine conservation?

P4

I think you have got the education site of it for involvement and you also got the hardcore data collection as well. It can also be used in indirect way to engage stakeholders say if you are worried about overfishing or entanglement or something like that in Langstone Harbour for the

fisheries. Then, you could engage stakeholders from the fisheries in citizen science and get them involve for other means so as get more information from the people that are directly involve in local area as well. That may be a bad example for Langstone Harbour, but I think getting everyone involve in an area is very important test of understanding what is going on and can lead to behavioural changes as well. And I think citizen science is a bit a part of that because you are getting people involve often.

Participant 5

INTERVIEWEE COASTAL AND MARINE ENVIRONMENT CITIZEN SCIENCE PROJECT(s)

Q.1. Citizen Science Project(s) Overview

Researcher

Tell me a bit about your project(s)? Size, research, history, who runs it, funding?

P5

The size of the project is that – it runs over 4 years. Started in September 2018 and finishes in September 2022. Basically, we hope to run 12 surveys a year, but as we train more volunteers we will hopefully run more surveys next years. Our citizen science project is very much part of our overall project called 'Secrets of the Solent' which is a behavioural change project.

The research is collecting species presence and occurrence data from intertidal shores on Hampshire and Isle of Wight. These our intertidal surveys are part of our overall project 'Secrets of the Solent' to be used as a tool to engage and educate the public on local marine life whilst gathering valuable data or local marine species. It is a follow on from Shore search which the Trust has run for the last 10 years.

I am in charge of it and is run as part of the project mentioned above. The funding is from National Lottery Heritage Fund, and there is other source of fund. No volunteers contributing to fund the project. We got quite a lot of people involved, about 200 volunteers at present, and those who are actively coming on to the survey at the moment probably about 100.

Q.2. Role in the Project(s)

Researcher

What are your roles in the project(s)?

P5

I coordinate participants and project activities. I engage with the participants on outreach and education. I teach/organise science for the project.

Q.3. Purpose/Focus of the Project(s)

Researcher

What is the key purpose (benefit/ focus) of your project(s)?

P5

The purpose of the project include: collecting data and producing new knowledge for science; providing data to policy-makers and marine managers for conservation purpose; informing

ocean literacy to educate public about challenges/issues in coastal and marine environment (creating pro-environmental behaviour). However as our intertidal surveying is used to support our larger project 'Secrets of the Solent' in public behavioural change, I would therefore say its key purpose would be for benefiting natural environment, by learning about and protecting it by educating and involving the public in its protection.

Q.4. Interaction with Participants

Researcher

How does your project interact with its participants?

P5

We interact with the participants of our project through: internet, meet-ups, newsletters, education sessions and programme training.

Q.5. Feedback to Participant

Researcher

Does your project(s) normally send feedback to participants? How?

P5

Yes it does. Through emails, blogs and newsletters. Also during training sessions we ask for feedback on our training. At the end of each year we also discuss our surveys and kind of methods with a few select interested volunteers who have a quite extreme background in Marine science / biology. So they are professors, not normal public members. They got a great details of what is going on and they like to kind of review and make sure we are being effective with it. They are interested in the data to be honest and we are very much interested in enquiring how we inspiring people, so is nice balance really.

INTERVIEWEE OPINIONS ON INTEREST AND ENGAGEMENT OF THE PARTICIPANTS

Q.6. Role of Citizen Science to Inform Coastal and Marine Conservation

Researcher

Do you think citizen science has a role to inform the public about coastal and marine environment conservation?

P5

Absolutely, yes. It gives the public actual experience and knowledge of what is going on in and around their environment. It is first-hand knowledge which they can believe and pass on to others. It gives them more understanding of the natural world. They can actually understand

the threats, learn about it. Be impassioned and fall in love with their local area and kindle a desire to protect it. Citizen science always makes the public feel they are part of something, and not an outsider. They feel fulfilled that they are contributing to its protection and helps build a community.

Yes. We always teach our participants about marine conservation during surveys and training sessions.

Yes, it increased awareness. During our survey's we always impart knowledge of what is happening with the local environment. i.e climate change effects, man's interference and invasive species. Also people can see for themselves. We also teaching people on this survey to noticing what they haven't seen or noticed before. And when you start noticing, you start to see the changes, you start to see the patterns and you start to see the data on what people are talking about on our shore for yourself.

Yes, it changed opinions. It made people see their local shore as an abundant environment full of life and not an empty shore they thought it to be. Made people want to protect it and learn more about it. This is done by first-hand experience of science of the environment and through observation and time. Also, by education and community team work.

Q.7. Citizen science and increase public understanding of the environment

Researcher

Do you think that public participation in your coastal and marine citizen science project(s) increases participant's general understanding about:

The coastal and marine environment?

Coastal and marine conservation?

P5

Yes, it increase understanding of the coastal and marine environment because if you speak to our volunteers and ask them and also can see interest from the questions they ask.

It also increases understanding of coastal and marine conservation. For evidence, we have not do any evaluation, monitoring on that yet, but it would be part of our project to do such thing. However, I have spoken to my volunteers, I have seen the changes especially on few people when they start asking questions more. Again, wanted to impart knowledge more because the curiosity is there.

Q.8. Citizen science to influence coastal and marine management

Researcher

Do you think citizen science can influence coastal and marine conservation, management and policy in Langstone Harbour? How? At what scale (temporal, spatial)?

P5

Yes, I do think it can influence because as I said before experiences lead to education and understanding. So, our project provides that experience and community feeling of doing good and positive things. Likeminded people would end up helping create movements that can spread to other people. So, citizen science project very much helps empower, educate and bring people together over a common cause.

It influence policy, well obviously through education in collecting data. That is where citizen science is quite important because you need public opinion behind that data, forcing those in government to actually act on it. So the more people who know about it, the more people who feel connected to that, so the strongly this data is correct and need to be acted upon then you going to get the policy changes that you need.

I wouldn't be able to say at what temporal or spatial scale.

Q.9. Citizen science to increase environmental stewardship

Researcher

Do you think the awareness that citizen science creates about marine issues can promote greater trust in marine conservation and management? (Clarify) Compared to those who don't participate in citizen science? How? Can you give any examples?

P5

Yes, I do think that awareness can create a greater trust in marine conservation because people trust what they see and experience. We engaged them in an open discourse based on generated scientific knowledge that they can understand, access and trust. People being provided with the first-hand experience and seeing the changes on their shore. So is very hard to disbelieve something or ignore something when you are in it, you are experiencing it and you are seeing those changes for yourself. Is very easy to discard when someone tells you something or not listen to it but is very hard to get away from the fact that you are in. And also because you are creating a trust and relationship with the volunteers, you are taking them, educating them and becoming their teacher, you have that relationship with trust. They trust that you are providing them with the correct information and informing them about what is actually going on. For example, I also create a relationship with my volunteers and they trust me to provide them with correct information and facts on our marine environment. I am their initial teacher and create

trust to listen and think over what I am saying, alongside showing them what I am talking about.

In term of example, obviously we now had two marine conservation zones landed in the Isle of Wight and potentially that has some links to us promoting the right information encouraging people.

Talking to volunteers before and after surveys. Often hearing them say ‘I never knew that’ them asking for more information and where to find further information and certain issues. Seeing they go out and buy literature on the marine environment to bring on the next surveys.

Q.10. Citizen science as a tool for coastal and marine conservation

Researcher

Would you recommend the use of citizen science as a tool in other ways for coastal and marine conservation?

P5

Yes, absolutely. For example, in our survey, citizen science has improved and sped up environmental changes detection and identifying invasive species. However, before conducting citizen science and there is need to weight its strengths and weaknesses and interactions with participants have to be transparent so that to create social dimensions.

Appendix G: Project Timeline

Task	June				July				August				September				October
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15	Week 16	Week 17
Meeting with Supervisor																	
Finalising Research topic																	
Establish aims and objectives																	
Literature review																	
Dissertation methodology																	
Questionnaire design and survey																	
Survey data collection																	
Interview schedule design																	
Interviews																	
Data interpretation and analysis																	
Findings																	
Conclusions																	
References																	
Abstract																	
Review																	
Printing, Binding & submission																	