Community Involvement in Coastal Management: A Case Study of Citizen Science and Public Participation in North West England

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Abstract

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Coastlines face anthropogenic challenges including climate-related flooding and erosion, and marine litter. Managing these challenges requires a transformational shift towards collaboration with the communities whose livelihoods and place-connections depend on coastal spaces. Approaches including citizen science—the active involvement of people in research—and public participation in decision-making could help coastal communities engage in understanding, monitoring, and managing these challenges. However, the design of such approaches often overlooks people, leaving them without a meaningful role in research or decision-making. This thesis aims to engage a community in a participant-focused citizen science project called Coast Watchers in North West England that builds people's understanding and ability to participate in resilience-based coastal management. Through a mixed-methods, place-based case study, the work undertakes several phases to engage people in collaboratively designing, conducting, and evaluating Coast Watchers. Crucially, the work examines how coastal communities can move beyond citizen science monitoring to actively participate in coastal management decisions. Findings suggest that people hold deep attachments to coastal space, although factors such as marine litter can provoke negative experiences. Accounting for people's coastal values and concerns is crucial when collaboratively designing a citizen science project to ensure it provides meaningful impact. Evaluating people's experiences from a year of marine litter citizen science surveying indicates that such work offers experiential learning opportunities. However, whist citizen science can support positive learning outcomes and foster heightened environmental awareness, it does not offer participants a route into coastal management decision-making. This is because, outside of consultation-based involvement, there are few opportunities for people's voices to be heard in decision-making, with several challenges at the root of this. Overall, the thesis provides an important contribution to the growing field of participatory coastal management, highlighting the urgent need for resources to support coastal communities to become empowered agents in managing current and future challenges.

Author's Declaration

I declare that the work in this thesis is my own and has not been submitted for another degree or qualification at any other institution.

Many of the ideas in this thesis were the product of discussion with my supervisors Dr Suzana Ilic, Dr Alexandra Gormally-Sutton and Professor Michael R. James at Lancaster University.

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I’ve always loved the coast. But, growing up in landlocked Leicestershire, it took a combination of family seaside holidays (too many to count – thanks Mum & Dad!) and an inspirational Geography teacher to help me realise that I could turn that love into a career.

A Geography degree later, I’m now not only working at the coast, but have had the incredible opportunity to dedicate five years of my life conducting PhD research at Lancaster University to help advance our understanding of coastal management. To this day, I’m still unsure how I was selected as a successful PhD candidate after *that* interview, but I’m extremely grateful I was!

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List of Abbreviations

3Cs	Championing Coastal Coordination
ACE	Acquaint, Collaborate, Empower
ATL	Advance the Line
CAG	Coastal Action Group
CPA	Coastal Protection Authority
CSO	Combined Sewer Overflow
DAD	Decide, Announce, Defend
DEFRA	Department for Environment Food and Rural Affairs
EA	Environment Agency
EDD	Engage, Deliberate, Decide
EU	European Union
FCERM	Flood and coastal erosion risk management
FLAG	Flood Action Group
FRM	Flood risk management
GBBC	Great British Beach Clean
GHG	Greenhouse Gas
GPS	Global Positioning System
Hs	Significant wave height
HTL	Hold the Line
ICZM	Integrated Coastal Zone Management
LA	Local Authority
LLFA	Lead Local Flood Authority
MR	Managed Realignment
MBP	Morecambe Bay Partnership
NAI	No Active Intervention
NBS	Nature Based Solutions
NW	North West
PAR	Participatory Action Research

PPE	Personal Protective Equipment
RFCC	Regional Flood & Coast Committee
RMA	Risk Management Authority
SAS	Surfers Against Sewage
SLR	Sea Level Rise
SMP	Shoreline Management Plan
SMP22	Shoreline Management Plan Great Ormes Head to Scotland
SQ	Sub-question
UK	United Kingdom
US	United States
UU	United Utilities

Chapter One

Chapter One: Introduction

1.1. Research Context

Coastal environments offer essential ecosystem services, including habitats, carbon sinks, and buffers against flooding and erosion. The coast also provides cultural and economic benefits, hosting an estimated 271 million recreational visits annually in England alone (Elliot *et al.,* 2018). Positive mental health, physical health and wellbeing benefits have been associated with spending time in and living at the coast (White *et al.,* 2013a; Hooyberg *et al.,* 2020), leading to the conceptualisation of 'healthy blue spaces' (Foley & Kistemann, 2015) and opportunities for individuals to develop unique coastal place attachments (Diamond *et al.,* 2024).

However, these coastal spaces are changing. The world's coasts and oceans are described as 'ground zero' for numerous anthropogenic challenges including species loss, habitat destruction, plastic pollution, and climate change (Cigliano *et al.,* 2017; Nelms *et al.,* 2017). Climate change is the global, long-term adjustment of Earth's weather and annual temperature in response to the release of greenhouse gases (GHG), including carbon dioxide (Met Office, N.D.). Increasing atmospheric GHG concentrations are driving increased global temperatures, with the global average surface temperature warming by approximately one degree Celsius since the pre-industrial era (Lindsey & Dahlman, 2024). The rate of this warming is increasing, with the warmest five years on record observed in the last two decades in the UK (Met Office, N.D). Prevented from escaping Earth's system and into space by GHGs, over 90% of this excess heat is absorbed and stored in the ocean, driving ocean heat waves, ice sheet melt, coral bleaching, more intense tropical storms and SLR (Lindsey & Dahlman, 2023; Wright & Thom, 2023).

SLR, driven primarily by thermal expansion of the ocean and ice sheet and glacial melt (Howard *et al.,* 2019), is one of the most significant implications of a warming climate. Although predicting future SLR extents is complicated by uncertainties in the underpinning science (e.g. future emission scenarios and degree of warming, mitigation efforts, ice melt rates, feedback loops and ocean heat redistributions), the consensus is that sea levels are rising and will continue to do so for centuries to come. Current predictions suggest global SLR will likely be 0.38 – 0.77 m (1.01 m at the top of likely range) by 2100 depending on mitigation efforts (Fox-Kemper *et al.,* 2021), although SLR could be as much as 1.32 m

(Horton *et al.,* 2020) or even 2.3 m under a strong warming scenario (Fox-Kemper *et al.,* 2021). Moreover, the main uncertainty is *when,* not *if*, SLR that exceeds the likely limit of 1.01 m will occur (Fox-Kemper *et al.,* 2021). Even if GHG emissions are stabilised, sea levels are expected to continue to rise well beyond 2100 because it takes centuries for the oceans to respond to warming air temperatures (Haigh *et al.,* 2022). Superimposing storm surges, powerful storm waves and tidal processes onto an increasing sea level baseline drives the increased potential for extreme water levels, erosion and coastal flooding (Haigh *et al.,* 2022; Wright & Thom, 2023).

The projected impacts of SLR and associated flooding is increasing the vulnerability of coastal regions. This vulnerability is magnified by a high global coastal population density, with coastal regions experiencing higher rates of population growth and urbanisation than inland areas (Neumann *et al.,* 2015). As such, a SLR of 2 m could result in 2.4% of the global population being displaced (Nicholls *et al.,* 2011). Other implications include loss of lives, incomes, homes, infrastructure and cultural sites, impacts that are disproportionately spread geographically, with some locations like small island states more vulnerable (Martyr-Koller *et al.,* 2021). Without adaptation of coastal systems - actions and adjustments taken to reduce or avoid harm (IPCC, 2014) - economic damages from SLR related flooding could be as much as US$ 10.2 trillion annually by 2100 under a 1.5 °C warming scenario, increasing to a worst-case scenario of US$ 27 trillion per year if the 2 °C warming limit is surpassed (Jevrejeva *et al.,* 2018). For coastal environments globally, SLR is likely to cause a decline of wetlands (Blankespoor *et al.,* 2014), irreversibly change barrier islands and spits (Williams, 2013) and erode sandy beaches (Vousdoukas *et al.,* 2020).

The picture for the UK follows this global forecast, with high confidence that mean sea level will rise between 0.27 and 1.12 m by 2100 around the UK (Haigh *et al.,* 2022). Regionally, the amount of SLR will be strongly determined by localised factors, including differences in ocean circulation and glacial isostatic adjustment, whereby a rising Scotland is expected to experience a lesser rate of SLR compared with a sinking southern England (Howard *et al.,* 2019). Consequently, 'it is almost certain that England will have to adapt to at least 1m of SLR at some point in the future' (CCC, 2018; p.9). Combining SLR with the likelihood of more frequent and intense weather extremes (Met Office, N.D.a), there is an increased potential for more extreme water levels and wave overtopping events (Haigh *et al.,* 2022). Nearshore waves are also expected to be higher and break later, transmitting greater energy and erosion potential to the coastline (Howard *et al.,* 2019). With SLR also likely to reduce nearshore sediment supply from offshore and longshore sources, and the inability of coastal systems to migrate and roll-back landwards because of engineered structures (a process termed 'coastal squeeze'), erosion rates are expected to increase in the future (Masselink *et al.,* 2020). As a result, the continued decline of saltmarshes, shingle beaches and sand dunes are anticipated (Haigh *et al.,* 2022).

Whilst presenting global and national threats, climate challenges will be most acutely experienced by individuals on the local scale, whereby coastal communities are conceptualised to be on the 'frontline' of climate change impacts (Carcia-Soto *et al.,* 2017; Arnall, 2023). This is because climate-associated changes become risks when they encounter human development in the marine and coastal zones. Coastal risks are 'the ecological, social, economical, functional, and cultural damages possibly caused to coastal areas due to their geographical location', regulated by the frequency, magnitude and type of hazard (e.g. coastal flooding and/or erosion), and the vulnerability (degree of exposure) to it (Batista, 2019, p.524). The vulnerability of coastal regions globally to these climate change hazards is magnified by extensive development, industrialisation, and population concentration in coastal areas (Neumann *et al.,* 2015).

Consequently, in England, not accounting for coastal defences (20% of which are projected to be vulnerable to failure in a 0.5 m SLR scenario), currently around '520,000 properties (including 370,000 homes) are located in areas with a 0.5% or greater annual risk from coastal flooding and 8,900 properties are located in areas at risk from coastal erosion' (CCC, 2018; p.9). Annual economic damages from flooding and erosion are more than £260 million (CCC, 2018) and will likely only increase as more properties are exposed to flood or erosion risks from SLR. Consequently, by the 2050's roughly 30% of England's coastline, including around 120,000–160,000 properties, may face pressures to realign (Sayers *et al.,* 2022). By the 2080s, the number of at-risk properties increases, with '1.5 million properties (including 1.2 million homes) may be in areas with a 0.5% of greater annual level of flood risk and over 100,000 properties may be at risk from coastal erosion' (CCC, 2018; p.10).

Set against these anthropogenic challenges is the fact that many coastal communities in the UK share common underlying socio-economic inequalities. Coastal areas are typically poorer and older than the UK average (CCC, 2018) and face socio-economic challenges including high youth outmigration and inward elderly migration, high proportions of retirees and benefit claimants, poor-quality housing, over-reliance on tourism, seasonal employment, low income and pressure on services during the summer (Zsamboky *et al.,* 2011). Coastal communities across England also display some of the worst mental and physical health outcomes compared to inland communities (Whitty, 2021). Moreover, climate change is also likely to impact people's relationships with the coast and the blue health benefits it provides (Jarratt *et al.,* 2020). Such underlying challenges reduce people's capacity to adapt and increase the vulnerability of some coastal areas to climate change (Zsamboky *et al.,* 2011; CCC, 2018).

It is this combination of physical, social and economic challenges that must be addressed by the field of coastal management. Typically presented as a practice of reducing flood and erosion risks facing coastal communities, assets and infrastructure (e.g. Wentworth & O'Neill, 2021), coastal management has traditionally focussed on engineered defences to physically protect assets in the coastal zone (Pontee, 2017). The 1800's witnessed a proliferation of hard engineered physical structures (e.g. sea walls) to resist flooding and erosion to support Britain's growing industrial, military, and navigational needs (Brown *et al.,* 2023). Coastal defences were also built to support agricultural land reclamation and protect the growing number of large Victorian seaside resorts from erosion (Pontee, 2017) and were then upgraded in reaction to significant flood or erosion events (Mcglashan *et al.,* 2003; Haigh *et al.,* 2022; Brown *et al.,* 2023). The approach reflected a 'military' focussed mentality pitting human engineering in a battle to control natural coastal systems (Haigh *et al.,* 2022).

However, by the late 1990's, the sustainability of this defence paradigm was under question. The continued use of static engineered structures as the principal coastal defence approach was seen to be contradicting the impacts of SLR, stalling required adaptation, restricting the natural functioning of coastal systems (French *et al.,* 2016), increasing the financial consequences of flood and erosion events (Dean, 1999), and magnifying long-term risks to coastal communities and infrastructure (McNamara *et al.,* 2023). In place of a defence-based ideology, a holistic and risk-based approach to flood and coastal management has emerged (EA, 2010; Brown *et al.,* 2023). This approach recognised that, whilst physical coastal defences are an important tool in the coastal management armoury, maintaining a static defence, or 'hold the line' tradition is not a realistic long-term option for coastal management (Ledoux *et al.,* 2005). This is because 'it is not cost effective, desirable, or feasible to protect all areas to the same standard, necessitating risk-based methodologies to determine which areas require protection and what standard of protection should be afforded' (Pollard *et al.,* 2019, p.575).

The transition from a defence paradigm to risk-based methodologies has been seen globally, including in the United States (US) and Europe, paving the way for alternative and natural forms of coastal management to be considered and applied alongside physical defences (Buser, 2020; Scott *et al.,* 2020). These include 'softer' or hybrid approaches like Nature Based Solutions (NBS) that aim to work with, not against, the natural coastal environment (French *et al.,* 2016; Pontee, 2017), or beach management strategies to identify solutions that sustain the long-term health of beach environments (Mead, 2017).

In England, there is now a nuanced transition within this overarching risk-based approach towards building 'resilience' to challenges posed by climate change at the coast (EA, 2020). Building resilience – 'the capacity of people and places to plan for, better protect, respond to, and recover from flooding and coastal change' (EA, 2020, p.25) - is the headline message of the Environment Agency's (EA) National Flood and Coastal Erosion Risk Management (FCERM) Strategy. The strategy outlines a vision for: 'a nation ready for, and resilient to, flooding and coastal change – today, tomorrow and to the year 2100' (EA, 2020, p.6). Building coastal resilience is seen as a long-term process that increases the knowledge and capacity of coastal communities to better understand and prepare for coastal change and have a voice in shaping how resilience is achieved (Famuditi, 2016; EA, 2020).

Fundamentally, this emerging resilience paradigm (Van Der Plank *et al.,* 2022) marks a transition towards a more participatory approach to managing flooding and coastal change. Set within the context of socio-economic disparities in coastal communities, this paradigm presents an array of opportunities (and challenges) to reimagine how coastal communities can be better engaged to create social opportunities, encourage life-long learning and promote citizen involvement in the management of coastal environments.

Public engagement describes the myriad of passive or active ways organisations seek to involve the public in their work (Burdett, 2024; NCCPE, 2024). Engagement is commonly undertaken to increase awareness, gain local knowledge, increase buy-in, and facilitate dialogue and relationships between stakeholders (McKinley *et al.,* 2021). At the coast, engagement could help to both illuminate and better manage the impacts of global coastal challenges on local physical coastal spaces and human place-based experiences and connections (Bell *et al.,* 2015). This work seeks to engage coastal communities by placing people at the centre of two fundamental concepts: citizen science and public participation in decision-making.

Citizen science is the active engagement of people working in partnership with scientists to undertake research and generate new knowledge (Bergerot, 2022). Recent decades have witnessed a rapid growth in the number and scale of citizen science projects globally (Haklay *et al.,* 2018; Hacking *et al.,* 2024), with projects mobilising masses of people to collect data to better understand the environment on spatial and temporal scales and resolutions previously unattainable by lone researchers (Bonney *et al.,* 2014). Coastal environments - particularly beaches - have been identified as opportune places for citizen science projects, both for the research opportunities they present and because of the wellbeing value and social benefits that public engagement in blue spaces can offer (Fanini *et al.,* 2021).

Moreover, although the term ‘citizen science’ is relatively new in scientific literature, appetite for involving citizens in coastal research has been evident since at least the 1960’s. Notably, eminent coastal geomorphologist Steers (1969, p.V) wrote: ‘Anyone who visits a part of the coast at fairly frequent intervals, and who observes it carefully, is in a position to make useful and even valuable contributions to our knowledge of coastal processes’. Since then, estimates suggest there may be as many as 500 marine and coastal citizen science projects in Europe (Garcia-Soto *et al.,* 2021), exploring phenomena such as coastal change using emerging technologies, or mobilising large numbers of people to monitor marine litter.

The second concept, public participation, describes the activities that seek to incorporate people’s concerns, needs, interests, and values[1] into decision-making and agenda setting (Rowe & Frewer, 2005; Nabatchi & Leighninger, 2015). Involving communities, with their deep-rooted interests, connections, and values in coastal spaces, is especially important in decision-making and planning at the coast (Nursey-Bray *et al.,* 2017) and is something that has long-been recognised globally (e.g. Shabman, 1974) and in the UK (e.g. Edwards *et al.,* 1997). Public participation in decision making is becoming increasingly important within the context of the emerging resilience paradigm in FCERM.

Importantly, engaging communities in citizen science and public participation activities at the coast is certainly not new. However, the approaches commonly taken in formally organised activities (e.g. government authority or academic led) are not necessarily designed with citizens at the fore. For instance, a critique of citizen science is its emphasis

[1] In this work, ‘value’ is not used in its monetary context but rather to describe the personal significance of coastal spaces (e.g. the value of place-based health and wellbeing benefits) or an individual's perception of the usefulness of something (e.g. the value of lay knowledge in decision-making).

on science-focussed outcomes, including enhanced data collection. In contrast, participant-focussed benefits or impacts often go unexplored (Haywood, 2014a; Bonney *et al.,* 2016; Leonard *et al.,* 2023), including in marine litter citizen science (Kawabe *et al.*, 2022; Severin *et al.*, 2023a). Furthermore, public participation activities in coastal management are traditionally top-down and consultation-based (Famuditi *et al.,* 2018; Bradshaw *et al.,* 2021; Bradshaw, 2022), whereby they can unintentionally exacerbate conflicts and fail to provide people with a meaningful voice or role. Yet, As Ellsworth *et al*. (1997, p.122) note, 'as long as the public remain on the fringe of ecosystem decision making, we will not develop the required coalitions, or lever the resources necessary, to address complex coastal issues.'

Consequently, there is a limited understanding of the way in which communities can be mobilised to be more fully engaged with, and ultimately benefit from, aspects of the coastal management process, including monitoring, knowledge-building and decision-making. For instance, there is an urgent need to better understand the ways in which citizen science, as an engagement tool, can be designed and implemented to achieve more than data collection, and instead contribute to management needs, generate positive learning outcomes, or even build resilience to coastal change. Moreover, if citizen scientists and coastal communities in general are to have voices in resilience-building decisions, there is an important need for research to explore the opportunities for people to participate in coastal management decisions beyond consultation processes. Addressing these gaps is fundamental to supporting place-connected coastal communities in becoming empowered and active agents in the management of their local coastlines that face evolving anthropogenic challenges.

To address these gaps, this thesis explores how coastal communities can have more meaningful and active roles in coastal management processes. Specifically, the work seeks to engage a coastal community in collaboratively designing, conducting and evaluating a citizen science project, both to better illuminate the social outcomes of such projects on participants learning and understanding of coastal change, and as a tool to increase people's ability to participate more fully in coastal management decision-making processes. The research is undertaken through a single place-based case study in North West (NW) England which, whilst limited in its generalisability to other locations to some extent, supports the development of strong researcher-participant relationships and can offer rich and novel insights that can be compared and tested in other cases (Berardo *et al.*, 2024). Consequently, through a mixed-methods and place-based case study this thesis aims to engage people in a participant-focussed citizen science project that builds people's understanding and ability to participate in a resilience-based coastal management in North West England.

1.2. The Research Location

This place-based research is focussed on England's North West coast (Figure 1.1), a region that spans over 1400 km across the four counties of Cheshire, Merseyside, Lancashire and Cumbria. The NW's coastline is typically low-lying, characterised by estuaries, intertidal mudflats, saltmarshes, sand dunes and beaches, with over 80% of the region's coastal habitats protected by national and international environmental designations (NWCF, 2024). Approximately one-third of the region's six million residents live along the coast, whilst coastal settlements account for around a quarter of the region's jobs (NWCF, 2024). The coastline is also home to significant ports, including Liverpool, Fleetwood, and Heysham, as well as prominent tourist destinations like Blackpool and Morecambe; NWCF, 2024).

Figure 1.1. *The coastal region of NW England within Great Britain (Inset).*

However, in line with the national picture, the region is vulnerable to a changing climate. Notably, the Lancashire coast has been described as the most sensitive area of the county to climate change (Atkins, 2021). This may be in part a result of the SLR related flood risk facing the low-lying coastal peninsula, with SLR rates at Heysham measured at ~4 mm yr^{-1}, more than double the long-term UK average (1.4 ± 0.2 mm yr^{-1}; Atkins, 2021), whilst modelled wind and wave projections to 2100 in Liverpool Bay suggest the potential for increased severity of large and extreme wave events and significant wave heights through the winter months (Brown *et al.,* 2012).

Chapters four, five and six focus specifically on the Fylde Coast, a low-lying coastal plain in Lancashire, bounded by the Irish Sea to the West, Morecambe Bay to the North and the River Ribble to the South (Figure 1.2). Climatically, the Fylde coastline is warmer, sunnier, dryer and windier compared to the UK and NW England averages (Met Office, N.D.b). The coastline is macrotidal (tide range of 8.0 – 9.0 m) and features an approximately 17.5 km-long concrete sea wall and promenade connecting the conurbations of Fleetwood, Cleveleys, and the coastal resort town of Blackpool.

Figure 1.2. *The Fylde Coast. Inset, the location of the Fylde within Great Britain.*

Historically, the region, and Blackpool in particular, has a strong tourist tradition. Tourism was facilitated by the arrival of the railway in the mid-19th century (Sweeney & Thomas, 2015) and wakes weeks, a Lancashire tradition whereby each mill town would shut down for a different week throughout the summer (Poole, 1984), ensuring a constant flow of tourists seeking the coast. However, driven in part by the subsequent socio-economic decline of both Blackpool's tourism and Fleetwood's fisheries, parts of the region face several socio-economic challenges characteristic of disadvantaged UK coastal areas (Zsamboky *et al.,* 2011), including poor health indicators (Green & Shore, 2019), an aging population (average age of 45 compared to the UK average of 39; Scrivens, 2019), high crime rates and high deprivation (Ordonez, 2018). In particular, Blackpool is the most deprived LA in England and has the worst life expectancy in the UK (Whitty, 2021).

Again, the Fylde Coast is vulnerable to climate change impacts. Although projecting climate impacts down to a local level is difficult, as site-specific factors will strongly determine the response of a coast to climate change (Masselink *et al.,* 2020), confidence in local predictions can be increased through local-scale data collection and studies. Several studies are available to help explore possible climate change impacts on the Fylde Coast, particularly in the Wyre Local Authority (LA) in the north of the Fylde peninsula. Notably, a report undertaken by Jacobs (2016) highlights the risk to the peninsula from sea-borne tidal flooding, wave overtopping, and inland fluvial sources (Jacobs, 2016); a compound flood risk that has been modelled to increase the economic implications of flooding in Fleetwood by a factor of eight compared with a storm surge event alone (Prime *et al.,* 2015). Consequently, the Wyre is projected to be the second most impacted authority in England from SLR related flooding by 2050, with an estimated 12,000 properties at risk (Sayers *et al.,* 2022).

This combination of stacked environmental and socio-economic challenges facing communities on the Fylde Coast, and across the wider NW region, presents a strong rationale for public engagement to enhance social opportunities, learning, participation and resilience.

1.3. The Citizen Science Case Study: Coast Watchers

The thesis is rooted in a case study citizen science project called Coast Watchers on the Fylde Coast. Coast Watchers, an initiative founded by Rabbit Patch, Wyre Council and

Lancaster University, was formed with the intention of engaging people with monitoring and better understanding the Fylde's changing coastal environment. The initiative was firstly developed by Michael Lusty (2019) in his Masters-level research project at Lancaster University. Lusty worked with a small group of volunteers using smartphone cameras to create 3D models to monitor physical coastal change around a sea wall. This PhD project was proposed to build upon Lusty's work by harnessing emerging technologies to build an ecosystem of citizen sensors who could monitor and catalogue coastal change as part of a citizen observatory. The proposal emphasised the value of citizen science for low-cost monitoring and data collection, with the first few months of this PhD project dedicated to developing this proposal in late 2019 and early-2020.

However, with the onset of the COVID-19 pandemic in Spring 2020, which restricted in-person citizen science activities and shifted all research activities online, the nature of Coast Watchers changed. The pandemic period became an opportunity to pause and develop Coast Watchers differently, whereby greater emphasis was placed on people's motivations and coastal concerns (explored in Chapter 4) to increase the potential relevance, appeal and value of Coast Watchers locally. Consequently, the focus of Coast Watchers, and this thesis, shifts from a primarily physical Geography-based project to one that integrates human Geography elements more fully and embraces a more participant-focussed citizen science. The resulting thesis is a product of the unique social conditions under which it was developed and an evolving epistemological perspective.

1.4. Thesis Aim, Objectives & Research Questions

This study provides a novel demonstration of how a place-based citizen science project can be designed, how it can offer experiential learning opportunities to improve community understanding of coastal change, and ultimately what roles engaged citizens do and could play in a resilience-based coastal management. Undertaking such research is key to understanding the impact of global anthropogenic challenges on local coastal communities; identify participants' outcomes and experiences in coastal citizen science projects; explore where, when, and how people can engage in resilience-based coastal management; and to demonstrate the importance of a holistic coastal management that accounts for both physical environmental change and the diverse needs, values, and experiences of people in coastal spaces. The thesis aims to:

Aim: *To engage people in a participant-focussed citizen science project that builds people's understanding and ability to participate in a resilience-based coastal management in North West England*.

The aim is underpinned by four research objectives. The first three objectives directly respond to the need to reimagine a participant-focussed citizen science, one that better understands its participants, their needs, concerns, experiences and outcomes. Objective one, set within a COVID-19 context on the Fylde Coast in NW England, grounds the project in place to elicit people's emotional connections to place, values, concerns and potential motivations for involvement in a citizen science project:

Objective One: *Determine people's values and concerns in coastal blue space, framed during the COVID-19 pandemic on the Fylde Coast, to ground the research in place.*

Three research questions are posed to explore this:

1. *What value do residents and tourists of the Fylde Coast attach to local coastal blue space, in terms of wellbeing, mental health, physical health and importance?*
2. *To what extent did the COVID-19 pandemic, and resulting lockdowns, impact upon this value and change the nature of place interactions?*
3. *Reflecting on the experiences in and value of blue space during the pandemic, has the pandemic influenced people's motivations for involvement or disinvolvement in the protection of the coastal environment?*

The second objective seeks to involve participants and stakeholders in collaboratively designing the Coast Watchers citizen science project that goes beyond contributory data collection. It explores how the collaborative design process can account for and balance input from different stakeholders and ensure that both participants and science benefit from the collaboration:

Objective Two: *Informed by coastal values and concerns, characterise the extent to which a citizen science project can be collaboratively designed to provide both participant- and scientific-focussed outcomes.*

Two research questions are presented to understand this:

1. *To what extent can a collaborative design process account for different stakeholder's interests, concerns and outcomes in the design of a citizen science project to understand coastal change on Rossall Beach?*
2. *Is a collaborative process able to address the overarching 'science-centric' critique of citizen science by fostering a participant-focussed citizen science?*

Objective three engages people in Coast Watchers and seeks to offer a novel case study of both science- and participant- focussed outcomes, including the extent to which citizen science can foster positive outcomes and experiences:

Objective Three: *Identify the outcomes of citizen science for both adding to our understanding of coastal change and delivering benefits for participants.*

Two research questions are investigated:

1. *What contribution(s) can Coast Watchers make to our understanding of the types, distributions and processes affecting marine litter accumulation?*
2. *To what extent can a marine litter citizen science project also account for, and better understand, participant experiences, outcomes and benefits?*

Lastly, objective four expands the focus of research beyond citizen science to consider how the public could participate in a resilience-based coastal management. It was always an objective of this thesis to understand how engaged citizen scientists could actively participate in decision making at the coast - for instance, how citizen science data informs coastal monitoring, decision making, or even how citizen scientists, as empowered individuals, could get their voices heard. This would help to ensure that citizen science is not only an academic data collection exercise but carries value and purpose for coastal management decisions.

However, it was during the development of the final research phase associated with objective four that the researcher began working part-time on a coastal management project. It was through this position that the researcher gained an insider understanding of the key challenges facing coastal management in practice – most notably how to engage coastal communities to adapt and build resilience to coastal change. Academic and grey literature suggests that this is a long-standing issue. But, with the publication of the latest national FCERM Strategy in 2020, a document that outlines a renewed intent for public participation, there is an opportunity to research how, when and where communities can participate in practice, what challenges and blockers they face, and what the future may hold:

Objective Four: *Evaluate the roles and responsibilities that people have, and could have, within a resilience-based management of their local coastal environment by exploring the extent to which public participation within decision-making is achieved, and the space, challenges and opportunities for people within a future participatory coastal management.*

The following research questions are posed to address this objective:

1. *How is coastal management conducted and what are the rationales for community involvement in it?*
2. *What are the roles and responsibilities for people and communities within coastal management in the North West; when and where can they contribute and what challenges do they encounter in practice?*
3. *What does the future hold for a collaborative and participatory coastal management under a resilience paradigm?*

1.5. Thesis Structure

The thesis consists of eight chapters. References and supplementary material for each chapter (Appendix) are provided after the synthesis and conclusion.

Chapter Two provides a comprehensive introduction to the two fundamental research concepts used in this work, citizen science and public participation. The chapter also provides an overview of the emerging resilience-based paradigm for FCERM in England.

Chapter Three introduces the research methodology. The chapter outlines the place-based, mixed-methods approach undertaken, reflecting upon the researcher's positionality and the strengths and weaknesses of the research methods employed.

Chapter Four seeks to inform the design of the Coast Watchers citizen science project by grounding the project in place and understanding people's value of coastal blue space on the Fylde Coast within NW England. Aligning with ***Objective One***, the chapter considers people's local coastal values, concerns and emotional connections to it. Undertaken during the COVID-19 pandemic, the chapter reflects on the impact of the pandemic on people's values, place-experiences and potential motivations for participation in a citizen science project. Findings indicate that, alongside a reduced sense of safety in coastal space during this time, the issue of increased marine litter proved to affect people's everyday place encounters.

Chapter Five addresses ***Objective Two*** by bringing together various stakeholders to collaboratively design Coast Watchers at Rossall on the Fylde Coast. The chapter seeks alignment between coastal interests, concerns and needs that could be addressed through the project. The issue of marine litter featured again in the collaborative process and proved a feasible research topic to pursue through citizen science.

Chapter Six presents the process of and outcomes from conducting Coast Watchers to explore the anthropogenic challenge of marine litter. The chapter provides a novel investigation of both science-focussed and, critically, participant-focussed outcomes to satisfy ***Objective Three***. Results suggest that marine-litter citizen science can support positive learning outcomes, change preconceptions and foster a heightened sense of environmental awareness for some participants.

Chapter Seven explores ***Objective Four***, namely the ways in which coastal communities could engage beyond citizen science and into participation with coastal management – investigating how, where and when people can and could contribute towards decisions about how their local coast is managed. The chapter expands the research focus beyond the Fylde Coast to include coastal communities and coastal practitioners around the NW coast. The chapter identifies significant challenges amounting to a lack of public participation in practice, including low readiness, climate change intangibility and systemic issues, but suggests that an actions-based engagement could stimulate agency and provide people with roles in coastal management.

Chapter Eight summaries the key findings, offers wider reflections and provides recommendations for future work.

Chapter Two

Chapter Two: Citizen Science & Public Participation at the Coast

2.1. Introduction

The chapter begins by introducing the emerging resilience-based flood and coastal erosion risk management (FCERM) paradigm within the context of climate change and a changing coastal environment. The two fundamental research concepts, citizen science and public participation, which could help to build coastal community resilience, are then considered in detail. This includes reflections on definitions, examples, benefits, challenges and critiques in relation to their applications at the coast. Importantly, research gaps and emerging questions are outlined at the end of each section, establishing the direction of the thesis for subsequent chapters.

2.2. Coastal Management in England

Coastal management is typically viewed as the practice of reducing flood and erosion risks facing coastal communities, assets and infrastructure (e.g. Wentworth & O'Neill, 2021). In recent decades, coastal and flood risk management has experienced a transition away from a defence-based practice towards more holistic, risk-based approaches (EA, 2010; Brown *et al.,* 2023), a recognition of the unsustainability of maintaining a static defence, or 'hold the line' tradition, for all coastal places into the future (Ledoux *et al.,* 2005). In the UK, the production of the first Shoreline Management Plan (SMP) in the mid to late 1990s marked an innovative step towards a more strategic and risk-based approach to coastal management (O'Riordan & Ward, 1997; EA, 2010; SCG, 2024). The SMP, split across 22 sediment cells[2] (Figure 2.1), draws upon a comprehensive assessment of the flood and coastal erosion risks and socio-economic factors to define the preferred policy option to sustainably manage risks to a specific section of coastline, or policy unit, until 2100 (EA, 2010; Hardiman, 2015; NWENWCG, 2023). The SMP is the main tool for guiding local coastal management decisions (Buser, 2020).

[2] A sediment cell is a length of coastline within which sediment movement is largely self-contained (DEFRA, 2006).

This SMP is separated into three epochs, short-term (0-20 years, 2005 - 2025), medium-term (20-50 years, 2025 – 2055), and long-term (50 to 100 years 2055 - 2100), allowing for transitions in the preferred policy approach which account for changing physical processes and resulting risks to people and the environment. For each policy unity, the SMP identifies one of four preferred policy options across each epoch:

(1) Hold the Line (HTL) – Physically defend and maintain the existing or future coastline position.
(2) Advance the Line (ATL) – Move the coastline shoreward of its present position *(uncommon)*.
(3) Managed Realignment (MR) – A controlled movement of the coastline landwards of its current position.
(4) No Active Intervention (NAI) – Allow coastal process to occur unhindered, with no investment in coastal defences.

***Figure 2.1**. (i) The principle of the sediment cell informed the development of the 22 second generation SMPs around the English and Welsh coastline (SCG, 2024). (ii) The NW region sits in SMP22: Great Ormes Head to Scotland (SECG, 2024).*

From the SMP, more detailed strategies may be recommended to help progress with an individual coastal defence scheme or project in a specific location (EA, 2010). However, to be considered for funding, schemes must align with the national FCERM Strategy, which provides the framework for all operational activities and decision-making in England[3] (EA, 2020). Consequently, schemes must contribute towards 'outcome measures', which can include delivering ecological (e.g. creating habitats) and socio-economic benefits (e.g. achieving a sufficient benefit cost ratio, protecting a sufficient number of properties and reducing flood probability in deprived areas; EA, 2010; Zsamboky *et al.,* 2011). The SMP is a living document, undergoing a major revision in 2010 and a refresh from 2019 onwards to accommodate coastal changes and updated data (Townend *et al.,* 2021).

However, SMPs are not without issue. This is largely because the current shoreline management process remains most efficient for achieving defence-based HTL policies, with significant uncertainty about how non-defence policies (e.g. MR) can be delivered or funded (Brown *et al.,* 2023). Several compounding issues make achieving MR controversial, namely that it can be perceived as 'giving up land to the sea' or that it brings the risk of flooding closer to inland communities (Hardiman, 2015). Further complications include the potential need for community relocation and resulting inability of residents to sell their homes (Zsamboky *et al.,* 2011). The political landscape may also cause local councillors to avoid backing potentially controversial MR projects, since the decisions may be economically or politically damaging across their four-year campaign (Few *et al.,* 2007). Consequently, non-defence policies within the SMP have been described as 'aspirational', lacking the political or economic capacity to carry them out in practice (Brown *et al.,* 2023). In which case, contentious or difficult decisions are commonly passed forwards, whereby it becomes someone else's problem, although this only serves to 'store up' the long-term coastal climate risk (Brown *et al.,* 2023). This amounts to a juxtaposition between the short-term economic, social and political landscapes, and the long-term increasing climate risk; a clash of decision-making timescales that restrict local abilities to adapt to coastal climate hazards (Few *et al.,* 2007).

As the SMP enters its second epoch in 2025, it faces a real test because a large proportion (19%) of policy units have MR as their preferred option in epoch two (Brown *et al.,* 2023),

[3] For clarity of terminology in this thesis, FCERM describes all activities to manage inland and coastal flooding and coastal erosion (including shoreline management planning). Coastal management refers to coastal-specific FCERM activities. The National FCERM Strategy provides the overarching framework for all FCERM activities and decision-making in England. The Strategy is separate from the SMP, which sets one of four non-statutory policy options for local coastlines.

with 6% of HTL policy units in epoch one transitioning to MR (Hardiman, 2015). This is particularly relevant in the NW, where there is an almost 50% increase in the number of MR policy units in the second epoch (Figure 2.2). Alongside the challenges listed above, the current epoch-based approach fails to plan for when or how this transition will occur, providing instead a 30-year window (for epoch two) which creates uncertainty for coastal practitioners, landowners and communities. To facilitate this transition, there is increased emphasis on adaptation, which considers change not as a single action, but a process of actions and adjustments. Adaptation can encompass a suite of approaches such as NBS, retreat and accommodation responses, which can include changed practices in the coastal zone (e.g. planting salt tolerant crops; Rahman *et al.,* 2022), early warning systems, architectural change (e.g. raising buildings), advanced monitoring, enhanced early warning systems, or improved planning (Bongarts Lebbe *et al.,* 2021).

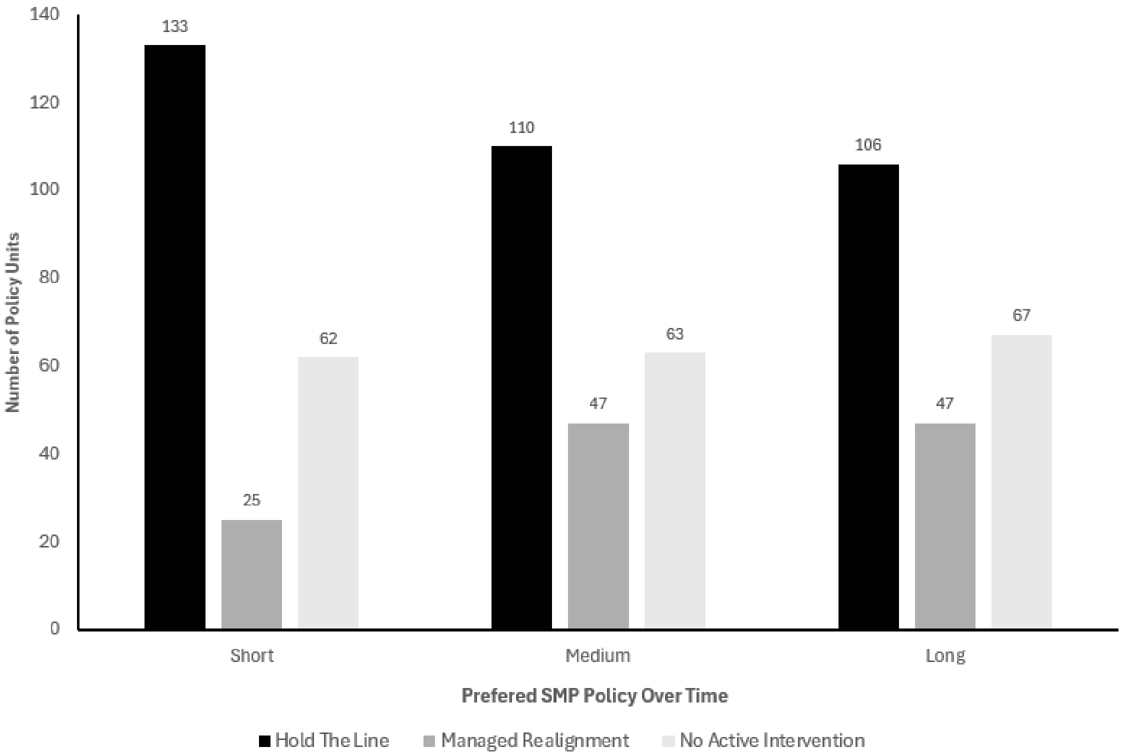

Figure 2.2*. SMP policies for policy units in the NW (SMP22) across short-, medium- and long-term epochs, indicating the reduction in HTL and increase in MR and NAI policy units over time (adapted from personal communications).*

There are also a broad range of stakeholders, 'individuals and groups, which may affect or be affected by the coastal decision' (Mcglashan *et al.,* 2003, p.87), who have an array of interests in the coastal zone and involvement in FCERM, although not all parties have statutory risk management responsibility (Figure 2.3). Because of the number of players involved, coastal management is described as an ‘awkward to administer’ (O'Riordan & Ward, 1997), complex, contradictory, fragmented and inconsistent process across coastal areas (Mcglashan *et al.,* 2003; EA, 2010; Buchan & Yates, 2019). Nationally, DEFRA are the lead government body for FCERM, setting national policy and providing funding to the EA, who supervise the implementation of SMPs by Coastal Protection Authorities (CPA). Coastal flood and erosion risks are managed separately[4], with the EA leading, alongside Lead Local Flood Authorities (LLFA), on flood risk, and CPAs managing erosion risk (EA, 2010). Beyond this, there are several actors who have Risk Management Authority (RMA) and statutory responsibility for FCERM, including government departments and agencies, internal drainage boards, landowners and the Regional Flood and Coast Committee.

Coastal communities, or the public, are also described as having a role, although a non-statutory one, for understanding and managing their own personal risks. This raises an important question – who are the ‘public’, and what is a (coastal) community? Simply, the term ‘public’ in this work is an umbrella term describing anyone with an interest in a decision (Petts & Leach, 2000), whilst a coastal community can be defined according to its spatial location, for instance ‘any local authority areas that adjoins the sea and/or coastline’ (Zsamboky *et al.,* 2011, p.5). Spatial groupings of communities may also be further defined by a shared collective risk, whereby it is a group of people within defined geographical boundaries who share a common fate or exposure to a hazard (Potter & Fitton, 2023). Alongside its spatial element, a community can also be defined by its psychology (e.g. local or group identity; Twigger Ross *et al.,* 2011) or social structure, including a community as a ‘system’ (a community is a sum of its constituent parts, each carrying out a role in order for the system to run effectively); as a network (a community as a social and political network linking individuals, community organisations and leaders); or as a collection of individuals (each individual has their own sense of community which can change in time and space; Famuditi, 2016). For the context of this work, a coastal community is simply defined by its geographical proximity to coastal space, accounting for a collection of individuals, or public, who both reside in or visit the coast for work or leisure. These communities are the stakeholders of interest in this research.

[4] This separation of risk is a key critique of current coastal management, as it fails to consider the interplay between erosion and resulting flood risk, both of which will change under climate change, and therefore impact the extent of flood and erosion risk (Pollard *et al.,* 2019).

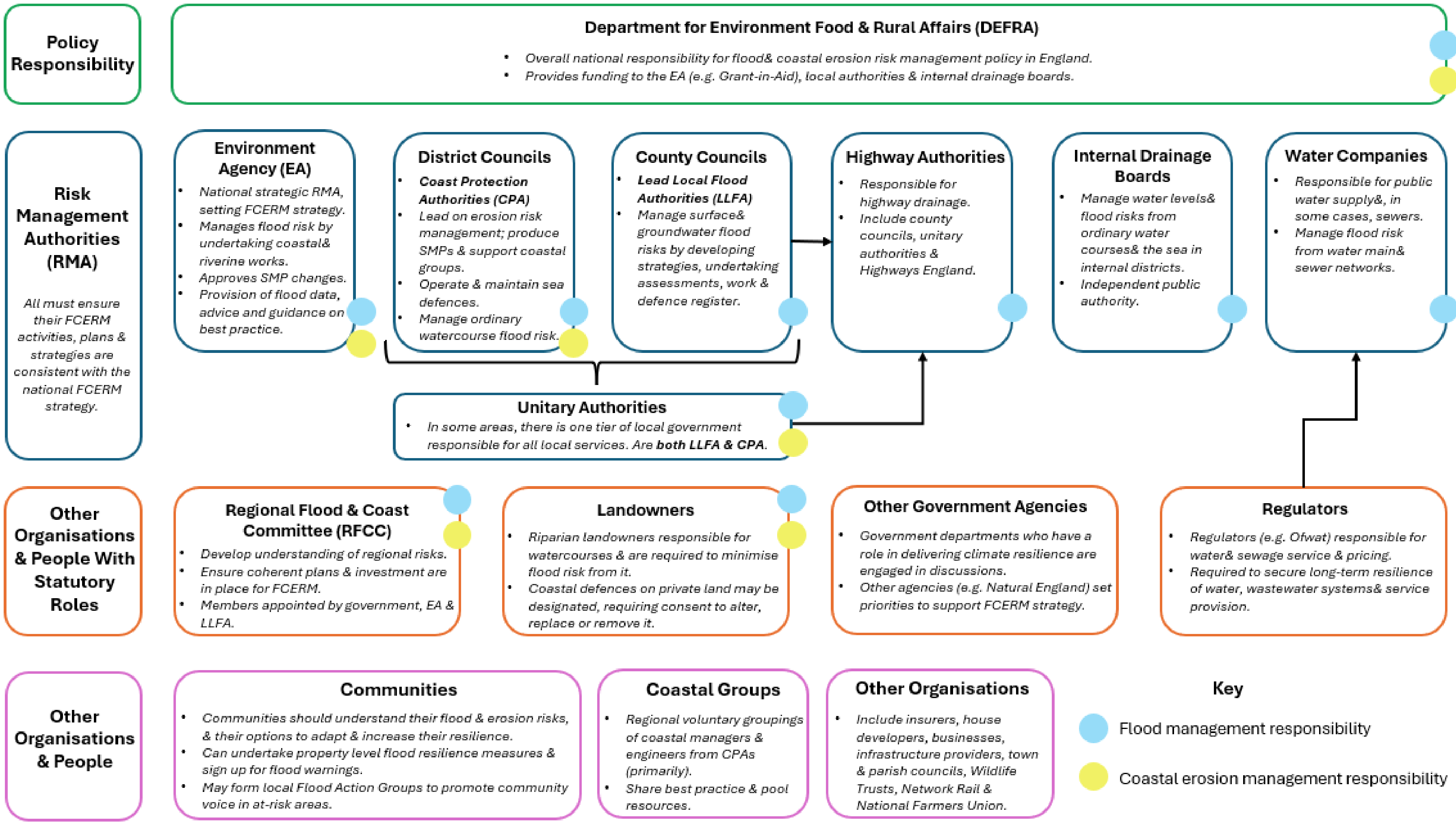

***Figure 2.3**. Summary of the roles and responsibilities of the key stakeholders involved in FCERM in England. Summarised from EA (2015; 2020) and CSP (2024).*

2.3. A New Direction in Coastal Management – Towards Resilience

Globally, coastal management has undergone a shift from resistance, defence-based approaches, to risk-based approaches. In England, there is now a nuanced transition within this overarching risk-based approach towards a resilience paradigm (Van Der Plank *et al.,* 2022), whereby adaptation is part of an array of tools, including physical defences, NBS and warning systems, to build 'coastal resilience' (EA, 2020). Notably, the national FCERM Strategy for England outlines a headline vision for '*a nation ready for, and resilient to, flooding and coastal change – today, tomorrow and to the year 2100'* [5] (EA, 2020, p.6). It is recognised that there are multiple forms, meanings, concepts and definitions of 'resilience' across a diversity of fast-moving disciplines (Hutter & Bailey, 2022). Therefore, the purpose of this section is not to provide an exhaustive review of resilience, but to contextualise the concept of resilience at the coast against the questions posed by Townend *et al.* (2021, p.3): '*resilience for whom?*' and '*resilience against what?*'.

Resilience for whom?

Resilience 'is the ability of a community or society, along with the biophysical systems on which they depend, to resist or absorb the impacts (deaths, damage, losses) of hazards, rapidly recover from those impacts and reduce future vulnerabilities through adaptive strategies' (Berke & Lyles, 2013, p.183). Applied to the coast, there is an opportunity to differentiate between different systems: 'the capacity of the socioeconomic and natural systems in the coastal environment to cope with disturbances, induced by factors such as SLR, extreme events and human impacts, by adapting whilst maintaining their essential functions' (Masselink & Lazarus, 2019, p.10). Under this definition, UK coastal management is, at least in strategy, targeting a broader systems approach that increases the capacity of both natural coastal environments and, crucially, social systems (people) to plan for, respond to and recover from coastal change (EA, 2020). Consequently, the transition to resilience demands more than the adaptation of physical coastal environments, there is an increasing focus on 'social resilience', including the role that communities can play in building resilience (Nye *et al.,* 2011; Potter & Fitton, 2023). Within the national FCERM

[5] Whilst the 2011 national FCERM strategy recognised the need for climate resilience (EA, 2011), it was the 2020 iteration (EA, 2020) that definitively set out a vision and core ambitions to build 'resilience'.

Strategy, the need to build the social resilience of a 'nation' of coastal communities is seen as critical, whereby people's voices are heard, and they can better prepare for and adapt to coastal risks (EA, 2020).

This shift from a discipline focussed on physical defences to one that places an increased emphasis on the interactions between both physical and human systems to build resilience is reminiscent of a 'social turn' in FCERM (Nye *et al.,* 2011). The opportunity arises to redefine coastal management within this social context. As noted, coastal management in the UK can largely be expressed as a practice of risk reduction (e.g. Wentworth & O'Neill, 2021), but coastal management may be defined as *more* than this. Coastal management is a practice of managing the overlapping and interrelated geographical influences (people, space and place) that shape unique *coastal spaces* (Fletcher & Smith, 2007). In this sense, the definition of coastal management must consider the practice to be managing a socio-ecological system, accounting for both the physical *and human* elements influencing coastal spaces (Bradshaw, 2022). This includes the people who live, work and use coastal space; the people, agencies and organisations that manage and govern it; and the immaterial relations, values, experiences, emotions and connections that shape how people use and experience the coast. In the context of this work, which places people and coastal communities at the forefront, coastal management is redefined as a practice that encompasses both the physical and human elements within a coastal socio-ecological system.

Building resilience in a socio-ecological system demands four critical factors (Folke *et al.,* 2002, p.355):

1. *Learning to live with change and uncertainty*.
2. *Nurturing diversity for reorganisation and renewal*.
3. *Combining different types of knowledge for learning*.
4. *Creating opportunity for self-organisation toward social–ecological sustainability*.

Interestingly, the first and third of these factors emphasise the role of 'learning' in building resilience. Folke *et al.* (2002, p.371) continue: 'all forms of relevant information should be mustered to increase knowledge and understanding for improved management of complex ecosystems', including combining place-based experiential knowledge from local and indigenous communities with scientific insights. Viewing learning and knowledge building as a central component to building resilience is further emphasised by Adekola *et al.* (2020, p.40), who 'argue for better integration of all types of (local and scientific) expertise and knowledge through, for example, public engagement, to improve collaboration and learning between the different stakeholder groups in building community resilience'. Here, the role of public engagement to facilitate resilience building is emphasised, a matter which Potter & Fitton (2023, p.24) build upon by identifying different purposes for public engagement to build resilience in a flood context:

1. *Better integration and understanding of scientific and local expertise and knowledge of flood risk, drawing on local experiential knowledge and the experience of flood events*.
2. *Communities becoming more effective agents in the decision-making process*.

Such statements suggest that resilience can be built through mutual learning and knowledge sharing, with a role for community engagement in this process (Potter & Fitton, 2023).

Resilience against what?

Commonly, resilience in FCERM literature focusses on building social and community resilience to short-term disasters (Hutter & Bailey, 2022) or emergency situations like flooding (e.g. Twigger-Ross *et al.,* 2014), including communities using local resources and expertise to 'prepare and respond to, and to recover from emergencies, in ways that sustain an acceptable level of community functioning' (Twigger Ross *et al.,* 2011, p.7). Similarly, the UK Government (N.D.) frames building resilience in terms of preparing for crises and emergencies. However, if communities are to be engaged in building resilience not just to single hazards, but to long-term coastal change including anthropogenic challenges (e.g. biodiversity loss, marine pollution) and physical processes (e.g. gradual erosion; Townend *et al.,* 2021), there is an opportunity to view resilience building as a long-term *process*, rather than an *outcome* (Twigger Ross *et al.,* 2011). In which case, building resilience is seen as a long-term process that increases the knowledge and capacity of coastal communities to better understand and prepare for coastal change and participate in decisions about how the coast is managed (Cone *et al.,* 2013; Famuditi, 2016). Here, two concepts are considered that could help to build community understanding and facilitate involvement in decision-making: citizen science and public participation.

2.4. Public Engagement & Citizen Science

Public engagement is a broad term, describing the myriad of passive or active ways organisations seek to involve the public in their work (Burdett, 2024; NCCPE, 2024). The rationale for public engagement in science can derive from a claimed disconnect, or gap, between science and the public that must be bridged (Weingart *et al.,* 2021). Traditionally, this gap may be fuelled by several critiques: scientific understanding is of a greater level of knowing than everyday expertise, citizen views have been neglected in scientific debate (Irwin, 1995), disadvantaged and indigenous communities have been exploited in the name of science (English *et al.,* 2018), and research lacks practical application to end users (e.g. coastal monitoring; Van Koningsveld, 2003). To address this gap, historical engagement focussed on enhancing the public's understanding of science by disseminating scientific and technical expertise through exhibitions, museums, activities, and the press (Irwin, 1995). Increasing public understanding of science was also seen as important to develop a strong democratic society, limit civil unrest, legitimise the emerging capitalist system and raise the quality of decision-making, particularly on controversial issues (Irwin, 1995; Brossard & Lewenstein, 2010).

There have also been extensive efforts to encourage scientists to become public communicators and share their work to build public rapport, feed into policy making and enhance science-society relationships (Dudo & Besley, 2016). This effort was captured well by the Royal Society (1985, p.24): 'it is clearly a part of each scientist's professional responsibility to promote the public understanding of science'. Practical educational initiatives emerged, and abundant funding has been directed into researching science and public attitudes towards science, aiming to increase public support for science and research and enhance 'scientific literacy' (Sturgis & Allum, 2004). In the coastal and marine sphere, public engagement has been reformulated into a variety of terms and practices, including the emergence of 'Ocean Literacy' to encourage positive action towards the ocean (OCT, 2024). Yet, despite these efforts, and the sense that public engagement has become an academic 'buzzword', the gap is suggested to remain unfilled (Weingart *et al.,* 2021). In fact, Weingart *et al.* (2021) argues that it is only widening given the increasing complexity of decisions which governments make, and hence an increasing reliance on specialised scientific advice.

The gap's persistence may be also be a result of the way public engagement is done. Public engagement can largely be categorised as a top-down practice, a transmission of repeated information and messages from organisations (e.g. universities, governments) to the public (Mazumdar *et al.,* 2018; Weingart *et al.,* 2021). Such approaches can assume a 'deficit' of knowledge that must be filled, under the illusion that filling it will address scientific illiteracy and resolve the deficit (Lewenstein, 2003; Sturgis & Allum, 2004). This deficit model (Lewenstein, 2003) views the public as homogenously impoverished by a lack of scientific knowhow and reinforces a superiority of scientific knowledge over public ignorance. In response, several alternative models have been proposed, including the contextual (public as individuals who absorb and respond to new information in different ways), lay-expertise (local knowledge and technical expertise are valued equally) and public participation (involvement in science through activities to decentralise control and empower the public) models (Lewenstein, 2003).

However, there is no single mode of conducting or defining public engagement (Maile & Griffiths, 2014), and public engagement work typically combines different aspects of each model to tailor the engagement to different scenarios (Brossard & Lewenstein, 2010). Instead, it may be better to view public engagement as a continuum, with information distribution at one end, and empowering citizens in the decision-making process (re-defined later as public participation) at the other (Katsonis, 2019). What is clear though, is that a top-down transmission of information to the public from scientists is incompatible with the two-way mutual learning and knowledge sharing required to build resilience (Adekola *et al.,* 2020). To achieve this, an alternative model or approach to public engagement is required.

2.4.1. What is Citizen Science?

Citizen science describes a broad spectrum of activities that involve citizens, or non-professional scientists, in organised research efforts, often through data collection (Berkes, 2015). Whilst the concept is nested within the overarching sphere of public engagement (Agnew *et al.,* 2022), it is categorically 'more' than public engagement (GOS, 2023). It is here that citizen science diverges from the four traditional public engagement models, as crucially, citizen science does science 'with', and not 'on' citizens (Garcia-Soto *et al.,* 2017; GOS, 2023). Therefore, in theory at least, citizen science engagement transitions away from the top-down transmission of knowledge to satisfy a perceived deficit in public understanding, to an engagement that can facilitate community involvement in tackling environmental challenges (Garcia-Soto *et al.,* 2017). This transition is consistent with recent shifts in environmental research practices, which are placing an increased emphasis on conducting impactful and relevant research for a range of stakeholders beyond the academy (e.g. public and decision-makers) and on engaging the wider public in research (Bracken *et al.,* 2015).

Citizen science can also be seen as a process, a two-way exchange of knowledge and data between researchers and the community that enhances monitoring capabilities and the scientific understanding of environmental issues (Garcia-Soto *et al.,* 2017). However, defining citizen science can be difficult. The term has been employed for such a wide range of purposes and applied in numerous contexts that any single definition would fail to capture the diverse approaches, epistemologies, worldviews, and ontologies shaping its meaning and practical application (Haklay *et al.,* 2021). But, citizen science provides a useful catch-all umbrella term to capture this diversity and represent a host of participatory practices in which people are involved in aspects of the scientific method, including public participation in scientific research (Haywood, 2014a), community based-monitoring (Conrad & Hilchey, 2011) crowdsourcing, citizen observatories, volunteer-based monitoring, and participatory science (Cooper & Lewenstein, 2016; Haklay *et al.,* 2021; Bergerot, 2022).

The term 'citizen science' was formalised in the scientific literature in the mid-1990s (Bergerot, 2022). During this time, two principal and contrasting visions of citizen science emerged (Cooper & Lewenstein, 2016); Bonney's (1996) and Irwin's (1995). Bonney's vision of citizen science-focussed on data collection for the benefit of scientists (Bonney, 1996; Cooper & Lewenstein, 2016; Kimura & Kinchy, 2019). For Irwin (1995), the nature of citizen science shifts away from the scientist and is reorientated on the citizen, becoming a democratic process enacted by citizens to serve the needs and concerns of society and involve people more deeply in decision-making about environmental threats. The vision is rooted in the emergence of a 'risk society' during the 1960s and 1970s, a movement concerned with tackling the global environmental threats society was causing through modernism, capitalism, and industrialisation (Irwin, 1995). It was a period that re-framed the relationship between science, citizenship and knowledge; whereby science, as performed by professionals, becomes contested and something to struggle against, birthing a citizen science tradition by people, for the benefit of people (Irwin, 1995; Kimura & Kinchy, 2019). There are overlaps between these two visions, namely 'the production of new scientific knowledge, the disclosure of science and the transformation of the relationship between science and society' (Bergerot, 2022, p.2). They converge to a definition of citizen science as ‘a scientific project involving a partnership with volunteers, both novices and experts, in the generation of new knowledge’ (Bergerot, 2022, p.2).

Although the term ‘citizen science’ is relatively new in scientific literature, it describes a practice that has been undertaken for decades without the citizen science tag (Kimura & Kinchy, 2019). This is particularly true for conservation and ecological research, whereby volunteer and amateur ornithologists have been involved in collecting data and generating new knowledge since at least the late 1800’s (Bonney *et al.,* 2009), with bird monitoring projects some of the longest running and largest (global) of all citizen science activities (Sullivan *et al.,* 2014). In this field, citizen science, as it may now retrospectively be referred to, has enabled data to be collected over greater spaces and time periods than would otherwise be possible for lone researchers (Dickinson & Bonney, 2012).

From early examples of amateur involvement in science, the number and scale of citizen science projects citizen science has expanded dramatically (Haklay *et al.,* 2018; Hacking *et al.,* 2024), with an immeasurable number of projects now collecting data to better understand the environment and climate change (Bonney *et al.,* 2014). This growth has been facilitated by the global reach and visibility afforded by the internet (Dickinson & Bonney, 2012; Bonney *et al.,* 2014), coinciding with an international increase in scientific literacy, and, particularly in advanced economies, an increased life expectancy, which has presented more opportunities to (re)engage older and retired adults with scientific topics (Haklay *et al.,* 2018). The volume of published citizen science research has also increased, with the number of scientific publications including citizen science in their title, abstract or keywords generally increasing year on year since the 1990’s (Bergerot, 2022). Given this growth, and the fact that citizen science provides a unique context for citizen involvement in scientific research, some authors have argued for citizen science to be considered a distinct scientific field of inquiry (Jordan *et al.,* 2015).

2.4.2. A Typology of Citizen Science

As noted, citizen science is a broad term encompassing an extensive range of activities and purposes, and applied in innumerable research contexts (Haklay *et al.,* 2021). It is useful to sort through this diversity and messiness by exploring the typologies or ‘families’ (Haklay *et al.,* 2018) of citizen science approaches and governance structures (Conrad & Hilchey, 2011), although it must be noted that such typologies can unhelpfully create a hierarchy of superior citizen science types (Kimura & Kinchy, 2019). In which case, it is recognised that there is perhaps no one size fits all 'best practice'; the approach to citizen science is likely to be highly context-specific, although understanding a typology can help to match the goals of a project with the appropriate level of citizen involvement (Cigliano & Ballard, 2017). Numerous typologies have been applied to citizen science; several are outlined and synthesised here.

Most simply, citizen science projects can be distinguished by the timescales of involvement. Projects can involve short-term data collection or long-term, involved work researching, analysing data or collaborating with scientists in established practices (e.g. archaeological activities) over longer time scales (Haklay *et al.,* 2018; Koedel *et al.,* 2024); a factor likely to be determined by the geographic scale of the work and available resources. Citizen science approaches can also be categorised according to the nature of activities participants perform (e.g. Bonney *et al.,* 2016), and how they achieve environmental impact (van Noordwijk *et al.,* 2021; Table 2.1).

Table 2.1. *A framework of citizen science projects according to the possible pathways that they use to achieve environmental impact (van Noordwijk et al., 2021).*

Citizen Science Approach	Description	Audience	Impact Pathways
Mass Participation	Simple tasks, limited commitment, well-advertised and clear societal relevance. Low barriers to participation, including limited time commitment and pre-existing knowledge. Collects data which would otherwise be hard to collect.	Reaches extensive, and often new, audience over large geographic scales. Motivations can include curiosity, intrigue, doing something enjoyable or helping the environment	Evidence for policy, Behaviour change and Social network championing.
Captive Learning Projects	Awareness raising and education about environmental issues. Simple tasks but can be scaled.	Orchestrated by a citizen science leader with groups (e.g. schools, businesses, education groups etc.).	Behaviour change and Social network championing.
Place-Based Community Action	Improves the environment locally. Citizen or researcher led, but benefits from co-design to encourage sense of ownership. Participation highest when the research tasks are simple and do not require prior subject knowledge.	Attracts place-connected local participants. People likely to benefit from environmental improvement. Health and social benefits for participants.	Environmental management, Evidence for policy, Behaviour change, Political advocacy, Social network championing and Community action.
Interest Group Investigation	Researching specific topics or phenomena (e.g. biodiversity monitoring). Tasks can be complex and time consuming.	Limited audience. Attracts those with a pre-existing interest in, skill and knowledge of the research topic.	Environmental management, Evidence for policy and Political advocacy.

More commonly, citizen science project typologies focus on the degree of citizen involvement, 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). English *et al.* (2018) provide a pyramid to differentiate between different degrees of involvement (Figure 2.4), from low level (e.g. 'crowdsourcing') to higher degrees of involvement, including full citizen control (e.g. 'extreme'). In most cases, citizen science does involve some degree of researcher involvement, with citizens then involved in most, or some, aspects of the research process. Shirk *et al.* (2012) categorise public participation projects into five models according to the degree to public involvement: Contractual, Contributory, Collaborative, Co-Created and Collegial. Contractual projects do not fit the definition of citizen science, as they involve communities asking professional researchers to conduct a scientific investigation on their behalf (Shirk *et al.,* 2012) and are disregarded in the typology here. Collegial contributions are reframed here as ‘Extreme Citizen Science’, a term acknowledging cases of greatest citizen power and responsibility.

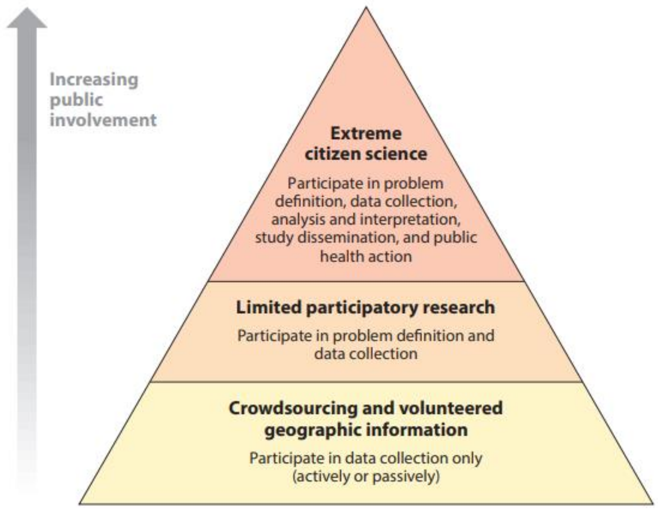

Figure 2.4. *Pyramid of public involvement in citizen science research (English et al., 2018).*

Contributory Citizen Science

Contributory citizen science involves the public contributing data to a scientist designed project (Shirk *et al.,* 2012) and is stated as the most popular form of ‘doing’ citizen science (Tweddle *et al.,* 2012; Hyder *et al.,* 2015; Robinson *et al.,* 2018). Contributory citizen science it is traditionally seen as a top-down, one-way transmission of data collected and submitted by participants for the primary benefit of the scientist (Dickinson & Bonney, 2012). An important success of contributory projects is their ability to harness large numbers of people (e.g. mass participation) to source large volumes of data (Roy *et al.,* 2012), although it is typically seen as a passive mode of data collection requiring low citizen involvement (Conrad & Hilchey, 2011; English *et al.,* 2018).

Contributory approaches are also commonly referred to as Crowdsourcing, Volunteered Geographic Information, or Citizen Observatory methods (Wehn *et al.,* 2015; English *et al.,* 2018; Mazumdar *et al.,* 2018). These methods have benefitted from the proliferation of technology, which has enabled the expansion of citizen science, or ‘citizen cyberscience’ (Haklay *et al.,* 2018). Advancing technology, particularly mobile phones, has allowed data to be collected in new ways and on greater scales, allowing citizens to become 'sensors' of environmental change (Goodchild, 2007; Mazumdar *et al.,* 2018). Websites and social media have offered platforms for doing more than data entry, they have facilitated learning, improved communication and discussion between citizens and researchers, improved data access and sharing capabilities, increased publicity and visibility of projects, increased awareness of issues and causes, and reached new participants and demographics (Triezenberg *et al.,* 2012; Tweddle *et al.,* 2012; Augar & Fluker, 2014).

Collaborative and Co-designed Citizen Science

Collaborative citizen science involves a plurality of stakeholders working together to develop a project (Conrad & Hilchey, 2011). Whilst the overall project is still often designed by a scientist, participants may have opportunities to contribute to multiple stages of the scientific process beyond data collection, including project design, question formulation, data analysis, and dissemination of findings (Shirk *et al.,* 2012; Tweddle *et al.,* 2012). In which case, projects offer greater potential for involvement than contributory citizen science, whereby they may better represent the needs of different stakeholders involved (Conrad & Hilchey, 2011).

In co-designed (or co-created) projects, the public have a much greater involvement in most or all research stages *with* scientists, including project development, knowledge creation, implementation, and dissemination (Dickinson & Bonney, 2012; Shirk *et al.,* 2012; Cazé *et al.,* 2022). In some instances, the community may even approach the scientists with a problem to develop a project around (Tweddle *et al.,* 2012). Co-design can be seen as three stage process of co-identification (identifying user needs and shaping research questions and project design around them), co-production (working together to answer questions and produce context-specific knowledge) and co-dissemination (sharing knowledge with wider stakeholders; IOC, 2021). By involving people in these stages, a co-design process shifts the emphasis of project design from an exclusively top-down, scientist-led practice (e.g. contributory), to a practice that is two-way and representative of a plurality of voices, interests and knowledges (Bracken *et al.,* 2015; Clarke *et al.,* 2023). Consequently, the emphasis of both science and social components in a project's design could support stronger science-society relationships (Bonney *et al.,* 2014).

Such collaborative and co-designed projects may then prove more appealing and relevant to prospective participants locally (Hart, 2021), since they may demonstrate clear personal, social or environmental outcomes, and align with their motivations (Garcia-Soto *et al.,* 2017). 'Matching' the data collection and engagement methods to local motivations may then attract, increase and sustain participation (Measham & Barnett, 2008; Wehn *et al.,* 2015; Land-Zandstra *et al.,* 2021; Koedel *et al.,* 2024), as participants will have a greater interest in and satisfaction from engaging with the project (Clary *et al.,* 1994; West & Pateman, 2016). For instance, if a common environmental interest or issue can be found in the coastal environment that people *care* about, then people may be more willing to give up their time and energy to volunteer, to take action to protect the environment and demonstrate pro-environmental behaviours (Ballard & Cigliano, 2017). Consequently, by targeting the citizen science project to specific audiences, the project's impact can be increased (Koedel *et al.,* 2024). On the contrary, failure to involve an array of stakeholders in identifying issues could instead lead to alienation (Bracken *et al.,* 2015) and hence failure of the citizen science project. Engaging relevant authorities in the process can also ensure citizen science data are of sufficient quality and relevance for environmental decision-making (Owen & Parker, 2018). Despite these benefits, co-designing citizen science projects is not widespread (Clarke *et al.,* 2023).

'Extreme' Citizen Science

At the top of English *et al.*'s (2018) pyramid sits 'extreme' citizen science. In such projects, citizens may have full control over the project, for instance when they are intrinsically motivated to 'do' science themselves without scientist input (Koedel *et al.,* 2024). Different nomenclature have been used to describe such citizen-led processes, including 'collegial' (Shirk *et al.,* 2012) 'transformative governance' (Conrad & Hilchey, 2011), 'Do It Yourself citizen science' (Garcia-Soto *et al.,* 2021), 'community science', (Haklay *et al.,* 2018), or 'undone' science (Frickel *et al.,* 2010). In many of these instances, projects are described as driven by citizens to address local concerns, including when citizens are mobilised to research unfunded or ignored research areas that may be important to them (e.g. air quality; Booker *et al.,* 2022; Evans *et al.,* 2023). In which case, citizens are involved in all aspects of the citizen science process, although as a result, the projects may have poor recognition, credibility or decision-making capacity (Conrad & Hilchey, 2011; Shirk *et al.,* 2012), particularly when the citizen science is deemed to veer into activism, and therefore deemed biased or politically motivated (Kimura & Kinchy, 2019).

2.4.3. Citizen Science at the Coast

Given the emerging environmental, conservation and climatic threats facing coastal and marine systems, new forms of data, data collection and stakeholder engagement are required to support mitigation and adaptation efforts (Cigliano & Ballard, 2017). Moreover, as part of the European Union's (EU) push for Integrated Coastal Zone Management (ICZM) in the early 2000's (Section 2.4.2), 'bottom-up' initiatives were encouraged to support public participation in coastal management, alongside the promotion of enhanced monitoring and dissemination of information to the public (Ferreira *et al.,* 2012). Offering a dual role of public engagement and enhanced data collection capabilities, the latter of which can benefit coastal research and management (Lucrezi, 2021), citizen science has been proposed as a way of addressing these needs at the coast (Cigliano & Ballard, 2017). Moreover, many coastal communities are already actively involved in formal and informal data collection activities, including on grass roots levels, recording phenomena including sea birds, shark and ray egg cases and litter, with or without the citizen science label.

Yet, compared with citizen science projects in the terrestrial environment, projects in water environments (including freshwater, coastal and marine) are reportedly fewer in number (Roy *et al.,* 2012). Even within the water sciences, citizen science has more commonly been applied in freshwater environments (Walker *et al.,* 2021) than in coastal or marine settings (Cigliano & Ballard, 2017). Problems of safety, access, logistics, equipment requirements, training needs and ownership in those settings may have contributed to this (Cigliano *et al.,* 2015; Garcia-Soto *et al.,* 2021). However, more recent estimates suggest there may be as many as 500 marine and coastal citizen science projects in Europe (Garcia-Soto *et al.,* 2021), although many of these projects are for marine biodiversity monitoring (Cousins *et al.,* 2017; Kelly *et al.,* 2020; Garcia-Soto *et al.,* 2021), not the focus of this research. But, particularly in recent years, there are several established and emerging examples of citizen science specifically in the beach environment, including for monitoring physical change and pollution threats (e.g. beach litter).

2.4.4. Citizen Science for Monitoring Physical Coastal Change

Long-term monitoring is fundamental to coastal management, providing data to evidence and understand the processes and mechanisms driving coastal change (Jaud *et al.,* 2019; Hart, 2020), and to evaluate the success of management strategies (Mead, 2017). Conventionally, this is achieved through in-situ (in the coastal environment itself) monitoring techniques, typically beach profiles; topographic surveys of the cross-shore elevation of the beach. On the Fylde Coast, profiles are undertaken at 500 m intervals along the beach and repeated bi-annually to understand changing beach elevation and hence patterns of erosion and accretion over time (Miles *et al.,* 2019). Various other equipment can be used to conduct experiments and collect data in the field, although such work is often logistical difficulty, expensive and time consuming (Holman *et al.,* 1993). Consequently, in-situ methods may provide temporally poor data (Davidson *et al.,* 2007), providing a limited understanding of short-term daily patterns and storm responses. Such methods and techniques may also demand specialist skills, rendering them incompatible with large scale public engagement and citizen science applications (Hart, 2020; Hart & Blenkinsopp, 2020).

As a result, in-situ monitoring of physical coastal change (e.g. beach morphology) is a rarely chosen research topic for citizen science (Thiel *et al.,* 2014). Therefore, projects in this space (Table 2.2) tend to be on small scales, often using simple methods to explore localised changes in morphology (e.g. Maine Beach Profiling Project; Hill *et al.,* 2002), wave dynamics (e.g. CLEARcoasts; SFP, 2024), sea level and temperature (e.g. SeCosta; Herrada *et al.,* 2024). Given their localised scale, some of the projects are collaborative, and even co-created, and may be classified as Place-Based Community Action or Captive Learning Projects, with opportunities for learning and involvement in more than data collection.

However, the increased availability of remotely sensed data in the 2000's represented a major shift in coastal monitoring (Sutherland, 2007), opening new possibilities to gather data over greater spatial and temporal scales. Remote sensing involves the gathering of information about a phenomenon (e.g. the coast) from a distance by measuring the reflection of emitted radiation from Earth's surfaces. Satellites (e.g. Landsat) provide decades of freely available data to monitor shorelines on global scales (Toure *et al.,* 2019; Vos *et al.,* 2019). Airborne LiDAR surveys, which construct a three-dimensional map of the surface it is measuring, have been used by the EA to monitor beaches across England (Miles, 2014). Ground based radar, which scans and detects backscatter off a surface from a fixed position, can monitor nearshore currents, sea state conditions and intertidal bathymetry (Atkinson *et al.,* 2017; Townsend *et al.,* 2023). Intertidal bathymetry can also be derived from video cameras (e.g. Argus), as employed on the Fylde Coast to study bar dynamics (de Alegria Arzaburu *et al.,* 2007).

Again, it is the proliferation of technology, specifically remote sensing techniques, that has enabled the growth of global, mass participation citizen science projects at the coast (Table 2.2). Projects are typically contributory in nature, involving the crowdsourcing of large volumes of remotely sensed data using mobile phones, capturing information about changing beach morphology, shoreline dynamics (e.g. Coastsnap; Harley & Kinsela, 2022) and sediment size (e.g. SandSnap; McFall *et al.,* 2023) on large spatial and temporal scales. An emerging and innovative trend in coastal citizen science is the piloting of photogrammetry techniques using smartphones (e.g. Structure from Motion (SfM) to create 3D models; James & Robson, 2012). Such techniques are low-cost (Pikelj *et al.,* 2018) and accurate (Westoby *et al.,* 2012), lending themselves to large scale contributory and mass participation citizen science initiatives (Luetzenburg *et al.,* 2021) and citizen observatories (Jaud *et al.,* 2019). SfM is a technique previously applied on a small-scale during a Coast Watchers pilot project at Rossall, UK, involving people in data-collection to identify changes in coastal processes around a sea wall (Lusty, 2019). Outputs were high-resolution (centimetric), but the method encountered data transfer issues and demanded high enthusiasm from a group of trained and dedicated citizens. The method also required extensive post-processing time from the lead researcher (Lusty, 2019), potentially reducing its application as a sustainable long-term citizen science approach.

***Table 2.2**. Sample of in-situ and remote sensing-based coastal citizen science projects globally.*

	Monitoring Focus	Examples	Method	Citizen Science Approach	Notes
In-Situ	***Beach Morphology***	**Maine Beach Profiling Project**, U.S. (Hill *et al.*, 2002)	Beach profiling, following Emery (1961) method	Contributory; Place-Based Community Action	Citizen science to engage people about erosion and collect otherwise hard to collect data.
		Coastwatch, Europe (Ferreira *et al.*, 2012)	Beach profiling, following Andrade & Ferreira (2006)	Contributory; Captive Learning Project	European wide project to monitor the coast, starting in 1988.
		Community Based Monitoring, Alaska (Buzard *et al.*, 2019)	Beach profiling, stakes and cameras	Co-created; Place-Based Community Action	Worked with the community to identify priority erosion sites.
		SeCosta, Spain (Herrada *et al.*, 2024)	Beach profilers and bathymetric probe	Collaborative; Captive Learning Project	Secondary school students gathering and analysing data.
	Sea Temperature		Bathythermograph Profiler		
	Sea Level		Barograph and tide gauge		
	Wave Dynamics	**CLEARcoasts**, Solway Firth (SFP, 2024)	Mini-buoys, following Balke *et al.* (2021)	Collaborative; Interest Group Investigation	Working with volunteers to monitor hydrodynamics around saltmarsh and honeycomb worm reef *(Sabellaria alveolata)*.
Remote Sensing	***Shoreline Position***	**CoastSnap**, Global (Harley & Kinsela, 2022)	Oblique image from smartphone in cradle to extract shoreline position	Contributory; Mass Participation	Repeated images to create a time series of shoreline change. Used in 21 countries.
	Beach Morphology	**CoastSnap Bournemouth**, UK (Hart & Blenkinsopp, 2020)	Oblique image from smartphone in cradle to extract beach profile against a groyne	Contributory; Mass Participation	Repeated images to create a time series of profile change.
		Pilot Project, Australia (Pucino *et al.*, 2021)	Unmanned Aerial Vehicles (UAVs)	Contributory; Interest Group Investigation	Demonstrates reliability of citizen science data from UAVs to monitor beach morphology.
	Sediment Size	**SandSnap**, U.S. (McFall *et al.*, 2023)	Photographing sand to extract grain size	Contributory; Mass Participation	Nationwide database of sand grain sizes on U.S. coastlines.

2.4.5. Citizen Science for Monitoring Marine Litter

Marine litter – 'any persistent, manufactured or processed solid material discarded, disposed of, or abandoned in the marine and coastal environment'- is a global problem (UNEP, 2021, p.11). The amount of litter entering the marine environment is increasing (Ryan *et al.,* 2009), forecasted to triple by 2040 (UNEP, 2021), whilst as much as 12,000 million metric tons of plastic could be in landfill or the environment by 2050 (Geyer *et al.,* 2017). Once in the marine and coastal environment, litter resides on the sea surface or sea floor, transported globally or deposited on beaches (Cheshire *et al.,* 2009; Nelms *et al.,* 2017). Plastic waste, the most common type of marine litter (Nelms *et al.,* 2017), has become so ubiquitous in the marine environment that a new marine microbial habitat is termed the 'plastisphere' (UNEP, 2021).

Plastic waste is particularly hazardous to marine ecosystems (Nelms *et al.,* 2017), posing risks of entanglement, laceration, drowning and starvation to marine life (UNEP, 2021). Microplastics can also be vectors of pollutants, binding to toxic chemicals in the surrounding water, which, when ingested by marine organisms, can travel through cell membranes (Williams & Rangel-Buitrago, 2019) and bioaccumulate – causing health issues (Rochman *et al.,* 2013). Human health is also threatened, particularly for fish-reliant coastal and indigenous communities, because of the likelihood of microplastic transfer up the food chain (UNEP, 2021). Litter can also injure beach users (Campbell *et al.,* 2016), and negatively impact upon tourism and people's coastal experiences (Nelms *et al.,* 2017; Adam, 2021), provoking anger (Shellock, 2019) and affecting the mental and physical health benefits gained from exposure to coastal space (Wyles *et al.,* 2016).

Despite the impact of litter on the marine and coastal environments, no single solution for managing the problem exists. Thus, 'without a well-designed and tailor-made management strategy for end-of-life plastics, humans are conducting a singular uncontrolled experiment on a global scale, in which billions of metric tons of material will accumulate across all major terrestrial and aquatic ecosystems on the planet' (Geyer *et al.,* 2017, p.3). Managing the problem demands a global effort to eliminate the input and increase the removal of litter from the marine environment. To inform, design and implement effective management strategies, research and monitoring are important to better understand litter abundance, sources, transport pathways and distributions across the marine environment (Ryan *et al.,* 2009; Asensio-Montesinos *et al.,* 2021; Nelms *et al.,* 2020).

Monitoring is typically achieved through beach litter surveys, a physical scan of the beach to identify and categorise (e.g. by material type and weight) macro-litter (>20 mm diameter; Cheshire *et al.,* 2009). Beach litter surveys occur over different spatial scales, including across entire beaches (e.g. Eriksson *et al.,* 2013), transects (e.g. Storrier *et al.,* 2007; Portz *et al.,* 2011), or in quadrats (e.g. Ariza *et al.,* 2008; Costa, 2010; Heo, 2013; Jayasiri, 2013; Korez, 2019). Repeating surveys over various temporal scales, from daily, to monthly, to yearly, can show the long-term balance of inputs and outputs of litter from the beach (Ryan *et al.,* 2009).

Novel survey methods have also been trialled, including using drone imagery to identify and classify beach litter (e.g. Bao *et al.,* 2018), or tagging and recapturing litter to assess short-term gains and losses (e.g. Williams & Tudor, 2001; Brennan *et al.,* 2018; Asensio-Montesinos *et al.,* 2021). Studies have also researched litter beyond the foreshore, using citizen scientists on ships to survey floating litter around Taiwan (e.g. Chiu *et al.,* 2020) or using divers to assess the presence and distribution of benthic litter (e.g. Renchen *et al.,* 2021). However, differences in methods and frequency of beach litter surveys limit the ability to understand and compare litter quantities and movement across beaches at regional, national, and international levels (Cheshire *et al.,* 2009). Consequently, knowledge of long-term litter movements, transport mechanisms and deposition and accumulation patterns on beaches is limited (Critchell & Lambrechts, 2016; Turrell, 2018), restricted by infrequent surveys, crude estimates and the biased removal of litter from beach cleaning (Ryan *et al.,* 2009). Moreover, achieving long-term data sets of marine litter across large geographic areas can be expensive, time consuming and laborious, particularly for lone researchers (Nelms *et al.,* 2022).

With its ability to mobilise large numbers of people to collect data over greater spaciotemporal scales than conventional monitoring (van Emmerik *et al.,* 2020), whilst simultaneously delivering public engagement outcomes, citizen science can help overcome some of the economic and practical limitations associated with monitoring marine litter. As a result, the number of citizen science projects monitoring marine litter is increasing (Kawabe *et al.,* 2022), with projects found globally (Table 2.3). Such projects have advanced the understanding of marine litter (Hidalgo-Ruz & Thiel, 2015), improved the representativeness of large scale, national data sets (Zorzo *et al.,* 2021) and supported the removal of litter from the environment (Severin *et al.,* 2023a; Wyles & Ghilardi-Lopes, 2023).

However, there are broader citizen science data quality considerations for beach litter sampling. For example, there are concerns surrounding the reliability of citizen science studies compared with professional studies (Hidalgo-Ruz & Thiel, 2015), including variability in data collection (Vincent *et al.,* 2017), problems of method standardisation, lack of technical details provided about how the surveys were undertaken, and logistical or administrative constraints (Nelms *et al.,* 2017). Litter survey frequency and area covered is also often limited by volunteer availability (Vincent *et al.,* 2017). Method standardisation and rigorous analysis can sometimes overcome these concerns (Nelms *et al.,* 2017), especially when trained volunteers are paired with researchers to reduce sampling biases and increase the reliability and robustness of citizen science data collection (Vincent *et al.,* 2017). Therefore, with appropriate protocols, methodology and training, citizen scientists can collect litter data of equivalent quality to that collected by researchers (van der Velde *et al.,* 2017).

Table 2.3. *Sample of marine litter citizen science projects globally.*

	Examples	Method	Citizen Science Approach	Notes
Litter on Beaches	**Marine Debris Tracker**, Global (Jambeck & Johnsen, 2015)	App for recording the location and description of beach litter items.	Contributory; Mass Participation	Crowdsourcing data collection.
	Great British Beach Clean, UK (MCS, 2024)	Direct litter collection from beaches around the UK and Northern Island.	Contributory; Mass Participation	An annual, week-long event. In 2023, 428 beach cleans took place, including on Rossall.
	National Coastal Cleanup and Monitoring Project, China (Chen *et al.*, 2020)	Direct litter collection from 24 beaches.	Contributory; Place-Based Community Action/Mass Participation	Volunteers trained to collected litter from a 105m wide sample area.
	Científicos de la Basura [Litter Scientists], Chile (Eastman *et al* ., 2014)	Direct litter collection and accompanying survey with school students.	Collaborative; Captive Learning Project	Nationwide project collecting litter and raising awareness.
	SEACleaner, Italy (Locritani *et al* ., 2019)	Direct litter collection and accompanying survey with high school students.	Collaborative; Captive Learning Project	Aim to raise awareness of the marine pollution problem in the high school students.
	CrowdWater, Global (Van Emmerik *et al.*, 2020)	App for recording plastic on riverbanks, lakes shores and floating plastic in rivers.	Contributory; Mass Participation	Crowdsourcing data collection.
Floating Litter	**The Ocean Cleanup**, Global (TOC, 2024)	App for counting and categorising floating plastic on the sea surface.	Contributory; Mass Participation	Crowdsourcing data collection.
	Unnamed , Taiwan (Chiu *et al.*, 2020)	Explore distribution and density of floating marine litter in the waters around Taiwan from volunteer observations.	Contributory; Interest Group Investigation	Floating litter observed from ships.

2.4.6. Citizen Science Benefits & Outcomes

Various positive outcomes and benefits derived from doing citizen science are expressed in the literature. The primary focus is on data collection capabilities, particularly the ability to mobilise masses of people to collect data on spatial and temporal scales and resolutions previously unattainable by lone researchers (Bonney *et al.,* 2014). This data collection is seen as a low-cost and time-efficient alternative to traditional coastal monitoring techniques (Meyer *et al.,* 2017; Pucino *et al.,* 2021), and capable of generating new knowledge about how the marine and coastal environments are changing[6] (Thiel *et al.,* 2014; Garcia-Soto *et al.,* 2017). For management purposes, this data collection can complement ongoing agency monitoring by filling gaps in the spatial and temporal coverage of data (Hadj-Hammou *et al.,* 2017) and provide evidence for environmental protection agencies to find solutions to environmental issues (Owen & Parker, 2018), including on rocky coasts (e.g. Turicchia *et al.,* 2021) and coral reefs (e.g. Crabbe, 2012). Citizen science data are also described as able to shape policy; by advocating for policy change based on the data collected, by collecting targeted data on demand which contributes to a specific policy need, or by monitoring the effectiveness of existing policies (Cigliano *et al.,* 2015).

The value of citizen science transcends the scientific, management and policy benefits as it can also carry wider societal and environmental impact. For participants, there are opportunities to increase their nature connectedness (Pocock *et al.,* 2023), engage with places they love, to interact with them and conserve them (Ballard & Cigliano, 2017), and feel good emotionally and mentally as a result (Koss & Kingsley, 2010). Pedagogical outcomes are also central to citizen science. Outcomes can include increasing the public's access to science, knowledge and learning (Dickinson & Bonney, 2012), and development of participant's skills, expertise (Bergerot, 2022), critical thinking and scientific literacy (Conrad & Hilchey, 2011; Cigliano *et al.,* 2015). Citizen science can also raise people's awareness of the marine and coastal environments, including coastal processes (Ferreira *et al.,* 2012) and management issues (Meyer *et al.,* 2017), potentially shaping place connections and developing pro-environmental behaviours (Koss & Kingsley, 2010; Cigliano *et al.,* 2015).

Beyond the data and the individual, the literature highlights transformational outcomes from citizen science for science-public relations. Notably, authors argue that it 'has the

[6] This is particularly important for issues like marine litter, where citizen science data sets are often the only data sets (Hyder *et al.,* 2015).

potential to build bridges between science and the public' (Dickinson & Bonney, 2012, p.10). This may be achieved through its capacity to increase the everyday relevance of science and embrace citizen input, allowing for the creation of new common knowledges (Bergerot, 2022). In this sense, citizen science can provide a medium to challenge the dominant voices in science (western, male, white), whereby local, marginalised or ignored people's experiences, voices and knowledges are taken seriously in environmental decision-making (Bonney *et al.,* 2016; Kimura & Kinchy, 2019). Consequently, there are democratic benefits, since citizen science could empower people to challenge and 'implement change to the systemic and structural sources of environmental problems' (Kimura & Kinchy, 2019, p.31), increasing public inclusion in governance, decision-making and environmental democracy (increasing the accessibility of environmental science and expertise to the public; Conrad & Hilchey, 2011).

2.4.7. A Critique of Citizen Science

Whilst the benefits and value of citizen sciences schemes for scientists are clear and well reported (Bonney *et al.,* 2016; Walker *et al.,* 2021), primarily the enhanced data collection and monitoring capabilities afforded by citizen science projects (Garcia-Soto *et al.,* 2017; Hadj-Hammou *et al.,* 2017), there are several challenges and critiques of the citizen science practice that mean many of these benefits go unrealised in practice. A significant problem is that citizen science methods are not universally accepted as scientifically valid (Bonney *et al.,* 2014), with concerns about data quality, accuracy and reliability (Conrad & Hilchey, 2011; Sullivan *et al.,* 2014). As a result, despite the abundance of data collected across various disciplines, data commonly fails to be used in decision-making processes, policy creation, or published in scientific journals (Conrad & Hilchey, 2011; Turicchia *et al.,* 2021). This can also be the case for marine citizen science projects (Kelly *et al.,* 2020). Such problems may perpetuate a disconnect between the citizen scientists collecting the data, and the scientists and decision-makers.

There are also concerns about the mode of contributory data collection. Notably, it is commonly cited in the literature that citizen scientists are 'efficient' and 'cost-saving' tools for data collection (Hacking *et al.,* 2024). However, the costs of citizens time, effort and resources may go unaccounted, raising important ethical questions about whether data collection responsibilities should be devolved to unpaid volunteers in the first place. Moreover, such devolution of monitoring responsibility from agencies and researchers to citizen scientists may only occur as part of cost-cutting measures (e.g. to overcome academic funding shortages; Kimura & Kinchy, 2019), but without the accompanying transfer of responsibility or power in the decision-making process (Berkes, 2015). As Meyer *et al.* (2017, p.135) caution, 'collecting data is not necessarily the same as participating in management processes.'

Furthermore, this typical emphasis of citizen science on data (Wolff, 2021; Wyles & Ghilardi-Lopes, 2023) can consign volunteers to the singular aspect of data collection in the research process (Stevens *et al.,* 2014; Kelly *et al.,* 2020). Contributory citizen science projects often consider participants as 'sensors' (Goodchild, 2007; Mazumdar *et al.,* 2018) or 'crowdsources' (Wehn *et al.,* 2015) of data, mechanistic and top-down approaches that serve the needs of scientists and remove any effort on the part of the participant (Walker *et al.,* 2021). Engagement with the method, data collected, or analysis is restricted, detaching the participants from the scientific process involved in doing citizen science and any resulting emotional connections to the space (Haywood, 2014b). Consequently, the experiences and benefits for the participants are often relegated below the value of the data collected, limiting the capacity of schemes to carry any meaningful benefits for participants (Haywood, 2014b). However, it must be added that it is not always the goal or purpose of a citizen science project to focus on the public benefits or achieve a greater degree of public understanding of science (Bonney *et al.,* 2016). In which case, given the data-focussed benefits that contributory citizen science projects can achieve, it could be argued that projects are valuable, providing the projects are transparent in their intentions and do not present as delivering public benefits if not exploring its public impact.

However, the focus on science and data specific benefits has left a sizeable evidence gap of participant-focussed benefits (Robinson *et al.,* 2018). In which case, impacts on the participants involved are often just assumed to be positive or listed as possible 'co-benefits' (Bonney *et al.,* 2016; Leonard *et al.,* 2023). Such 'co-benefits' can include connection of people to their local ecosystems, improved scientific literacy and critical thinking (Cigliano *et al.,* 2015), increased exposure to science and knowledge of environmental issues (Dickinson & Bonney, 2012). Yet, in practice, these 'co-benefits' often go unexplored and unquantified (Haywood, 2014a; Bonney *et al.,* 2016; Leonard *et al.,* 2023), with limited evidence that citizen science projects are delivering an increased understanding of science for their participants (Bonney *et al.,* 2016). Notably, a review of 549 citizen science publications in the water sciences reported that 32% of publications only suggested potential participant benefits and 24% had no mention of benefits at all (Walker *et al.,* 2021). Moreover, of the publications that provided actual benefits, just 16% investigated benefits, whilst other publications only inferred, observed or attributed them (Walker *et al.,* 2021). This could be a result of several factors. For instance, few projects are designed to achieve public understanding outcomes (Bonney *et al.,* 2016), evaluations of citizen science projects are typically data- or researcher-orientated to satisfy funding requirements (Haywood, 2016), and, unlike researcher-focussed benefits (e.g. amount of data collected), participant-focussed benefits are difficult to measure and quantify (Leonard *et al.,* 2023).

Yet, for citizen science to be sustainable, and for it to achieve positive decision-making and research outcomes, both the citizens and scientists involved must mutually benefit (Vann-Sander *et al.,* 2016; Robinson *et al.,* 2018). As Kawabe *et al.* (2022, p.10) note: 'for citizen science research to truly advance, the scientific aspects of the environmental issue should not be considered independent from those related to the citizen scientists'. As a result, there have been calls from scholars to critically reflect upon the citizen science process for participants: 'given the time and commitment made by citizen scientists for the benefit of research, the scientific community should more widely evaluate whether participants are also benefiting and ensure they are not negatively impacted' (Walker *et al.,* 2021, p.24). Other authors have posited: 'careful evaluation of community-level outcomes of citizen science is sorely needed' (Bonney *et al.,* 2016, p.10). Such work could better understand and evaluate participant motivations, values, learning, lived experiences, perspectives, benefits and outcomes (Bonney *et al.,* 2016; Haywood, 2016; Garcia-Soto *et al.,* 2017). This critique of citizen science, that its dominant, data-focussed science-centric tradition has failed to properly account for participant benefits, possibly amounts to a much greater 'crisis' facing the purpose and utility of citizen science (Vann-Sander *et al.,* 2016). In this sense, perhaps a paradigm shift is required to see beyond a science-centric understanding of citizen science, to one which places greater value on a citizen-centric perspective (Vann-Sander *et al.,* 2016).

2.4.8. Principles of Citizen Science

To ensure citizen science projects are designed, funded, implemented and evaluated effectively, various manuals, handbooks and 'how to' guides have been created (e.g. Tweddle *et al.,* 2012; Pocock *et al.,* 2014; HLS, 2019), including for marine and coastal research (e.g. Garcia-Soto *et al.,* 2017). Given the extensive detail these guides offer regarding citizen science design and best practice, the aim here is not to duplicate them, but to highlight key processes and frameworks that could apply to a citizen science project in this work. Three core frameworks for delivering a citizen science project are identified here; Garcia-Soto *et al.* (2017), building on the work of Bonney *et al.* (2009), provide a nine-step process for designing a citizen science scheme (Figure 2.5); Tweddle *et al.* (2012) offer a comprehensive five phase flow chart (Figure 2.6); whilst Shirk *et al.* (2012) present a framework to guide public participation projects (Figure 2.7).

1. Choose a scientific question
2. Form an interdisciplinary team
3. Develop, test, and refine protocols, data forms, and educational support materials
4. Recruit participants
5. Train participants
6. Accept, edit, and display data
7. Analyse and interpret data
8. Disseminate results
9. Measure outcomes

Figure 2.5. *Nine-step process for designing a citizen science scheme (Garcia-Soto et al., 2017).*

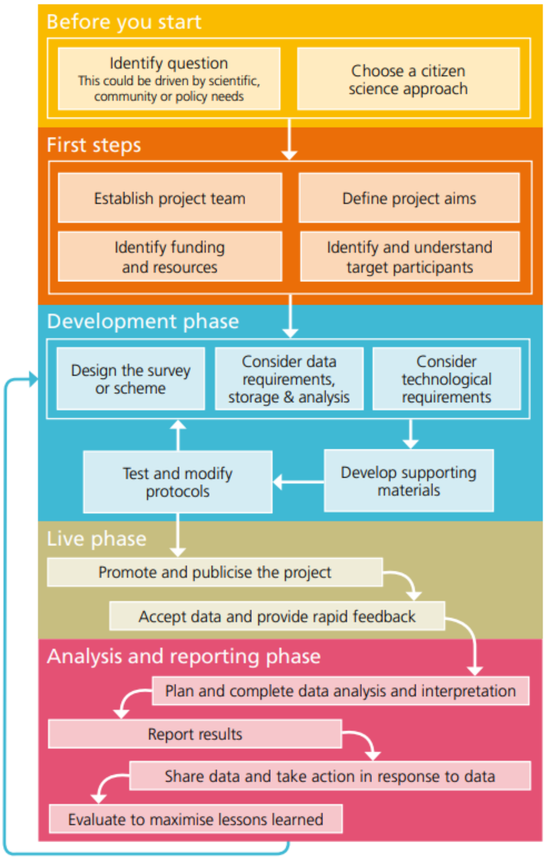

***Figure 2.6**. Five-stage flow chart to design and conduct a citizen science project, indicating the iterative 'final analysis and reporting phase' to inform future project developments and directions (Tweddle et al., 2012).*

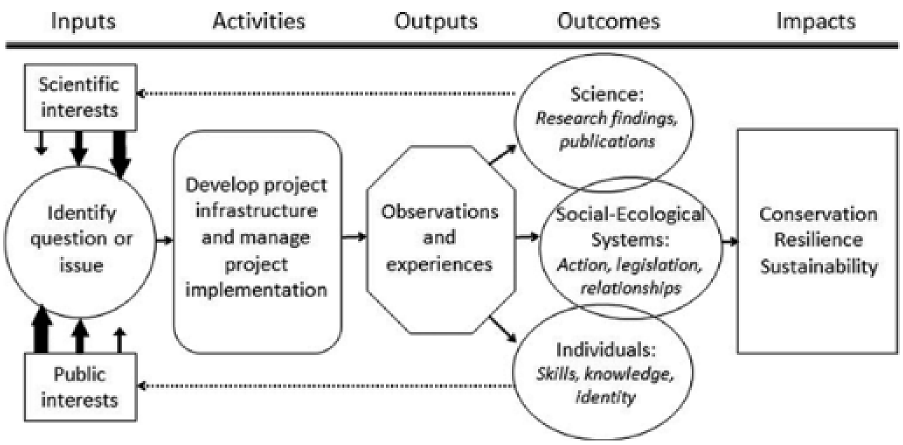

***Figure 2.7**. Framework for public participation in scientific research. Recognising the array of citizen science approaches, the framework provides different sized arrows to balance scientific and public input into question identification, with feedback arrows acknowledging how outcomes can shape future interests, questions and issues (Shirk et al., 2012).*

There is overlap between these models, allowing them to be largely reduced to four broad stages of (1) question identification, (2) infrastructure, protocol and method development, (3) a 'live' phase of delivery, and (4) wider dissemination and impact evaluation. However, what is evident is that all three models are largely geared towards a traditional contributory project, whereby participant input is absent in most stages. Particularly for Garcia-Soto *et al*. (2017), participants are first accounted for at stage four (recruitment), after the question has been developed in stage one. Although both Tweddle *et al*. (2018) and Shirk *et al*. (2012) recognise that people can be involved in the project development stages to different extents, there is no explicit recognition of participant involvement beyond balancing public input into the question or understanding the target audience. Using collaboratively designed, co-designed, or even 'extreme' citizen science models, which involve participants in multiple, or all, stages of the project, there is an opportunity to re-imagine the top-down, science-focussed models by emphasising the two-way, joint contributions that both researchers and participants can make to different aspects of the project.

Considering the lack of specific model for a non-contributory project, it is perhaps more useful to design a project not by a fixed model or framework, but by a set of fundamental principles. Notably, Robinson *et al*. (2018) set out ten principles for citizen science developed by an international group of citizen science practitioners and researchers, which are valid regardless of the citizen science approach (Figure 2.8).

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 leaders 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.*

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.*

8. **Citizen scientists are acknowledged in project results and publications.**

9. **Citizen science programmes are evaluated for their scientific output, data quality, participant experience and wider societal or policy impact.**

10. **The leaders of citizen science projects take into consideration legal and ethical issues surrounding copyright, intellectual property, data-sharing agreements, confidentiality, attribution and the environmental impact of any activities.**

Figure 2.8. *Ten principles of citizen science (Robinson et al., 2018, p.29).*

Of the ten principles, number three is perhaps the most significant to the sustainability (Robinson *et al.,* 2018) and success of citizen science schemes, since success is defined as ‘when citizens are satisfied and useful scientific data has been obtained to answer scientific questions’ (Garcia-Soto *et al.,* 2017, p.17). Whilst the weighting of scientist and participant input varies across citizen science projects, achieving both science-focused data collection and participant-focused learning outcomes requires a project design that balances the needs of both groups (Jordan *et al.,* 2012). Edelson & Kirn (2018) introduce the concept of ‘design strategies’ to ensure specific scientific and learning project goals and outcomes are met. Particularly relevant to citizen-oriented citizen science are the design strategies aimed at delivering community empowerment outcomes. These strategies include supporting community creation of projects and accepting participant suggestions to influence the study design (Edelson & Kirn, 2018). Both elements can be integrated into the formulation of a collaborative or co-designed citizen science approach.

2.4.9. Redefining 'Citizen Science' & Research Gaps

It is clear that a paradigm shift in citizen science is needed. This would transition away from the science-centric understanding of citizen science (Vann-Sander *et al.,* 2016), to one that actively supports, and understands the experiences of, participants in aspects of the scientific process beyond data collection (Robinson *et al.,* 2018; Kelly *et al.,* 2020). Consequently, there is an opportunity to re-characterise the typology of citizen science and reconsider what is, and what is not, considered 'citizen science.'

This is particularly apparent when comparing 'contributory' citizen science approaches with more participatory approaches, including 'collaborative,' 'co-designed,' and 'extreme'. Contributory forms are characterised by their hierarchical nature (with a clear distinction between researchers and the public), top-down structure, and science-first approach, where the primary focus is on data collection. In such projects, participants often only contribute through ad-hoc or one-off activities (e.g. providing a photograph, spot measurement, field observation, etc.). However, this can feel tokenistic (Hacking *et al.,* 2024), or even patronising, to suggest that a one-off contribution qualifies as 'scientific,' or that such limited involvement warrants the term 'citizen scientist.' In these cases, participants have little influence over the science, and the science gains little from the participants (Evans *et al.,* 2023). In which case, despite their ubiquitous application in citizen science (Tweddle *et al.,* 2012; Hyder *et al.,* 2015; Robinson *et al.,* 2018), it could be argued that contributory forms of citizen science do not sufficiently involve participants in the research process for it to be considered 'citizen science'.

Principle three of Robinson *et al.*'s (2018) 10 principles of citizen science states that both professional scientists and citizen scientists should benefit from participation. Whilst it is acknowledged that contributory projects can make volunteers feel they are contributing to something meaningful and helping to answer important questions (Philips *et al.,* 2019; O'Reilly & Starrs, 2023), to what extent do these benefits compare with the opportunities for experiential learning, social outcomes, or positive shifts in attitudes towards science offered by more participatory forms of 'citizen science'? Authors argue that citizen science is distinct from traditional science due to its bottom-up perspective (Golumbic, 2024) and its capacity to foster engagement that 'initiates and sustains lifelong learning' (Philips *et al.,* 2019, p. 684). Critically, a top-down approach with minimal participant involvement does not meet these expectations of citizen science.

Given these shortcomings, it is unsurprising that scholars have begun to explore new terminology to better differentiate these forms of public engagement in science. Consequently, social scientists increasingly classify more participatory forms as ‘community science,’ distinct from the top-down, science-led ‘citizen science’ (Hacking *et al.,* 2024). However, considering the argument that contributory approaches fail to meet the bottom-up and lifelong engagement principles fundamental to citizen science, it is worth questioning whether they should still be classified as 'citizen science' at all. Instead, a case could be made for a shift in terminology. Under this redefinition, 'citizen science' would describe the more participatory forms of public involvement in science (e.g. 'collaborative,' 'co-created,' or 'extreme'), characterised by reduced or absent hierarchical structures and a greater overlap between science, researchers, and participants. Meanwhile, 'crowdsourcing' could be used to describe science-led, potentially tokenistic forms of data contribution. This reframing would evoke Irwin’s (1995) vision of citizen science as by the people, for the people, ensuring citizens are *actively involved* in scientific endeavour that produces new knowledge (Robinson *et al.,* 2024).

This argument is not to suggest that crowdsourcing approaches are invalid. On the contrary, they can produce high-quality data that informs decision-making, an outcome that has led some projects to shift towards a more ‘science-first’ crowdsourced model for their data collection benefits and attractiveness to funders (e.g. Waterwatch; O’Reilly & Starrs, 2023). However, the argument is that for projects to be described as citizen science, participants should have the opportunity to be involved in multiple aspects of the research process beyond data collection (Figure 2.9). This does not mean the benefits of crowdsourced and citizen science approaches cannot overlap; participants may derive personal fulfilment from crowdsourced projects, whilst co-designed projects can generate data that informs decisions. Instead, by clarifying the definitional and conceptual distinctions between these approaches, greater certainty could be provided for academic practice regarding what is expected of a citizen science project, including how citizens are viewed, the roles they can play, and the possible benefits that may be generated. Moreover, such a definitional shift would address the critique of a science-focused 'citizen science,' and ensure that, by definition, all citizen science is participatory.

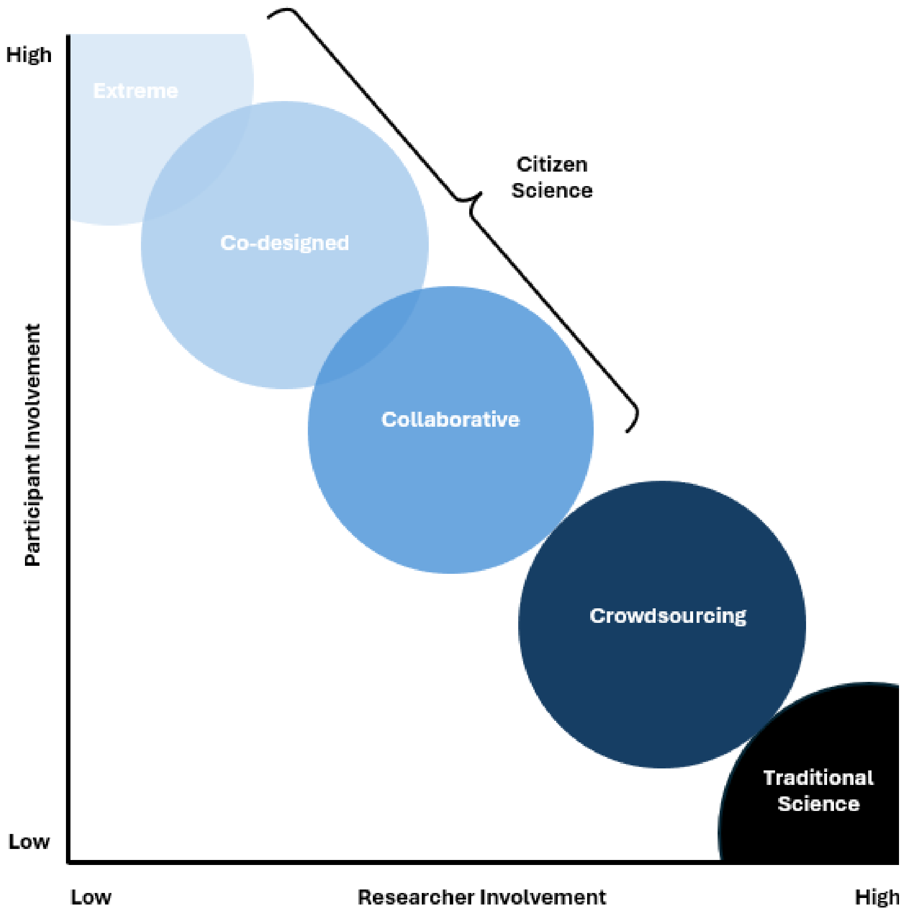

Figure 2.9. *A revised typology of citizen science, based upon the extent of participant and researcher involvement, that makes a clear distinction between traditional science, crowdsourcing and citizen science approaches. Boundaries between the different forms of citizen science are overlapped to reflect the lack of arbitrary distinction between them.*

A definitional shift in citizen science, which offers greater participant involvement, and carries greater benefit, value and relevance for both scientists and participants, could be particularly pertinent at the coast. This is because citizen science could be viewed as part of a wider effort to empower coastal communities to monitor, understand and manage their local coastal environments in the wake of growing anthropogenic threats. Coast Watchers seeks to fit within this proposed definitional shift through a collaborative, participant-focussed citizen science project that builds people's understanding and ability to participate in a resilience-based coastal management.

2.5. Public Participation in Coastal Management

Globally, coastal management has experienced a transition to risk-based methodologies. This has seen a shift away from a total reliance on hard defence structures, towards more natural and adaptive approaches. In the UK, such approaches are part of broader toolkit to build resilience to coastal change (Section 2.2.2), including a focus on social resilience, where people and communities understand their responsibilities and can contribute to decisions that affect them (EA, 2020). So far, the chapter has focussed only on how an improved understanding of coastal change could be built through public engagement activities, principally citizen science. This section explores how a more informed public could contribute to decisions about how the coast is managed, characterised here by the term 'public participation'. The purpose here is twofold: introduce and contextualise the concept of public participation within a resilience-based FCERM and investigate how public participation currently plays out in coastal management.

Whilst closely related to public engagement, public participation is *more* than engagement and citizen science, since the focus moves beyond involvement of people in scientific research to actively account for people in decision-making. Therefore, public participation is defined as 'the practice of involving members of the public in the agenda setting, decision-making, and policy-forming activities of organisations/institutions responsible for policy development' (Rowe & Frewer, 2005, p.253), accounting for 'people's concerns, needs, interests, and values' (Nabatchi & Leighninger, 2015, p.6). The term captures a spectrum of definitionally similar concepts that seek to involve people in environmental decision-making, including participatory resource management (Hare *et al.,* 2003), co-operative environmental management (Plummer & FitzGibbon, 2004) and collaborative governance (Bradshaw, 2022).

The shift towards a greater participation in FCERM activities is occurring within a much broader historical context. Notably, public participation in decision-making has been at the forefront of public discourse for many years. A participatory turn was witnessed in the 1960s, involving a global proliferation of methods to widen participation in governance and provide opportunities for citizens to have a say on the things that affect their lives and to influence political and bureaucratic decision-making processes (Bherer *et al.,* 2016; Yuille, 2023). Since then, public participation in decision-making has been observed across a spectrum of issues and management topics (Yuille, 2023). Within the context of a recent and international 'democratic deficit'[7], whereby people feel disconnected from those who make decisions on their behalf, demand for pluralist and participatory democracy is only increasing (Yuille, 2023).

Several international conventions have also ratified the need to engage people in decision-making. They include the EU's Subsidiarity Principle, which calls for decisions to be undertaken at the lowest possible level (Hegarty, 1997); Principle 10 of the Rio Declaration 1992, which stipulates that participation in environmental decision-making from those who are directly dependent on the environment is integral to environmental governance (Kearney *et al.,* 2007; Coenen, 2009); and the 1998 Aarhus Convention, which mandated the right for people to participate in environmental decision-making (Garcia-Soto *et al.,* 2017; Schade *et al.,* 2021). Lately, the United Nations 2030 Agenda for Sustainable Development called for 'responsive, inclusive, and participatory and representative decision-making at all levels' (UN, 2015, p. 25). Similarly, in flood risk management (FRM), the 2007 EU Floods Directive requires an active involvement of all interested parties in FRM activities, including the public (Evers, 2012; Wehn *et al.,* 2015), in a shift from flood protection towards prevention and public preparedness (Cassel & Hinsberger, 2017). Such emphasis on community and stakeholder inclusion in decision-making may also reflect a more civic approach to environmental policy making and delivery in the UK (Nye *et al.,* 2011), including in water resource management more generally (e.g. catchment management). In such cases, the role of traditional Government is decreasing, with decision-making increasingly based on collaboration between a greater number of private, civic, and public groups (Watson, 2015).

Discussion concerning public participation within coastal management can be traced back to at least the 1970's, particularly in the US (e.g. Shabman, 1974), where public participation was a requirement of the 1972 Coastal Zone Management Act (Ashbaugh & Sorensen, 1976). In the UK, the need to include stakeholders in developing effective coastal management decisions has long been recognised (e.g. Edwards *et al.,* 1997). There have also been long standing calls for increased stakeholder engagement and responsibility in FCERM from scholars (e.g. O'Riordan & Ward, 1997; Seebauer *et al.,* 2019; Van Der Plank *et al.,* 2019) and managing authorities (e.g. EA, 2005; 2007; 2009a; 2009b). For instance, participation is seen as increasingly necessary when making difficult decisions (e.g. MR) or

[7] A 'democratic deficit' is typically associated with declining trust in experts and declining electoral turnouts (Petts & Leach, 2000), with the recent 2024 UK general election typifying this, seeing a 52% turnout, the lowest since 1928 (Mason, 2024).

for planning adaptation, whereby it has been recommended that 'decisions that have a significant impact on communities need to be taken in collaboration with those communities' (CCC, 2018, p.11). Consequently, 'participatory approaches are increasingly framed as being integral to successful and sustainable management of coastal resources and spaces' (McKinley *et al.,* 2021, p.1).

There are many reasons why public participation in FCERM is described as integral. Participatory approaches can create long-term efficiencies, minimise conflict, build trust and co-operative relationships, and generate two-way learning between institutional and local stakeholders (O'Riordan & Ward, 1997; Petts & Leach, 2000; Reed *et al.,* 2018). In turn, decision quality and legitimacy may be improved (Coenen, 2009; Cliquet *et al.,* 2010; Mees *et al.,* 2017; Begg *et al.,* 2018), creating stakeholders and local champions who are supportive of, and may better adopt, the solutions, policies and decisions made (Stojanovic & Ballinger, 2009). Collaborative initiatives can value and integrate local knowledge and technical expertise into decision-making (Petts & Leach, 2000; Famuditi *et al.,* 2018; Tubridy *et al.,* 2022), improving understanding of local risks and issues, identify consensus or conflict between locals and officials, and tackle environmental challenges (Mehring *et al.,* 2018; Schade *et al.,* 2021; Hemmerling *et al.,* 2022). Although truly participatory approaches will be more onerous on staff time and resources than a top-down decision-making practice, the 'benefit gained by building trust and co-operative relationships at an early stage should result in cost savings by getting things done in the longer run, due to the reduced risk of time consuming and politically contentious opposition' (O'Riordan & Ward, 1997, p.264).

2.5.1. Forms of Public Participation

Public participation can occur in diverse forms and contexts, be designed for different motivations and purposes, and be conducted across different scales and spaces (Reed *et al.,* 2018). Notably, participation can occur in 'invited' spaces, where people's input has been sought by organisations or agencies, or 'invented' spaces, whereby people have driven for their voice to be heard in the face of exclusion (Yuille, 2023). Participation can also be categorised based on the level of personal involvement individuals have in decision-making. For example, participation can be 'indirect' - people making decisions through a representative, for instance through voting – or 'direct' – people are personally involved in affecting decisions (Nabatchi & Leighninger, 2015). Direct participation is divided into three main forms: thick, thin and conventional participation (Table 2.4).

***Table 2.4**. Differences between think, thin and conventional forms of public participation (adapted from Nabatchi & Leighninger, 2015).*

Type of Participation	Description	Advantages	Disadvantages
Thick Participation	Describes the involvement of large numbers of people operating in small groups through dialogue, debate and action planning (e.g. citizen assemblies, citizen juries).	Can be powerful and meaningful.	Often intensive and time-consuming.
Thin Participation	Ways for individuals, often in very large numbers, to share ideas, opinions and concerns quickly (e.g. Crowdsourcing).	Fast and convenient.	Less likely to produce the same depth of participation compared to thick forms of participation.
Conventional Participation	Conventional, older forms of participation developed to uphold order, accountability and transparency. Often involves people addressing officials in public meetings.	Limited advantages. Often seen as an official form of public participation.	Described as 'bad' and problematic – harmful to the institutions involved (decreased public trust towards them), harmful to the people representing the agencies (can face abuse from an angered public) and harmful to the citizens (increase their sense of powerlessness). Lack of cost/benefit for people to attend - participant numbers decreasing as a result.

Moreover, like the typology of citizen science (Section 2.3.2), participatory approaches are typically categorised according to their degree of citizen engagement and power. The first effort to categorise approaches was Arstein's (1969) pioneering 'ladder of participation', a typology still widely used to describe the extent of citizen's power in a 'participatory' programme (Figure 2.10). The extent of citizen control and power increases up the ladder, from non-participation (educating and curing) to tokenism (hearing voices but lacking power to ensure voices are heeded), through to degrees of citizen power (negotiation, engagement in trade-offs and full citizen control).

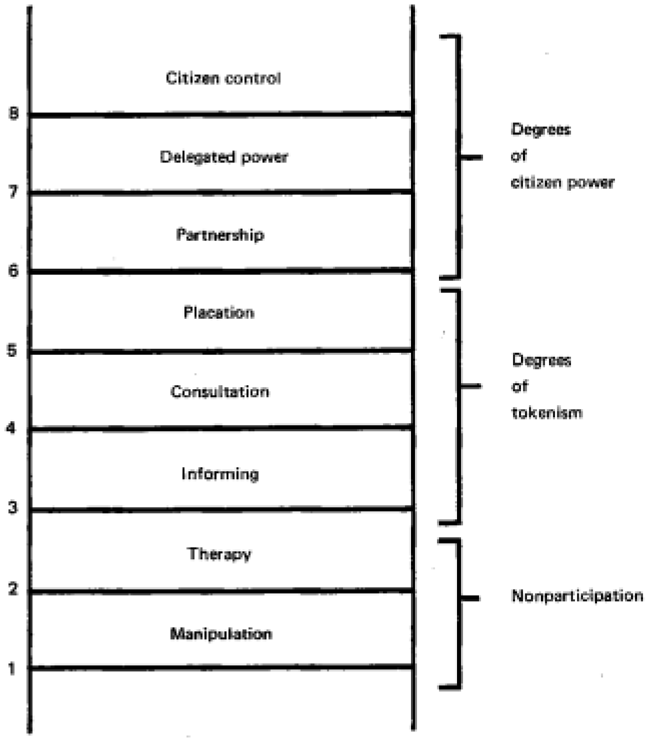

Figure 2.10. *A ladder of participation (Arnstein, 1969, p.217).*

Since Arnstein's ladder, various works have presented alternative spectrums of participation, including a re-categorisation from eight to five levels (Table 2.5; Nursey-Bray *et al.,* 2017; IAP2, 2018). Plummer & FitzGibbon (2004) build on Arnstein's ladder by introducing a multi-dimensional model of participation, accounting for the extent of citizen power, the scope of potential actors involved, and the institutional arrangements, accounting for the legislation, administrative structures, financial arrangements, political structures and traditional customs. Some authors also reject the notion of a hierarchical ladder, since it prioritises participatory forms higher up the ladder, yet there are many reasons why such processes can fail - including the influence of prior negative engagement experiences (Reed *et al.,* 2018). Consequently, there is no 'best' or 'correct' level to conduct public participation in decision-making, instead each level is highly context-specific and legitimate depending on the goals, resources, time frames and levels of concern regarding the decision (IAP2, 2018). To address this, Reed *et al.* (2018) present an alternative 'wheel of participation' (Figure 2.11), encouraging users to select the most appropriate form of participation based on the context and purpose, irrespective of how high up Arnstein's ladder it is.

Table 2.5. *An alternative spectrum of public participation, adapted from Nursey-Bray et al. (2017) and IAP2 (2018).*

Increasing Public Impact on the Decision

Type of Participation	Description	Example Activities	Limitations
Empower	Final decision placed in the public's hands.	Citizen Juries, referendums, formal community committees.	Expensive and time consuming. Representativeness can be questioned. Potentially divisive.
Collaborate	Partner with the public in each aspect of the decision-making process, from option identification to defining preferred solution.	Discussion groups offering input and advice on relevant issues.	Expensive and time consuming. Only relevant for specific issues. Bias towards funded interests.
Involve	Work directly with the public to ensure concerns and aspirations are understood and considered. Feedback should be provided on how public input has influenced the decision.	Co-management.	Demanding on local people, and resource and input intensive for both leading parties and public involved.
Consult	Obtain public feedback on decisions.	Open days, public hearings, focus groups, public comment.	Can be expensive & time consuming for complex issues, communities can feel 'betrayed' if they do not like the decision, power differences in whose voices are (not) included, issues of community commitment and capacity.
Inform	Provide information to the public to help them understand a problem, opportunity or solution.	Newsletter, websites, information meeting.	One way provision of information, top down, passive communication, limited public input.

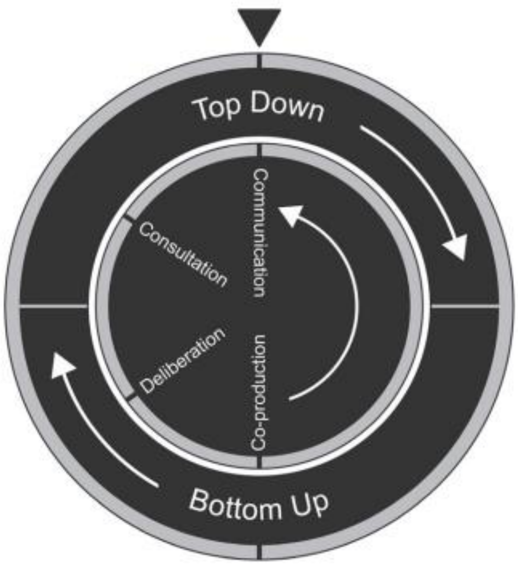

Figure 2.11. *The 'wheel of participation', an alternative to Arnstein's ladder (Reed et al., 2018, p.10).*

Whilst the context-specific nature of participation is recognised, meaning there are instances where consultation is the *most* appropriate form of participation (e.g. when a decision has been made and cannot change; Reed *et al.,* 2018), consultation is not deemed to provide citizens with sufficient power in the decision-making process for it to be considered truly participatory here. For instance, consultation is often simply viewed as a *one-way* supply of information or collection of public views (Evers, 2012; Burdett, 2024) accounted for only during a process initiated by the organiser (Rowe & Frewer, 2005). Crucially in such instances, this can mean that 'no formal dialogue exists between individual members of the public and the sponsors' (Rowe & Frewer, 2005, p.254). If public participation is defined as active public involvement in decision-making, involving a two-way exchange of information, whereby 'the act of dialogue and negotiation serves to transform opinions in the members of both parties' (Rowe & Frewer, 2005, p.256), then the typical tokenistic and one-way nature of consultation is evidently incongruous with this.

Consequently, it is specifically forms of Involving, Collaboration and Empowerment (IAP2, 2018), that aim to work *with* or give power to the public, that are considered truly participatory here. These forms also align with the concept of 'good' participation, which arises through the development of adult-adult relationships between participants and organisations, whereby more opportunities are given to all involved to digest and share information, including stories and personal experiences (Nabatchi & Leighninger, 2015). Thriving participation that delivers benefits to those involved should also be transparent and accountable (Gillgren *et al.,* 2019), factors that can only arise if the public are involved to a sufficient extent in the decision-making process.

Summarising this, a framework of participation has been developed for use in this work (Figure 2.12). The framework outlines seven forms of participation, with the three participatory models of citizen science (Collaborative, Co-design and Extreme) aligned against this. At the bottom of the framework, where the public have no impact on decision-making, are forms of nonparticipation (e.g. Manipulation). Forms of consultation (e.g. Inform/Information Provision and Consult) are then listed, with Contributory 'crowdsourcing' presented within this rung. These forms are classed as one-way forms of participation, with the flow of information *either* disseminated *to* the public (e.g. providing information, increasing public understanding of science), or being contributed *by* the public (e.g. consultation to hear the public, crowd sourced data gathering). More participatory forms are presented higher in the framework; listed in ascending order: Involve, Collaborate/Partner, Empower, Citizen Control. Collaborative, Co-design and Extreme citizen science initiatives align well with these forms of participation, since the public are offered greater, or lead (e.g. Extreme citizen science), roles in the decision-making and research processes.

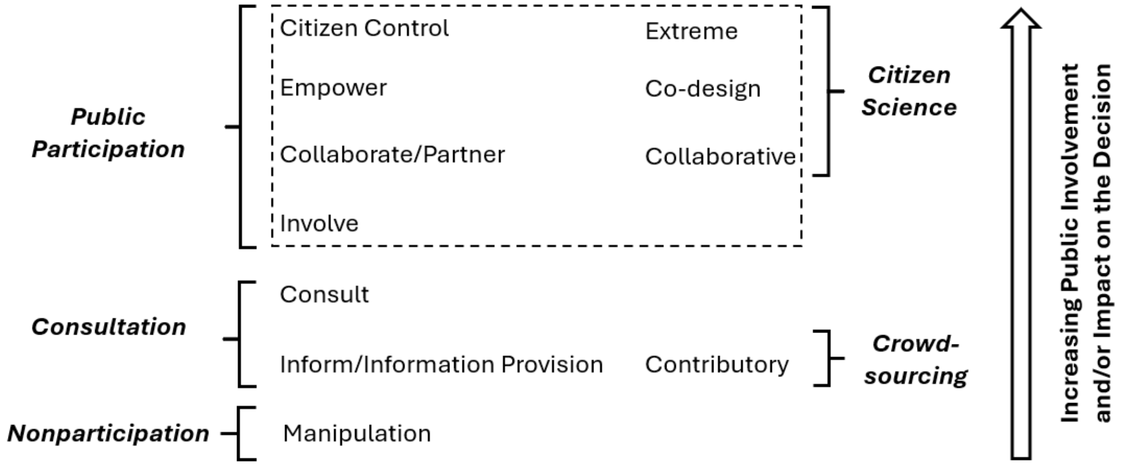

Figure 2.12. *Framework of public participation used in this research. The dotted box signals the forms of participation considered to be truly participatory.*

2.5.2. Public Participation in Practice: Coastal Action Groups, Integrated Coastal Zone Management & Coastal Partnerships

Some coastal communities have long participated in unofficial and self-organised groups to manage local coastal issues such as anti-social behaviour, marine litter, flooding and erosion. Groups include Coastal Action Groups (CAGs), community groups often formed in reaction to the perceived implications of non-defence SMP policies in local areas. Therefore, CAGs may challenge the SMP policy, demand social justice in shoreline management, campaign for greater participation in decision-making, lobby politicians, undertake demonstrations, and seek compensation (Famuditi, 2016; Famuditi *et al.,* 2018). Secondary aims of such groups include generating a local voice and building community awareness of issues (Famuditi *et al.,* 2018). Although similar in their grass-roots nature to the ubiquitous Flood Action Groups (FLAGs, community-led and autonomous groups formed across the UK to find local solutions to flood risk and provide training and information to the community; Dittrich *et al.,* 2016), CAGs are fewer in number, with just 11 groups identified that truly work on the coast (Famuditi, 2016). Groups are concentrated in South and East England, particularly in erosion hotspots like Happisburgh in Norfolk, where a CAG group formed in 1998 to fight for the renewal of coastal defences and campaign for social justice. Such groups show that some communities have long wanted a voice in coastal management and will self-mobilise to get one.

Internationally, it was the emergence of ICZM in the 1970's that offered formalised opportunities for stakeholder involvement in coastal management. ICZM evolved as an approach, or process, to address the disjointed, sectoral-based working practice of coastal stakeholders that perpetuated silo-based thinking, conflict between different actors, and failed to holistically address fundamental threats to the coastal and marine system (Ballinger, 2017). Consequently, ICZM seeks to provide a holistic coastal management approach by integrating and balancing the needs, interests and perspectives of different coastal users and stakeholders (Cheong *et al.,* 2013; Soriani *et al.,* 2015; Scott *et al.,* 2020), putting a greater emphasis on the unique physical, ecological, and social settings of different coastal spaces (Fletcher & Smith, 2007). Therefore, ICZM aims to not only manage physical coastal resources, but to also account for the people that impact and depend upon them, recognising that managing and protecting boundary-less coastal systems and resources is difficult without stakeholder and community collaboration (Deguit *et al.,* 2001). As a result, public participation is one of the central principles of ICZM (Cliquet *et al.,* 2010), laying the foundations for public involvement in coastal management decision-making globally (e.g. Ellsworth *et al.,* 1997; Cliquet *et al.,* 2010; Soriani *et al.,* 2015; Batista *et al.,* 2020).

Notably, in Australia, ICZM principles have led to the emergence of a national programme (Coastcare) encouraging community involvement in coastal management activities, including practical interventions, monitoring and planning (Harvey *et al.,* 2001), whilst the public have also been able to present management recommendations directly to Government through Coastal Reference Groups (Wescott, 1998). Public participation is now mandated in aspects of coastal management and adaptation planning in Australia (Elrick-Barr *et al.,* 2023), including in beach management strategies (e.g. DEH, 2005). Also following ICZM philosophy, Canada introduced the Ocean's Act in 1997, committing Government to implement public participation in the management of coastal and marine ecosystems (Kearney *et al.,* 2007). Such principles were demonstrated in the formation of the Atlantic Coastal Action Program, a pioneering community based coastal management initiative that legally empowered communities to set policies and priorities, with government agencies playing a secondary role by responding to community needs (Ellsworth *et al.,* 1997). Elsewhere, ICZM has been applied to support community participation in managing coastal resources in the Philippines (Deguit *et al.,* 2001) and in managing small-scale rural coastlines in Ireland (Power *et al.,* 2000).

In the UK, almost 100 Coastal and Estuary Partnerships spawned out of the ICZM movement (Stojanovic & Barker, 2008; Stojanovic & Ballinger, 2009) and were formed to enable greater 'bottom-up' public and multi-stakeholder participation and coordination in local coastal planning and management (Stojanovic & Ballinger, 2009; Buchan & Yates, 2019; McKinley *et al.,* 2021). Partnerships provided a nodal point for multiple coastal stakeholders to come together in forums, conferences, consultations, workshops and focus groups, producing reports and wider communication outputs to influence coastal and marine management (Stojanovic & Barker, 2008), including preferred FCERM options, SMP strategies and adaptation options (Hardiman, 2015). In the NW, partnerships include the North West Forum, Morecambe Bay Partnership (MBP) and Solway Firth Partnership.

However, although partnerships have provided economic, environmental and social benefits (Bradshaw, 2022), their success is arguably mixed, hampered by a reliance on voluntary participation from stakeholders (Stojanovic & Ballinger, 2009), a resource-intensive approach and plagued with issues of low efficacy, influence, and legitimacy (Stojanovic & Barker, 2008). Poor performance can largely be attributed to external factors, namely the absence of government support and statutory duty: 'The lack of a statutory basis or ongoing national programme has prevented coastal partnerships from becoming sustainable institutions with social capital, hampered the implementation of plans, and eroded commitment to partnerships' (Stojanovic & Barker, 2008, p.357). This may be in part because ICZM, the founding principle of partnerships, has been weakly implemented in practice in the UK, with the Government making little long-term investment in its future (Ballinger, 2017). With no statutory basis and lacking a centralised role, partnerships have become increasingly marginalised during tight financial times, losing funding and staff (CPN, 2013). Consequently, of the 95 partnerships identified in 2008 to facilitate multi-stakeholder collaboration (Stojanovic & Barker, 2008), just 50 remained in 2022 (CPN, 2022). Others face funding and operational challenges, requiring a diversification of their working model, including MBP, which in becoming a charity, shifted away from the LA funded partnership-based role.

Yet, it is perhaps only recent Government strategy that marks a strategic shift towards greater public participation in decision-making. Notably, the 2020 National FCERM Strategy, with its focus on a resilience, states: 'We all work best when we understand and feel involved in what is being discussed and decided. People want to have a voice to shape how resilience to flooding and coastal change is achieved in the places they live and work' (EA, 2020, p.95). The strategy's success will be defined according to engagement measures: 'From 2021 risk management authorities will encourage the development of the engagement skills and capabilities they need to better support communities to manage and adapt to future flooding and coastal change' (p.99). The accompanying policy statement declares: 'We will ensure our communities and business have the information they need to manage and prepare for their flood risk' (DEFRA, 2020b, p.7).

Such sentiment is reminiscent of a decentralised coastal management responsibility from national to local scales (McGinlay *et al.,* 2021), with a greater emphasis on a variety of actors to be more empowered and responsible to influence the decisions that affect them (Deeming, 2008; Blunkell, 2017; Van Der Plank *et al.,* 2022). This includes household and community responsibility to accept and manage their own flood and coastal risk (Snel *et al.,* 2021; Van Der Plank *et al.,* 2022; Blunkell, 2024), with the strategy declaring the need to ensure 'local people understand their risk to flooding and coastal change, and know their responsibilities and how to take action' (EA, 2020, p.8). The strategy continues, 'We all need to take action now so that we are ready for what the future will bring. Landowners, householders, businesses, insurers, emergency responders, environmental groups, community action groups, catchment partnerships, consultancies, regional flood and coastal committees, government agencies and many more, all have a vital part to play' (EA, 2020, p.17).

The UK Government is now beginning to fund innovative projects that promote the role of communities in adapting and building resilience at the coast. Projects include the 'Working together to adapt to a changing climate' initiative (Kelly & Kelly, 2023a) and DEFRA's £200 million 'Flood and Coastal Resilience Innovation Fund', which is funding three national programmes to improve flood and coastal resilience (EA, 2023). One programme, the 'Coastal Transition Accelerator Programme', targets at-risk communities (e.g. North Norfolk) in adaptation to erosion (EA, 2022). Another programme, the 'Flood and Coast Resilience Innovation Programme', is supporting 'Our Future Coast', a project testing and trialling the use of co-designed NBS to manage coastal change across NW England (MBP, 2024). The EA's Championing Coastal Coordination (3Cs) initiative has also emerged, funding projects to better coordinate the planning and delivery of place-based initiatives and engaging coastal champions to strengthen local stewardship (SEP, N.D.).

2.5.3. A Critique of a Resilience-based FCERM

To some extent, this decentralised responsibility for resilience-building is suggestive of a shift towards localism (Thaler & Priest, 2014; Begg *et al.,* 2018). Theoretically in such cases, decision-making is brought closer to affected citizens (Yuille, 2023) and power is redistributed to a greater number of people (Blunkell, 2017). However, it is unclear how much power will be devolved to people to build coastal resilience, or indeed the extent to which people will be able to contribute to decision-making processes. A key critique here is that individual responsibilities to build resilience and adapt to climate flood risks are uncertain and contested, whilst it is also unclear how stakeholders and the public can be supported in actualising resilience (Snel *et al.,* 2021; Van Der Plank *et al.,* 2022). As such, the transition to local resilience could be seen as politically and financially motivated to mask an inadequate government response to environmental problems, whereby responsibility is re-centred on the local without the transfer of resources, support, or funding (McGinlay *et al.,* 2021).

As a result, the shift to a resilience-based FCERM has been described as problematic, particularly regarding the re-centring of responsibility on coastal communities themselves:

'*Resilience thus leads us into a conceptual hall of mirrors: risk is owned by the individual, except when it isn't; the public purse can't be relied on to protect people, except when it can; protection is distinct from resilience but is also an example of it… depending on their location and situation, coastal dwellers might find themselves subject to any one of these versions of resilience, with differing responsibilities towards it, and potentially facing wildly different outcomes*' (Blunkell, 2024, p.643).

For instance, it is unclear how resilience, adaptation and SMPs align. Some communities may find themselves defended by public finances (e.g. HTL SMP policy), and thus considered resilient against flooding and erosion, yet others may be left to pick up the costs with minimal state support (e.g. MR or NAI SMP policy). This glaring contradiction of contrasting government (no) support for resilience building activities is particularly stark for communities facing coastal erosion. The SMP policy may call for MR to adapt to erosion, yet householders are then responsible for the demolition and clear up costs when their house is lost to erosion[8], 'that is not adaptation; that is abandonment' (Arnall, 2023, p.8).

[8] Government support is scant for households facing coastal erosion. Financial help is only through the Coastal Erosion Assistance Grant (DEFRA, 2020a), which offers just £6,000 per property. Even then, the fund goes to LAs to support demolition and removal costs for homes at imminent risk.

Therefore, if different versions of resilience can be applied to different coastal localities, then broader concerns are raised regarding *what* resilience looks like and *how* it can be measured. The stark sense of uncertainty regarding resilience has even been recognised by Parliament: 'Government has no overall measure of the resilience it expects to achieve and so does not know if it is making progress towards its ambition of a nation more resilient to flooding' (CPA, 2024, p.5). This uncertainty is worrying, as it offers no coherent measure of resilience for coastal practitioners and communities to start from or work towards, leaving space for ambiguity, debate and conflict.

Moreover, irrespective of the strategic intent to involve people in decision-making within a resilience-based FCERM - and mindful of the challenges faced by coastal partnerships in facilitating public participation in coastal management - it is worth questioning whether the infrastructure needed to support participation (Nabatchi & Leighninger, 2015) exists in practice. For instance, do laws mandate public participation? What rights to people have to participatory processes at the coast? Do coastal practitioners possess the skills, capacity, or statutory duty to involve the public?[9] Notably, outside of statutory responsibility for managing FCERM risks, very few bodies have the powers or duties to collaborate (Bradshaw, 2022). Bradshaw (2022) outlines several enabling powers that encourage more joined up management. These include the 2011 Localism Act ensuring public bodies and statutory consultees work together on planning issues[10], the 2010 Flood and Water Management Act requiring RMAs to *cooperate*[11], and the 2013 Coastal Concordat, again encouraging cooperation between Government authorities and other organisations operating at the coast. However, most of these duties only mandate cooperation between managing authorities and not for public participation in decision-making beyond formal consultation (rather than participation) processes (Bradshaw, 2022).

2.5.4. Participation as Consultation in FCERM

Whilst there is a clear intent and strategy for greater public participation in coastal management, and clear benefits of doing it in theory, the lack of existing statutory duty,

[9] Given the complexity of and number of stakeholders involved in existing FCERM decision-making (see Figure 2.3), these are difficult questions to answer, although the skills and capacity of coastal practitioners to involve the public in decision-making is considered in Chapter Seven.

[10] Whilst the Localism Act decentralised more power to local communities in planning, this has not necessarily been exerted yet in coastal management (Bradshaw, 2022).

[11] Distinction is made between *collaboration*, working together to achieve a shared goal, and *cooperation* – assisting or supporting without the same degree of involvement.

government backing or investment in public participation has rendered it weakly implemented in practice. Consequently, the traditional mode for public participation in FCERM is described as top-down (Nye *et al.,* 2011) and consultation based (Edwards *et al.,* 1997; O'Riordan & Ward, 1997). Since at least 2000, governments, LAs and agencies have sought to explore alternative approaches that permit greater public participation in day-to-day activities (Petts & Leach, 2000). In FCERM, this has led to over two decades worth of efforts to 'normalise' the way RMAs and the EA communicate, engage and involve communities in decision-making processes (Kelly & Kelly, 2019). Yet, despite these efforts, authors still describe consultation as the dominant paradigm for 'involving' people in coastal management (Famuditi *et al.,* 2018; Bradshaw *et al.,* 2021; Bradshaw, 2022), leaving people in the tokenistic lower rungs (informing, consultation) of Arnstein's (1969) ladder.

Such consultation often limits people to responding to lengthy policy statements in narrow time windows, 'constraining engagement across sectoral interest groups and limits engagement with coastal communities and their local knowledge' (Bradshaw, 2022, p.71). Individuals without a strong institutional representation are typically excluded from these processes (Mcglashan & Williams, 2003) or are confined to engaging only at 'end points' late in the FCERM process (e.g. appraising options; Lane *et al.,* 2011), whereby the key decisions have already been made. Engagement may even cease after one-off, ill-attended events (Elrick-Barr *et al.,* 2023). As a result, consultation often fails to get public 'buy-in' on the decision (Ellsworth *et al.,* 1997). The approach is well described by Mcglashan & Williams (2003, p.88):

'*In the UK, as with most industrialised countries, the current decision-making process starts as a reactive response to a particular problem. A local erosion event, or loss of beach frontage are typical of the problems that stimulate action. This leads to the generation of a proposal, usually, in the form of an engineering plan to treat the symptom and 'defend the coastline'. By this stage the ultimate action has already been largely determined. The next stage involves the developer in enumerating costs and benefits of the proposal… Consultation on the proposal is then based upon an already determined (and costed) solution resulting in a 'take it or leave it' proposition. It is only institutional stakeholders who have the resources and technical expertise necessary to meaningfully engage with the consultation process. Local stakeholders and individual actors face a fait accompli*'.

This consultation on a pre-determined decision may even be considered 'non-participation' (Mcglashan & Williams, 2003; McKinley *et al.,* 2021), whereby communities and stakeholders often have little or no opportunity to not accept a pre-determined decision[12], proposal or SMP policy (Walker, 2009; Famuditi *et al.,* 2018). As Brown *et al.* (2023, p.7) elicits: the 'decisions have already been set by the time the community is involved'. In such instances, 'participation can become geared towards getting local views to fit with predetermined strategies' (Few *et al.,* 2007, p.54), a feeling captured by the feelings of a participant in a coastal adaptation case study in the UK, who reported: '*the battle was lost – we were negotiating over the terms of our defeat*' (Blunkell, 2017, p.504). Without mechanisms for direct community involvement early in the decision-making process, people can be left as 'spectators' and information recipients (Wehn *et al.,* 2015). Such a consultation-based approach can be described as a 'DAD' (Decide, Announce, Defend) model of decision-making (EA, N.D.), whereby decisions are made, announced (the point at which people would be consulted) and then defended against any stakeholder opposition. Such a model is typical of traditional FCERM decision-making (EA, 2009b) and reminiscent of conventional participation – a product of outdated assumptions about participation; that participation should be periodic and temporary, and that citizens do not want to participate in government work (Nabatchi & Leighninger, 2015).

To some extent, SMPs are textbook examples of this 'DAD' approach. Although the SMP development process involved 'consultation', public participation was reportedly low (Famuditi, 2016), not early enough for people to influence decisions (Bennett-Lloyd *et al.,* 2019) or failed to invite or involve communities altogether (Day *et al.,* 2015). The result is 'a widespread sense of local unease and uncertainty about the future of people's homes and communities' (Nursey-Bray *et al.,* 2017, p.233), particularly in places where non-defence policies such as MR and NAI presented a stark contrast to the defence status quo. Notably, in Norfolk, Day *et al.* (2015, p.309) report 'many felt isolated and let down by the decision-making process', with 'people struggling to cope with being told that change will happen and feeling that a policy has been decided without full account being taken of their well-being' (p.317).

In some places, failure to involve people early enough galvanised local resistance to oppose the SMPs, with some CAGs (e.g. Happisburgh; Famuditi *et al.,* 2018) forming in reaction to the plans. In other areas, communities were unaware of decisions until plans to implement them were publicised (Famuditi *et al.,* 2018). Notably, in Fairbourne, Wales, the

[12] Examples of non-participation at the coast can be found elsewhere too (e.g. Belgium), with decisions pushed through without any form of consultation or information provision at all (Cliquet *et al.,* 2010).

announcement that a decision had been made to 'decommission' the village (MR epoch two, NAI epoch three) in the wake of climate challenges sparked conflict between the managing authorities and local community only *after* it was reported in the national press (Buser, 2020). Arnall & Hilson (2023) express this conflict in Fairbourne as a struggle between 'sea level rise imaginaries' – emergent, collectively produced visions and representations of coastal futures – whereby top-down, expert predictions of global climate change impacts are at odds with residents' local, place-based experiences and perceptions of climate change impacts. Such differences, perpetuated by insufficient 'consultation', have led to local resistance against authorities, and the mobilisation of the community to develop their own visions, plans and studies (Arnall & Hilson, 2023).

In these instances, whereby 'participation' processes have not necessarily presented the opportunity, capacity, or resources for people to be effectively heard, communities can lack social justice in decision-making. As a result, the consultation process may generate, rather than alleviate conflict (Hegarty, 1997; O'Riordan & Ward, 1997), incite suspicion of authorities (Edwards *et al.,* 1997), cause breakdowns in trust (EA, 2009b) and mean communities fail to 'buy into' a preferred solution and the constraints and limitations underpinning it (Scott *et al.,* 2020). Such processes can also feed a reported widespread perception amongst local people that engagement is only used to manage controversial issues – whereby institutions can deliver a decision whilst simultaneously achieving its public engagement commitments (Lane *et al.,* 2011). Failure to account for local and tacit knowledge in such processes can also reinforce an epistemological gap between local and technical knowledge, perpetuating a public distrust of managing authorities and the emergence of 'knowledge controversies', whereby scientific and policy maker claims are challenged (Hemmerling *et al.,* 2022). This dissonance is strongly felt between communities and government policy on the management, or lack of, in coastal locations where building or renewing coastal defences is not justifiable (Blunkell, 2017).

2.5.5. Barriers to Participation

Whilst communities need to be involved in FCERM *beyond* consultation if they are to have a truly participative role in coastal management, there are several underlying challenges that limit their ability to participate in practice (Table 2.6), irrespective of whether the decision-making process accounts for them or not. These challenges amount to a continued public absence and disengagement from coastal management, perpetuating conflict (Begg *et al.,* 2018) and a disconnect between the ambition for a more participatory FCERM and a public who are perceived to have a low awareness, responsibility and involvement in this process (Van Der Plank *et al.,* 2020).

Table 2.6. *Summary of the six engagement challenges identified from the 'Working together to adapt to a changing climate' project (Kelly & Kelly, 2023a).*

Challenge	Summary
1. Readiness	- The extent to which all coastal stakeholders, including communities and practitioners, have the knowledge and capacities required for long term decision making. - Includes the extent to which policies and processes account for climate change, attitudes, emotions, agency, levels of trusts, and capacity to collaborate. - Assessing readiness can help managing authorities decide where to invest resources. - Readiness may be a pre-condition to successful engagement.
2. Framing, Language & Communication	- Framing of coastal challenges, including flooding, erosion and climate change, affects people's responses to engagement. - Terminology (e.g. risk, adaptation, vulnerability) can be interpreted by people in different ways.
3. Climate Change, Emotions & Mental Health	- Coastal challenges can impact emotions and mental health, which can block engagement about difficult topics and questions. - No 'neat' correlation between exposure to coastal risks and levels of concern.
4. Place Attachment	- Place attachment make dealing with long term and unwelcome change difficult. - No single 'community view'.
5. Power, Politics & Conflict	- Conflict likely in risk management and adaptation decisions. - Power and influence uneven; some knowledge valued more than others, decision making responsibility rests with certain people.
6. Questions of Scale	- Organisations and communities think and work on different geographic and temporal scales. - Long term adaptation can seem a distraction of resources from current issues. - Conflicting scales a source of tension.

The readiness of coastal communities, and practitioners, to engage in decision-making processes, including levels of understanding, trust and capacity to participate, could be a pre-condition required for successful collaboration and engagement (Kelly & Kelly, 2023a). For instance, it has been found that people need 'sufficient knowledge, social capital and economic capacity' to begin engaging in the co-production of flood risk management (Mees *et al.,* 2017, p.836). Yet, it may be unclear whether such dimensions of readiness, and hence capacity to collaborate, exist in practice for both communities and practitioners (Kelly & Kelly, 2023a). People may lack the experience and ability to engage with complex coastal decision-making processes (Mcglashan *et al.,* 2003), whilst it is suggested that 'communities in England and Wales remain unprepared for contentious policy change' (Brown *et al.,* 2023, p.9). Instead, in some reported instances, public expectations are for the continuation of state protection against flood and erosion risks (Famuditi, 2016; Brown *et al.,* 2023; Kelly & Kelly, 2023b), demonstrating a defence-based mindset that is incompatible with the need for alternative adaptation solutions like MR under the resilience paradigm.

Issues of power are also entrenched within the existing decision-making process. Power appears to rest with decision-makers and statutory bodies, who set the conditions within which people can be involved, exemplified by the critique that coastal management decisions may already have been made before a deliberative process begins (Blunkell, 2017; Brown *et al.,* 2023). A lack of power and responsibility for the public in the decision-making process may be a result of the sense that public participation impedes on preferred outcomes and decisions (Blunkell, 2017). Participation may also increase the 'messiness' of decision-making, analogous to ordered objectivity and predictability of expert and scientist led decision-making (Petts & Leach, 2000), a factor which may have contributed to planners exercising a 'backlash' against participatory decision-making in the past (Hillier, 2003). Only when this power is relinquished by authorities can communities have any real power within the decision-making process (Edwards *et al.,* 1997). Failure to devolve power may make the push towards a 'participatory' management illusionary (Few *et al.,* 2007).

Disparities between communities may also affect the extent of their involvement in coastal management. Socio-economically, more affluent communities are likely to have a greater role than less well-off areas (Buser, 2020), since lower income or minority communities may lack the capacity, economic power or national strategic interest to be fully integrated into policy-forming processes (Thaler & Priest, 2014). Contrasting capacities for involvement may also be seen within individual communities, influenced by lack of time or opportunity (Smith & Bond, 2018), political orientation (Dean *et al.,* 2019), age (over-65's are more likely to be involved than younger people; Blunkell, 2017), and power (elite, powerful and articulate local actors may dominate opinion; Hillier, 2003; McGinlay *et al.,* 2021). Consequently, fundamental inequalities in power and representation between and within communities must be accounted for when engaging people in decision-making. In which case, communities should be treated as disparate with different perceptions (EA, 2007), abilities to engage and voices to share. Therefore, it is important to consider whose voices are, and whose are not, represented in the collaboration process, and the implications this might have for the decisions made (Booker *et al.,* 2022). It is also important to consider the costs to citizens involved in the decision-making process, including both wasted time (Blunkell, 2017) and possible financial losses, as compensation is unlikely to be given in non-defence scenarios (McGinlay *et al.,* 2021).

Current coastal management processes and accompanying *governance* structures - the mechanisms and processes by which power and decision-making are allocated among different actors (Kearney *et al.,* 2007) - may also limit public participation in practice. Issues include a lack of resources, tools, and guidance required to deliver national policy on local scales and support communities in building coastal resilience, whilst there is also uncertainty regarding the extent and timing of stakeholder involvement in decision-making (Milligan *et al.,* 2009; Van Der Plank *et al.,* 2019; McGinlay *et al.,* 2021). For instance, a traditional 'DAD' mindset has perpetuated amongst EA decision-makers, whereby engagement is 'telling people what is happening' (i.e. what engineering solution is to be imposed), rather than involving them in the decision itself (EA, 2009b).

Again, the SMP perpetuated this 'DAD' mindset. The SMP, whilst viewed as an opportunity for participation by the EA (2020, p.55): 'shoreline management plans can provide a basis for local engagement, consultation and political acceptance of future coastal change', is a set of policies which have *already* been decided. But, given the SMP is entering a transitional period in 2025 from epoch one (short-term) to epoch two (medium-term), which in some cases spells a transition in SMP policy, it is becoming increasingly imperative to engage and work with communities. This is to ensure the successful implementation of a resilient coastal future that allows, and does not inhibit, adaptation to coastal change. But where does this leave people? If the decision has already been made, yet people who may suffer economically or require relocation because of the decision are being asked to engage with it, then a top-down 'DAD' approach will be reinforced. In such instances, the transition from defending decisions to increased public participation in practice, without compensation for those who may lose out, has been described as a 'quantum leap' (Brennan, 2007, p.596).

Furthermore, even if there is an intent to involve people, the policies and directives do not necessarily support this. For instance, the EU Floods Directive 'does not specify who should participate in risk management processes or how participation should be facilitated' (Moon *et al.,* 2017*,* p.414). Consequently, when applied in practice to the Belfast Flood Forum – an approach appearing highly participatory on paper – it results in a tokenistic space that excludes the public and only offers participation for agencies, elite stakeholders and experts. Any ambition to decentralise responsibility from agencies to the public is an 'empty rhetoric' (Moon *et al.,* 2017). Consequently, perhaps irrespective of the desire to encourage participation, the governance infrastructure needed to facilitate public participation is insufficient (Hügel & Davies, 2020); feeding a 'governance vacuum' that fails to provide the necessary resources for practitioners or communities to adapt to the climate crisis (McGinlay *et al.,* 2021). As a result, community participation in coastal management in England is described as 'rudimentary' (Famuditi, 2016), with a persistent 'gap between the consistently growing call for greater inclusion of 'social' components in marine and coastal management issues and the development of global marine policy' (McKinley & Acott, 2018, p.220).

2.5.6. Overcoming These Issues

A transformation of statutory responsibilities and resources are required to facilitate greater public participation in coastal management. Central to this transformation is the need for power redistribution from decision-makers to the public (Few *et al.,* 2007). This requires a shift from a top-down 'DAD' form of decision-making to a more inclusive 'EDD' (Engage, Deliberate, Decide) model (Walker, 2009; EA, N.D.), whereby, unlike in the 'DAD' model, the decision is made at the end of the process. As such, communities are engaged earlier to share local knowledges, needs and concerns, and are involved in defining the problem, identifying possible solutions and developing plans (EA, 2010; Wehn *et al.,* 2015; Kelly & Kelly, 2019b). Whilst this approach may not lead to consensus, it leads to an improved understanding of why the decision has been made (EA, 2009b), making it the favoured approach for bringing the public and stakeholders into FCERM decision-making (EA, 2010).

This 'EDD' model also aligns with an appetite within some coastal communities for involvement in FCERM processes (EA, 2009b; Mehring *et al.,* 2018). For example, almost 70% of survey respondents in an English case study expressed desire to be involved in frequent shoreline management meetings (Famuditi, 2016)[13]. However, there is a danger here of associating more participation with achieving more democratic outcomes. This may not be the case, as Yuille (2022) notes that participation in 'invited' spaces, even if it is

[13] Interestingly, some studies have shown the contrary. In a Netherlands case study residents did not feel it was necessary for them to be involved in coastal management decisions. Instead, information provision about risks and personal responsibilities was deemed sufficient (Everts, 2013).

empowering, may only allow people to participate in a narrow band of decisions that have been predetermined by authorities – whereby participation just becomes a tool to legitimise decisions made elsewhere. Crucially, public participation processes must provide people with a role in decision-making in two main ways: (i) 'ensuring that *valuable* community knowledge and feedback is incorporated within upper-level decision-making, and (ii) by enabling high level policy makers to communicate management decisions, and necessary trade-offs, in ways that will be accepted and palatable to the various 'publics' involved in coastal regions' (Nursey-Bray *et al.,* 2017, p.223).

Importantly, by providing people with an early role in the decision-making process, it is hoped that situations where communities are forced to self-mobilise to get their voices heard (Day *et al.,* 2015) to resist 'DAD' decisions (e.g. CAGs) can be avoided. Instead, people will already be at the table. Famuditi (2016) introduces a five-step model to facilitate community participation in coastal management (Figure 2.13). The second step, inform, in its focus on education, could account for public engagement initiatives like citizen science. Reed *et al*. (2018) also present five recommendations for ensuring successful participation (Figure 2.14). Crucially, the first step encourages practitioners to contextualise the engagement, addressing 'the most common mistake made by people who are trying to engage the public is that they try to facilitate citizen participation without first trying to understand citizens' (Nabatchi & Leighninger, 2015, p.4). There is a rationale here to take time to understand and ground the participation in place to ensure it is suitable and aligns with local issues and knowledges – a theme established in Chapter 4.

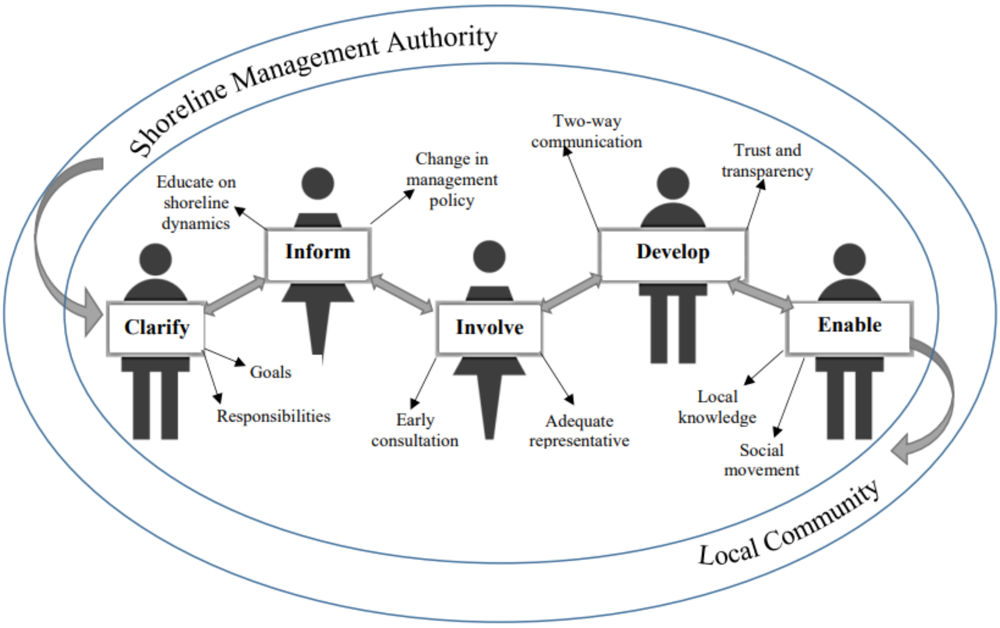

***Figure 2.13**. Coastal management participation model (Famuditi, 2016, p.225).*

1. *Take time to fully understand local context to determine the appropriate type of engagement approach and adapt its design to the context.*
2. *Get all affected parties involved in dialogue as soon as possible, to develop shared goals and coproduce outcomes based on the most relevant sources of knowledge.*
3. *Manage power dynamics, so every participant's contribution is valued and all have an equal opportunity to contribute.*
4. *Match the length and frequency of engagement to the goals of the process, recognizing that changes in deeply held values (that may be at the root of a conflict) are likely to take longer than changes in preferences.*
5. *Match the representation of stakeholder interests and decision-making power to the spatial scale of the issues being considered.*

***Figure 2.14.** Recommendations for successful public engagement and participation* (Reed *et al.*, 2018, p.15).

2.5.7. Public Participation Summary & Research Gaps

Public participation, describing the active involvement of people in decision-making, is increasingly emphasised in FCERM. The 2020 national FCERM Strategy, with its focus on building resilience, clearly states this intent. However, this intent is certainly not new. In 2007, DEFRA (2007, p.15) stated: 'it will be necessary to make a clear transition away from defending current decisions to more participation by the public in the overall decision-making process'. Shortly afterwards, the EA (2009b, p.2) claimed there is: 'simply no longer any choice in the matter: flood and coastal erosion risk management can no longer be imposed or delivered by the Environment Agency' (p.2). Yet, after two-decades worth of effort to 'normalise' public participation in FCERM (Kelly & Kelly, 2019a), there is still a sense that, in the literature at least, a traditional consultation and DAD, or even non-participation, approach remains engrained within FCERM and coastal management. Efforts have been made to rectify this, notably the emergence of coastal partnerships during the ICZM movement, yet their success has been limited by a lack of Government support and statutory role (Stojanovic & Barker, 2008).

The key question arising from this is - *why is there a renewed emphasis on participation now*? Could it be a result of the increased emphasis on resilience, and therefore increased decentralisation of risk responsibility to local levels? Or perhaps the imminent SMP transition to epoch two (2025), which will see an increase in non-defence policy units requiring people to undertake adaptive and transformational action? Irrespective of these drivers, there is a clear disconnect between the strategic intent to engage people in FCERM decisions, and the capacity for this to be undertaken in practice. If this disconnect and associated challenges are to be overcome, there is a pressing need to better understand how, when and where communities can participate in practice.

Further questions arising from this section include: what is a 'voice' in practice? What are people's and practitioners' rationales for public participation? What are the roles and responsibilities which people currently, and could have, in coastal management? Are there any further challenges or barriers to participation that must be overcome? And, how is the 2020 FCERM Strategy perceived, or playing out, on the ground? Such questions are explored in chapter 7, helping to address the dearth of research on the roles and responsibilities that stakeholders, including communities, can play in FCERM activities (Morrison *et al.,* 2018). It would also help to better understand possible opportunities to work with communities to build resilience and adapt to coastal change by making decisions together, flagged as one of the EA's (2024a) key research interests.

2.6. Concluding Remarks

Chapter 2 has introduced and contextualised the key research concepts of citizen science and public participation within the field of coastal management. Within a resilience-based FCERM, there is an emphasis on involving coastal communities in the decisions that affect them. The concept of citizen science was explored as an engagement tool that could help to build people's understanding of local coastal change, and hence their ability to participate in decision-making processes. Ultimately, for a more informed public to participate in making decisions, the opportunities and space within the decision-making processes need to be available. However, in coastal settings, it is evident that neither citizen science nor public participation are necessarily designed with people at the forefront. In citizen science, this stems from its typically science-focused, contributory nature, whilst in public participation, critiques centre around top-down, consultation-based approaches. This can result in people being left without a meaningful role or voice in the research or decision-making processes respectively.

This thesis addresses these overarching critiques by designing, and implementing, a participant-focussed citizen science project, and exploring the extent to which this can build the understanding and ability of people to participate in a resilience-based coastal management.

Chapter Three

Chapter Three: Methodology

3.1. Introduction

Chapter 3 sets out the research methodology – the rationale for and background to the overall research approach. Firstly, the chapter introduces the transdisciplinary, mixed-methods approach taken. The researcher's positionality and resulting reflexive approaches to minimise the impact of arising biases in the application of the methods are then acknowledged. Finally, an overview of the methods employed, including their strengths and weaknesses in the context of this work, is presented.

3.2. Methodological Approach

The research aims to examine the extent to which a participant-focussed citizen science can build the understanding and ability of people to participate in a resilience-based coastal management in NW England. Methodologically, the research takes an applied approach to address this aim, whereby the work addresses real-world problems, facilitates an experiential learning opportunity for participants, and offers actionable outcomes that influence the future design of citizen science projects and directions of coastal management. Rooted in this applied approach, the thesis does not seek to advance or critique theory, although the methodology is informed by the theoretical concept of *place*.

Place can be defined as a location, or space, which people have made meaningful to themselves and they are attached to (Cresswell, 2004). The concept of place is employed in two ways. The first, *sense of place*, considers the intimate and emotional relationships with place that describe how and why the place carries an individual, or shared (Cresswell, 2008), uniqueness or significance (Holloway & Hubbard, 2001). A sense of place within coastal space captures a person's lived experiences, reactions, and emotional encounters within that space (Jarrett, 2015). In this research, this includes how the space makes people feel, how it is made meaningful, how the space is constructed, contested, valued, and experienced through a pandemic, and ultimately how the pandemic has shaped the nature of place encounters (Chapter 4). Consequently, this research is grounded in people's lived experiences and sense of place within a Fylde coast setting. This provides a rich and textured case study of how people encountered the coast during the pandemic, in terms of their practices, emotions and experiences within them (Doughty, 2019), helping to 'deepen our understanding of individuals' lifelong experiences of coasts, and the meanings they attach to them' (Tunstall & Penning-Rowsell, 1998, p.330).

The thesis' case study focus aligns with the second application of place: *place-based*. Despite the frequent use of the term 'place-based' in the titles and text of published geographical and social sciences literature, few define what is meant by 'place-based' (e.g. Miller, 2007; Cutter *et al.,* 2008; Johnson, 2012; Moretti, 2024). In response, this work extends Haywood *et al.*'s (2024, p.1) definition of place-based as 'physically rooted in a distinct environment, history, culture, and economy' to also emphasise the integration of local knowledge and community participation in a local environment. Consequently, approaching the work through a place-based lens can help provide deep insights into the experiences of participants within citizen science (Chapter 6) and coastal management decision-making (Chapter 7). The benefits of taking a place-based approach in this work are numerous; the research can explore how global environmental challenges are tackled on local scales (e.g. marine litter; Chapter 6), support a community's understanding and resilience to local coastal change, and inform local coastal management strategies.

The combination of a place-based and applied methodological approach advances the academic study of coastal management, a field of geographic inquiry that emerged in the 1970s, focussed on how the overlapping and interrelated themes of space, place and people are managed across unique coastal spaces (Fletcher & Smith, 2007). Consequently, the work is important to inform a place-sensitive and holistic approach to coastal management that accounts for both physical coastal change and human experiences in coastal space, including people's emotional and embodied coastal connections (Bell *et al.,* 2015). However, the place-based approach may make findings difficult to generalise across diverse coastal areas with contrasting social, economic, and environmental characteristics, and different coastal management systems and stakeholders (Edwards *et al.,* 1997; Mehring *et al.,* 2018).

Developing a place-based, applied approach demands the separation of the aim into three consecutive research phases:

1. *Design a participant-focussed citizen science:* There is a need to ground the design of a citizen science project according to 'people's', or a community's, values, needs and concerns, such that it provides a local relevance and interest. This is achieved through a place-based, collaborative approach.

2. *Engage people in a participant-focussed citizen science:* Enable people to participate in a citizen science project that provides evidence to better understand and manage a local coastal phenomenon or problem and explores participant's outcomes and experiences.
3. *Understand how people can contribute to coastal management decisions in a resilience-based paradigm*: Situate the work within the wider coastal management discipline to characterise when, where and how people can contribute to coastal management decisions by exploring the current experiences and perceptions of practitioners and community members. Conclusions could inform future strategies or policy interventions to facilitate public participation in coastal management.

Each of these phases seeks to foster a link between academic practice and real-world practical application through participation - whereby non-academic stakeholders are involved in shaping and designing the research. In this sense, the work can be described *not* as multi- or interdisciplinary (which both, to different extents, bring together disciplines and perspectives to form new knowledge), but as *transdisciplinary*, whereby, crucially, a plurality of methods and a combination of participants are included in the research process[14] (Clifford *et al.,* 2016; Agnew *et al.,* 2022).

3.3. Positionality

Positionality is the consideration of how the research is affected by the position, privileges and identity of the researcher (Smith, 2016). Reflecting on positionality is important, as it acknowledges that the presence, relations and background of the researcher cannot be abstracted from the research process (researchers are not neutral observers), since they will affect participant interactions and shape each step of the research process.

[14] To some extent, the participatory approach evokes principles of Participatory Action Research (PAR), the democratisation of 'research design by studying an issue or phenomenon with the full engagement of those affected by it' (Breitbart, 2016, p.198). Principles include grounding the work in people's lived experiences (Chapter 4) and sustaining dialogue between the researcher and community (Chapters 5, 6 and 7). However, the work cannot be considered true PAR since it fails to provide the community with an opportunity to represent themselves, a central tenet of PAR (Breitbart, 2016). Instead, the community is represented by the researcher, who takes responsibility for producing, analysing, writing, and disseminating the work. This creates an imbalance of power between the researcher and non-academic stakeholders, making it difficult to consider the research as true PAR.

Understanding positionality is essential for maintaining the integrity and ethical standards of the work. Here, whilst the researcher's background (white, male, British) remains unchanged across the PhD, their life experiences have changed during, and been changed by, the PhD process.

Notably, during phase one of the research, the researcher could be considered an 'outsider'. Consequently, the researcher was unknown and had no connection to the participants, and, given the pandemic context which prohibited in-person contact, the researcher was spatially distant from participants. However, moving out of the pandemic, phase two of the thesis demanded building an increased rapport with, and participation from, participants in the Coast Watchers citizen science project. Consequently, the role of the researcher as an 'outsider' shifted, with a blurring of the distinction between researcher and participant as the researcher became increasingly involved with and known to the participants. In this instance, the researcher's role was presented not as a 'top-down' expert, but as a facilitator in the citizen science process to engage, listen to and interact with participants. Moving into the third and final phase of the thesis, positionality evolved again, with the researcher changing from full- to part-time PhD study in 2022 to pursue an opportunity to work on a coastal management project. In this case, the researcher became increasingly visible to coastal management practitioners and coastal communities beyond the Fylde Coast. Therefore, research was undertaken from an 'insider/outsider' perspective, whereby, despite 'being' a coastal practitioner, the very act of situating oneself amongst other practitioners placed the researcher in an 'outsider' position (Smith, 2016).

A shifting positionality was expected due to the applied and participatory nature of the research. However, it is recognised that such changes in positionality may affect the research process, particularly by introducing internal biases and preconceptions about the participants, their perspectives, and their experiences. Rather than attempting to eliminate the effect of changing positionality on the work, the researcher embarked on a reflexive process to acknowledge and mitigate effects on the research process (Holmes, 2020). Key to this is the use of triangulation, a methodological approach which combines multiple data collection methods to best answer a research question (Carter *et al.,* 2014; Clifford *et al.,* 2016). Triangulating information across different sources and methods can help to identify and fill knowledge gaps between the methods and test and increase the validity of data collected (Carter *et al.,* 2014). Crucially, triangulation allowed for the corroboration of findings and perspectives between different methods for each chapter, minimising the implication of potential researcher bias on any single method.

Other techniques were also used as part of a reflexive process. Techniques included continuous interaction with the academic supervisory team to discuss and evolve research plans, questions and data, mindful of any effect that underlying experiences and attitudes may have. The researcher was also conscious of the strengths and limitations of the 'insider/outsider' dynamic, particularly through phases two and three of the research. Notably, minimal separation between the researcher and participants affords constructive feedback on the work to be received from participants (e.g. through conversations, presentations, online articles), helping to ensure the work maintains local relevance and interest. Moreover, questions could be designed according to personal experiences (e.g. the current state of coastal management in practice), whilst the research outcomes could be tailored towards real-world needs to achieve meaningful impact (e.g. address the lack of participation in coastal management decision-making processes).

However, minimal separation could also be impactful to the quality of data collected. Notably, participants may not disclose information because they assume it is already known by the researcher, or participants may not feel comfortable fully disclosing information or opinions because of a power imbalance or fear of judgement. Practicing sound research ethics is crucial to managing this 'insider/outsider' dynamic, particularly when the interviewee is known to the researcher. Consequently, the following ethical practices were followed:

- Participants were provided a participant information sheet in advance of an interview, which detailed what was expected of them and that they could withdraw within four weeks of the interview.
- Participation required informed consent.
- If not conducted online, participants chose a location to conduct the interview that was safe and comfortable.
- Data are confidential and anonymous. Maintaining anonymity is particularly important for coastal practitioners operating around the NW, as they belong to a small and well-connected community. Consequently, pseudonyms are used for all participants throughout this thesis.

3.4. Methods Selection

The work takes a mixed-methods approach to best answer the research questions. Mixed-methods research can involve several separate methods that are analysed independently and form the basis of a single study, or it can involve several complementary methods that are analysed together, which would otherwise be insufficient to stand on their own to answer the research question (Morse, 2009). This research achieves the later approach, which is most appropriate to align with the trans-disciplinary nature of the work and the need for method triangulation to manage positionality. Each chapter combines multiple methods (Figure 3.1), collecting different forms of quantitative (e.g. science-focussed citizen science outcomes) and qualitative data (e.g. participants' input into the research, their experiences and outcomes from citizen science, and perceptions of public involvement in coastal management). Each method is then analysed and discussed as part of a single overlapping synthesis, resulting in an in-depth, rich and place-based narrative to address the research aim and objectives.

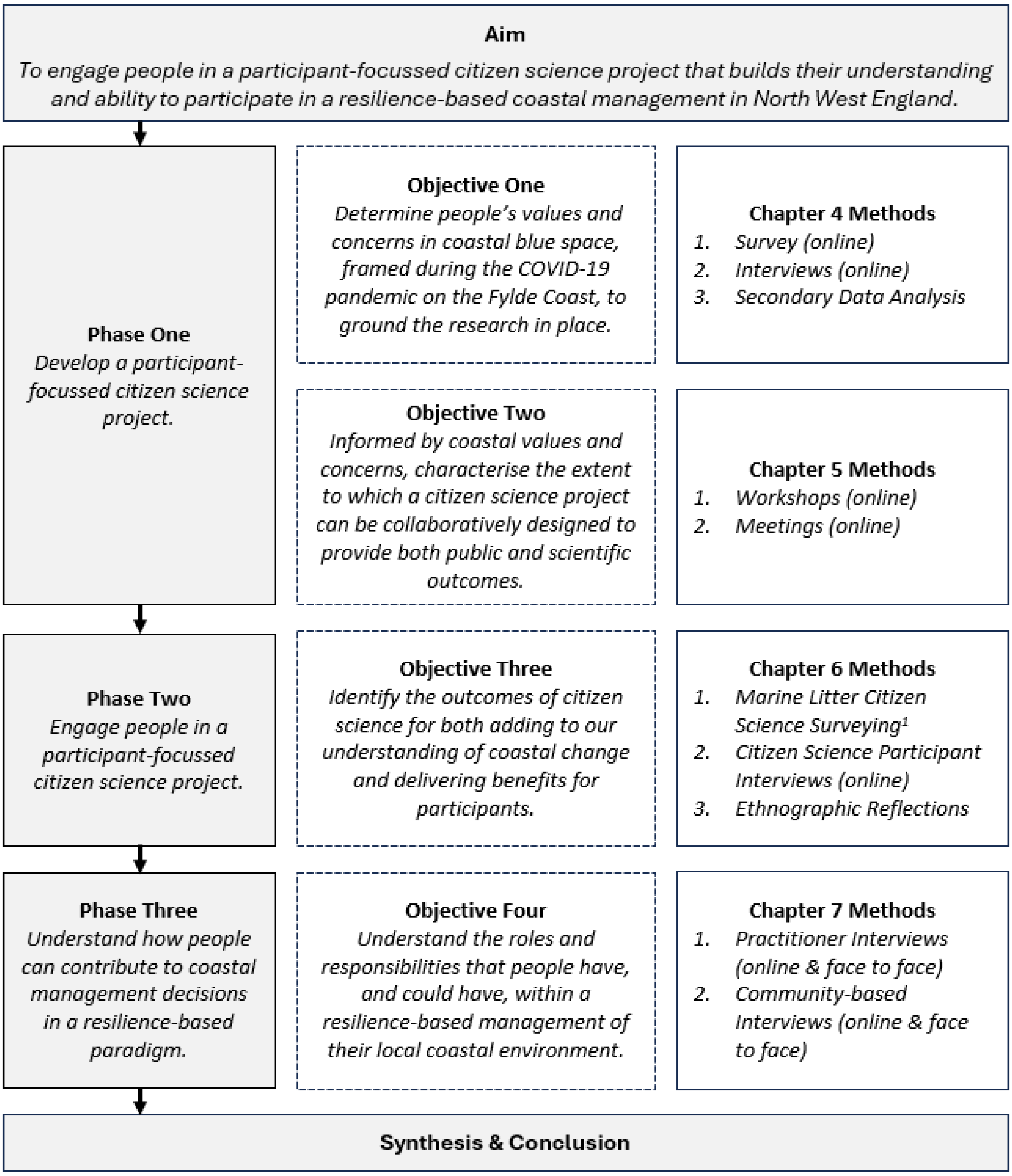

Figure 3.1. *Alignment between the research phases, research objectives and thesis chapters. Research methods per chapter are listed. [1]Marine litter citizen science surveying is the only quantitative method employed and is explained in Chapter 6.*

3.4.1. Overview of Key Qualitative Methods

Whilst each chapter details the specific application of the methods, a brief introduction to the key qualitative methods employed here, and their strengths and weaknesses, is provided.

Surveys

An online survey is employed in Chapter 4 to collect quick, large-scale insights into the target Fylde Coast population remotely, essential during a period of pandemic restrictions. The survey was used to supplement and enrich follow-on interviews (Dowling *et al.,* 2016), informing interview question design, and providing biographical context for each participant. A survey 'is a study which seeks to generate and analyse data on a specific subject from a particular sample population' (Kitchin & Tate, 2013, p.48), seeking to 'draw inferences about causation or patterns of influence from systematic covariation in the resulting data' (Sapsford, 2007, p.11). Within human geography, the survey is predominately administered in the form of a questionnaire, a fundamental method of qualitative primary data collection. A questionnaire involves the distribution of a set of questions that aim to gather information about and give insights into a human population, including indications of people's 'behaviour, attitudes and opinions and their awareness of specific issues' (Parfitt, 2008, p.78). Questionnaires are often distributed to a sample of the target population being investigated, whereby each member of the sample population receives the same questions, enabling trends, patterns, similarity and dissimilarity to be explored.

Strengths

- A questionnaire can draw upon a range of question styles, including a mixture of descriptive questions, analytical questions, short answer questions, lists, categories, rankings and scales (Kitchin & Tate, 2013). Some question styles (e.g. Likert) can provide insight into perceptions, strength of opinion and attitude levels – which could be difficult to gauge from other methods.
- Easy to complete for participants, enabling large amounts of data to be collected quickly.

Weaknesses

- Potential for response biases, which could introduce inaccuracies. They include acquiesce bias, the tendency for people respond to questions with agreement (e.g.

yes), rather than disagree (e.g. no; Barnette, 2000), regardless of the question content (Mayerl & Giehl, 2018). Social desirability bias may also be encountered, involving the respondent choosing an option that is most socially acceptable rather than a representation of their 'true' opinion or activity (Fisher, 1993). For example, a respondent pretending that they have not 'broken' lockdown rules during the pandemic for fear of judgement.

- Limited control over the sampling frame or geographic distribution of participants in an online survey (Wright, 2005). To mitigate this, the survey was distributed in Fylde Coast-specific resident and tourism groups on social media, whilst postcodes were collected to allow respondents locations to be screened and filtered.

Interviews

Semi-structured interviews are used in Chapters Four, Six and Seven to provide an in-depth understanding of people's experiences during the pandemic at the coast, outcomes from the Coast Watchers citizen science project and participation in coastal management processes respectively. Interviews, involving a researcher asking a series of open-ended questions to participants through conversation, are the dominant research method in qualitative human geography (Dowling *et al.,* 2016). They are useful for investigating 'complex behaviours, opinions, emotions and affects, and for collecting a diversity of experiences' (Longhurst, 2016, p.152). In which case, they can offer a deeper insight into participants opinions and experiences than is possible from a survey. Crucially, the aim of the interview method is *not* to be representative (Longhurst, 2016), but to account for a group of participants on account of their experiences related to the research topic (e.g. participants in the Coast Watchers project).

Strengths

- The semi-structured approach allows questions to be tailored and adapted to each participant, offering a deep insight into specific topics and themes.
- Provides a rich data set, useful for such case-study based research.

Weaknesses

- Time consuming for participants.
- Bias may be introduced because of the participative nature of the work, whereby participants may be known to the researcher from prior involvement (e.g. Coast

Watchers participant) or external settings (e.g. coastal management practitioners). In which case, participants may demonstrate 'demand characteristics', whereby they 'anticipate the goals of the researcher and attempt to satisfy those goals' (Kendall, 2010, p.134). To manage this, significant time was spent designing non-leading questions, with feedback sought from the academic supervisory team.

- Online interviews only provide a 'head shot' of the participant, meaning non-verbal gestures, emotions and expressive body movements are lost (Cater, 2011; Iacono *et al.,* 2016). This is a key drawback of the method compared to in-person interviews, which can draw on such cues to add depth to the data (McGuirk & O'Neill, 2016).

Participant Observation

Participant observation is a method to gather information about people, places and practices (Laurier, 2016). The method is used in Chapter 6 to supplement interviews and quantitative citizen science data by collecting information about how participants conduct the citizen science methods and interacted with others, the place and with the researcher. Participant observation was performed as an activity to both improve participants experiences (e.g. revising methods in response to direct feedback or observed body language) and to record information about spontaneous interactions or observations in-situ that would not be possible to collect in post-event interviews.

Strengths

- Uncovers aspects of participation that may otherwise be 'taken-for-granted', missed or ignored without direct acknowledgement and recording (Laurier, 2016), including participant interactions.
- Contributes to the refinement and enhancement of citizen science methods.

Weaknesses

- Limited generalisability of observations beyond the Coast Watchers group setting.
- Can be difficult to obtain informed consent, particularly if the participants are discussing sensitive topics. To mitigate this, no personal information was recorded, and observations remained anonymous.

Workshops

A workshop is 'an arrangement whereby a group of people learn, acquire new knowledge, perform creative problem-solving, or innovate in relation to a domain-specific issue' (Ørngreen & Levinsen, 2017, p.71). In Chapter 5, online workshops[15] are used as a research method with a dual purpose: to develop a sense of community for participants distributed across space (important during the context of the pandemic when restrictions prevented people meeting in-person), and to collaboratively design Coast Watchers.

Strengths

- Encourages collaboration, whereby participants play an active role in the research process.
- An uncommon research method in the literature (Ørngreen & Levinsen, 2017) – with its use here providing novelty and value to the thesis.

Weaknesses

- Potential for strong voices to dominate. In this case, the online nature of the workshop mitigated this, as break-out rooms were used to provide spaces for smaller group discussions.
- Difficultly documenting data from a workshop (Ørngreen & Levinsen, 2017), particularly if the role of the research is ill-defined (e.g. the researcher could be a note-taker/observer, or an active facilitator). A key advantage of the online format was that the workshop was recorded, and participants collaborated on an interactive virtual whiteboard. This made it easier for the researcher to act as a facilitator, and to summarise the discussions and outcomes after the workshop.

3.5. Conclusion

This thesis takes an applied approach that seeks to be meaningful and valuable for academia, for coastal management practice, and crucially, for the citizen science participants themselves. Although grounded in this applied approach, the work is informed by the theoretical concept of *place*, which offers a lens to explore people's *sense of place* at the coast and a *place-based* case study of participation in a local NW context. The case

[15] With the UK still in a phase of COVID-19 restrictions prohibiting indoor or outdoor gatherings and events, engagement methods needed to adapt, with online delivery a viable alternative (McKinley *et al.*, 2021).

study is separated into three research phases, each with corresponding research objectives, questions and chapters. Each chapter employs a range of methods, together providing a mixed-methods study to address the overarching aim. The researcher's positionality was also reported, with a reflection on the strategies (including method triangulation, ethical practice and supervisory discussion) used to mitigate any arising biases and ensure findings are credible and ethically sound. Overall, this chapter has established the overarching methodological approach that underpins the research chapters henceforth.

Chapter Four

Chapter Four: Grounding the Research in the Locality: An exploration of changing experiences in and the value of coastal blue space during the COVID-19 pandemic

Chapter 4 reflects upon the impact of the COVID-19 pandemic on people's experiences in coastal blue space and the health and wellbeing benefits derived from exposure to the coast. Undertaken after the UK's first 'lockdown' during summer 2020, the work employed a qualitative mixed methods approach through a survey and interviews to provide an in-depth case study of people's experiences in and value of coastal blue space before and during the pandemic on the Fylde Coast in Lancashire.

Findings show that participants valued the physical and mental health benefits derived from routine visits to coastal space, stimulated by emotional connections, a sense of escape and sensorial immersion. However, a busier coast in the lockdown's aftermath provoked a changed experience in coastal space for many participants due to a detachment from coastal space and the provoking of negative emotional experiences driven by heightened fears, reduced safety, and increased litter. Mitigatory responses, through a changed coastal routine, and reflective responses, through a changed value of the coast, were found, the latter due to an increased appreciation of the health benefits from coastal exposure for some participants.

The work provides an exploration of people's coastal values, uses, experiences and concerns within the context of the pandemic, helping to tease out themes and topics that could be explored within a citizen science project. Consequently, the chapter provides the first step in a participant-focussed, collaboratively designed citizen science approach employed in this research, by contextualising and grounding the project in place to better understand the local audience and inform the design of Coast Watchers.

Chapter 4 contributes to ***Objective One:*** *Determine people's values and concerns in coastal blue space, framed during the COVID-19 pandemic on the Fylde Coast, to ground the research in place.*

Three research questions are posed to explore this:

4. *What value do residents and tourists of the Fylde Coast attach to local coastal blue space, in terms of wellbeing, mental health, physical health and importance?*
5. *To what extent did the COVID-19 pandemic, and resulting lockdowns, impact upon this value and change the nature of place interactions?*
6. *Reflecting on the experiences in and value of blue space during the pandemic, has the pandemic influenced people's motivations for involvement or disinvolvement in the protection of the coastal environment?*

Chapter 4 is based upon: Earl, J., Gormally-Sutton, A., Ilic, S. & James, M.R. (2022) 'Best day since the bad germs came': exploring changing experiences in and the value of coastal blue space during the COVID-19 pandemic, a Fylde Coast case study. *Coastal Studies & Society*, 1(1), pp.97-119 (Appendix D).

4.1. Introduction

Blue spaces, compared to terrestrial and vegetated green spaces (Olive & Wheaton, 2021), are characterised by 'the presence of water and include inland and coastal aquatic environments' (Bell *et al.,* 2015, p.56). Blue spaces have long been associated with beneficially impacting human health and wellbeing (Foley & Kistemann, 2015), associations which were historically rooted in the apparent restorative and healing effect of water (Bell *et al.,* 2015). Recently, the literature field has evolved to focus on the health-enabling properties of 'healthy blue spaces' (Foley & Kistemann, 2015), due to the physical and mental health benefits which are described from blue space interactions (Hart, 2019). For example, living near to coastal space contributes to improved general health (Hooyberg *et al.,* 2020), including a higher likelihood of achieving physical activity (Shellock, 2019), activities which include swimming, water sports and walking (Olive & Wheaton, 2021).

Spending time in coastal blue space also contributes towards mental health and wellbeing benefits across the life course for residents and visitors alike (White *et al.,* 2013a; Kelly, 2018; Kelly, 2020). Coastal visits have been associated with stress relief (Tunstall & Penning-Rowsell, 1998; Wheeler *et al.,* 2012), reduced depression (Dempsey *et al.,* 2018), enhanced wellbeing (Wyles *et al.,* 2014) and increased calmness (Bell *et al.,* 2015), particularly due to the coast's restorative and therapeutic qualities (White *et al.,* 2013b; Shellock, 2019). As such, increased interactions with blue spaces have been suggested as a simple medical prescription to improve patient health (Hart, 2019). However, this notion of healthy blue space must not ignore the socio-economic challenges that many coastal communities face (Whitty, 2021), nor the broader social dynamics, contestations, and power relations in blue spaces that influence who can use the spaces and how they can be used (Olive & Wheaton, 2021). Moreover, different world views may not subscribe to this Eurocentric association between blue space, health, and wellbeing, and that different cultures may have alternative blue space relationships (Wheaton *et al.,* 2020).

This chapter explores how the COVID-19 pandemic impacted upon the association between coastal blue space, health, and wellbeing, and hence people's experiences in and value of coastal blue space in a UK context. COVID-19, first identified in China in 2019, has claimed over seven million lives globally, including over 230 thousand in the UK (WHO, 2024), and sparked global government responses to tackle the health emergency, including lockdowns, business shutdowns and social-distancing measures. Economically, UK coastal resort towns were amongst the most vulnerable places to the response measures because their economies and workforces are geared towards tourism, an economic sector which was strongly hit by business and travel shutdowns (Warren *et al.,* 2020). Combined with a high health vulnerability in coastal areas due to elderly populations, the pandemic was likely to exacerbate deprivation in coastal communities compared to non-coastal locations (Davenport *et al.,* 2021). However, there is also the need to document the social impact of the pandemic on people's experiences, emotions, sense of place and value of coastal space during this unique period. This chapter explores this through an in-depth qualitative case study of the Fylde Coast in Lancashire, UK.

Accounting for people's coastal values and sense of place during the COVID-19 pandemic, when increased pressure was placed on UK coastal space due to an escalating demand for coastal recreation (Morris *et al.,* 2020), can highlight factors that detrimentally impact people's coastal experiences. For example, factors including coastal developments (Kearns & Collins, 2012) and litter (Wyles *et al.,* 2016) are known to undermine the psychological and emotional benefits of coastal exposure. Accounting for these factors within coastal management may help to safeguard the health and wellbeing benefits for the 271 million recreational visits to English coastlines annually (Elliot *et al.,* 2018), from blue space investments like coastal defences and citizen science schemes (Britton *et al.,* 2020) or help to overcome health inequalities by identifying demographic groups who have varying coastal exposure (Elliot *et al.,* 2018). This study specifically investigates the impact of increased busyness, litter, and perceptions of reduced safety during the pandemic context.

Interestingly, coastal spaces have provided refuge or an escape from infectious diseases in the past. During the cholera epidemic in 18th century England, the Devonshire coastal town of Teignmouth was described by a newspaper as 'an arc of peace in the midst of a deluge of pestilence' (Wilson, 2002, cited in Andrews & Kearns, 2005, p.2703). This could possibly be interpreted both in the sense of a physical escape from the epidemic, and as a mental health escape from the anxieties of the time. Revisiting this theme during the contemporary COVID-19 pandemic provides an important window to explore how the pandemic and associated response measures impacted people's coastal experiences and sense of place. To achieve this, the chapter firstly outlines the research case study, before investigating how people valued the Fylde's coastal blue space before the pandemic, and then whether the pandemic has changed people's use of, experiences in, and sense of place in the Fylde's coastal blue space.

4.2. Methods

To explore people's experiences in and value of the coast along the Fylde during the COVID-19 pandemic, a qualitative mixed methods approach was employed through an online survey and interviews, which were undertaken during summer 2020 in the aftermath of the UK's first lockdown. The study received ethical approval (FST19136), with informed consent obtained from all participants before their involvement, whilst all data were anonymised, including the use of pseudonyms throughout the discussion.

The survey involved a sample of 137 people, 88 residents and 49 visitors of the Fylde coast, who self-selected themselves to answer an online survey of 26 questions (Appendix A) that was distributed to Fylde social media groups and email lists with the assistance of a local stakeholder. The questions were split across three sections, which explored participant's demographic, their use of the coast and its value to them under normal, pre-pandemic conditions, and lastly, the extent to which their experiences at the coast and value of it changed during the pandemic and resulting lockdown. It is recognised that relying on memory of pre-pandemic times and the non-probability sample are limitations of the methodology, particularly since the sample is not representative of the wider population (Bethlehem, 2010). However, the context of conducting research remotely during a pandemic and the a-geographic nature of online communities made achieving a random sample difficult (Wright, 2005; Van Selm & Jankowski, 2006). Moreover, the sample is useful in this exploratory, qualitative research, whereby the results reflect a sub-group of the population to provide an indication and validation of themes and theory for a specific, localised case study (Sue & Ritter, 2015; Etikan *et al.,* 2016). The sample comprised a majority female (68% female) and aging demographic, with 61 to 80 the dominant age category (59%) and 'retired' being the most numerous employment status (53%).

Follow-on synchronous interviews were conducted online using Microsoft Teams, involving a small sample of nine retired participants (six males, three females) who expressed interest after the survey. Seven interviewees live in the Fylde and two are frequent visitors, with all participants interviewed remotely from their homes. The interviews were semi-structured, with questions built around the salient themes identified in the survey and the participant's own experiences, emotions and interests expressed in the interview (Appendix A). Analysis involved data screening and calculation of summary statistics for the survey, and manual transcription and annotation of the interviews. Qualitative data were thematically coded using NVivo 12, building a mesh of codes and an overlapping synthesis of themes (Cope, 2010). Time was spent returning to the blue space literature to explore the themes identified, particularly place, emotional geographies, and health. Therefore, the data were approached both deductively and inductively; what is known about people's encounters with blue space, how this compares to the Fylde's unique coastal setting, and the extent to which the COVID-19 context has resulted in a coastal experience which contrasts the current way of knowing.

4.3. Results & Discussion

The results suggest that a difference exists between the experiences in and value of coastal blue space along the Fylde before and during the COVID-19 pandemic. Th first part of the discussion frames the perceived everyday coastal experiences and value of the coast for locals and visitors pre-pandemic. The second part examines how the pandemic has shaped local people's place interactions with and value of the coast, exploring the main concerns of increased busyness, increased litter, and reduced perceptions of safety.

4.3.1. The Everyday Value of the Fylde Coast Pre-Pandemic

Value was found in the physical and mental health benefits from routine immersion within coastal blue space. Local respondents reported that they visited the coast four to six times per week on average and 94% of respondents visited the coast at least once per week, whilst non-Fylde based respondents visited the coast monthly on average. Visits were predominately for recreation and leisure, including (dog) walking, cycling, and running. Unsurprisingly, 85% of participants agreed or strongly agreed that the coast was important for their physical health.

The flatness of the Fylde was integral to the production of this physical health benefit. In particular, the flat and accessible promenade (Figure 4.1) permitted a wide array of users and wellbeing activities, a function which was valued by some participants including Fleetwood resident Steven,

"*we've got such a smooth prom here, a lot of people cycle, a lot of people out with the dogs, a lot of runners like me, a lot of people just walking*".

The promenade is a safe space away from road traffic and coastal processes, whilst the flatness is particularly accessible for the aging demographic as found in other studies (e.g.

Tunstall & Penning-Rowsell, 1998). Mick outlined his thought process for choosing the Fylde for retirement:

"*I decided that the hills that I could walk up [now], five or ten years later might become a little bit more difficult, so I would become a little bit restricted by the geography of the place, so that's why I didn't go to Cornwall… as you get older you don't want to be running up hills anymore, you want some level ground*".

Moreover, the Fylde's distinctive macrotidal beach environment and extensive promenade provided an openness for leisure space and an escape from other beach users. As a result, the accessible promenade carries multiple social benefits beyond its defence function against flooding and erosion (Green & Shore, 2019), acting as a central component of the coastal experience by promoting routine physical wellness, wellbeing, and recreational activities at the coast (Walton, 2000).

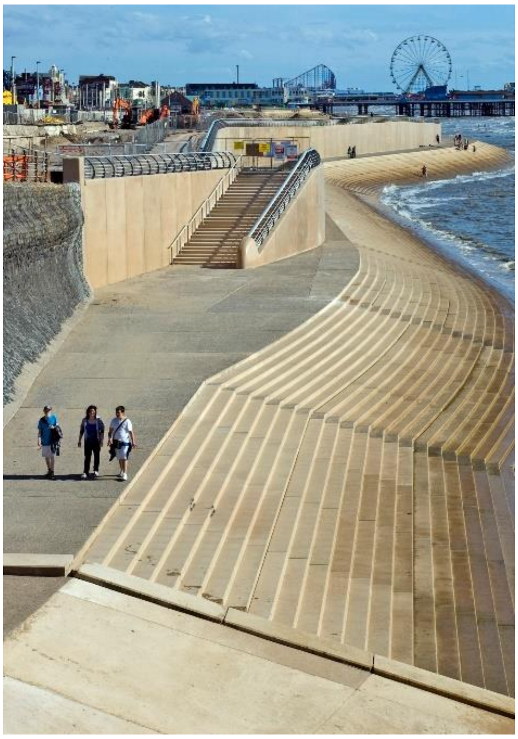

Figure 4.1. *Example of the concrete promenade which extends the length of the Fylde Coast, photographed here at Blackpool (Photo: Simon Chew).*

Routine access to this space facilitated this physical health value and contributed towards many of the older participants 'maintenance of habits and quality of life in retirement'

(Finlay *et al.,* 2015, p.100). Gammon & Jarratt (2019, p.46) also note 'that individuals are more open and more sensitive to the health-giving properties of blue spaces when there is time to focus and savour the moment', suggesting a duality between physical coastal exposure and mental health. This may be important for the Fylde's aging demographic, who may visit coastal space more often than younger people (Brown, 2020) and have more time in retirement for coastal immersion as part of their daily routines. Accordingly, 87% of respondents agreed that the coast was important for their mental health and 90% of respondents felt relaxed when in coastal space. Respondents also described feeling 'happy', 'peaceful', 'calm' and 'freedom' when in coastal space (Figure 4.2), terms that carry positive and hedonic mental health connotations (Kelly, 2020).

Figure 4.2. *Word cloud of people's responses to the survey question: 'What words would you use to describe how you feel at the coast and what the coast means to you?', whereby font sizes indicate more frequent use.*

Being at the coast also invoked an emotional value for many participants, expressed through a sense of place and belonging at the Fylde Coast. For some, the Fylde coast was not just a landscape to be observed or appreciated, it was a lived experience and integral to their lives and livelihoods, expressing that it is "*part of my life*", or that it "*means everything*". One interviewee described the sea as a "*magnet*", drawing them in until they cannot live without it – "*once it gets in your blood it stays with you*". Coastal visits provided an opportunity to reconnect with this emotional value, particularly through the recall of childhood memories or nostalgic reflections from retracing routines, activities, and visual stimuli in the coastal environment. For example, 77% of survey respondents reported that being in coastal blue space invoked positive memories, a finding which was to be expected, since memory is spatially and intimately connected to place and attachment to it, whereby childhood memories influence spatial memories in the present (Jones, 2005).

Consequently, for the sample's aging demographic, some of whom expressed childhood connections to the area through holidays, family, or have aged in place, past experiences and memories play an important role in their present-day attachment to the area and sense of place it generates. Moreover, such memory recall, specifically nostalgia, can benefit mood when in coastal space (Steele & Jarratt, 2019), whilst reminiscence may be a form of therapeutic activity to repair the losses of later life in older adults (Hockey *et al.,* 2005). For example, the coast offered opportunities for improved clarity of thought and enhanced connection to emotions and memory, particularly for those who are experiencing loss or trauma, with the seaside described as a backdrop to saying goodbye in the aftermath of loss by providing a sense of closeness to lost loved ones (Dickson, 2020). Brian, who experienced the loss of a loved one when he moved to Fleetwood, declared,

"*I just love going up and looking at the sea. It's very calming. When Molly died, it was down there I went to get close to my emotions... I'm not into religion at all, but if there was a god that's where you'd be close to him... I couldn't be without the coast now".*

Therefore, it highlights that coastal immersion can stimulate a reconnection to multiple timelines, whereby past experiences and memories can influence and add value to the present experience.

Emotional benefits were also found in the sense of mental escape afforded by blue space immersion for many participants. An escape was apparent through a separation from everyday concerns, a finding also identified at nearby seaside town Morecambe (Jarratt, 2015) and for aging adults in both blue and green spaces (Finlay *et al.,* 2015). Here, participants reported that when in coastal space "*the complexities of the world are literally behind me'*, or that they are '*disconnected from stresses of everyday life*". Wendy, a Cleveleys resident who had a demanding career in IT, built on this, stating,

"*You don't think of anything, you don't think of any problems or anything... it just takes away all your worries. You're in the now*".

Particularly for an aging demographic, coastal space may provide a relief from life's anxieties and stresses, offering an immersive, emotional, and therapeutic landscape to lose themselves in (Shellock, 2019).

Consequently, coastal space carries multiple layers of meaning that directly impact how people think and feel when present in it, providing a deep sense of emotional and refreshing escape that may not be apparent in other spaces. As such, being in coastal blue space is a 'restorative emotional journey' (Ryan, 2012), characterised by a dynamic body of evolving sights, sounds (White *et al.,* 2010), smells, movements, and routines, which provoke reactions and emotions in people and contribute to the coastal experience (Ryan, 2012; Lengen, 2015). In this sense, coastal space is not inanimate, with parallels between the refreshing mental benefit and the refreshing sensory nature of the physical coastal environment (Bell *et al.,* 2015), including the evolving vistas, the sea's rhythmic properties and the breeze, a characteristic that Annie, a Cleveleys resident, valued – "*it feels like it's just blowing away all my cares and woes, I'm just happy*". Therefore, the coast may be described as 'a rich, multisensory environment that allows us to reconnect with the natural world, relax and recover' (Steele & Jarratt, 2019, p.132).

Visually sensing the expansive views of the horizon and the varied colours, textures, and shapes in the coastal environment was perhaps the dominant physical sense in this case study. Many participants associated observing the ever-changing coastal scene with a mental health benefit, evoking feelings of reverence, memory recall and nostalgia. The accessible promenade was again important in facilitating this, offering a raised platform for viewing the coast in its dynamic state. Smell, sound, and touch were also important senses experienced by the participants, who correlated feeling the elements against their bodies with refreshment. Annie proclaimed,

"*I just feel free and everything feels clean… it's just a really good feeling that I get when I go to the sea front. I love to feel the sea breeze on my face, the sun on my face, the wind in my hair*".

Value was also found in the haptic nature of the beach (Obrador-Pons, 2007), particularly through physical immersion with the sediment and water which provided a closeness to nature, or through exposure to stormy sea conditions, which fuelled an almost sublime, high-energy experience for some participants.

Overall, the value of the Fylde Coast for participants aligns with current research in other coastal blue spaces, in that exposure offers physical and mental health benefits, particularly through a sense of a sense of place attachment and mental escape (Jarratt, 2015; Brown, 2020). The multisensory nature of the coast was also an important driver of the health benefits derived from coastal immersion along the Fylde, although it is a largely underexplored aspect of the coastal blue space literature and warrants further research. At this juncture, it is important to explore how local people's experiences in and value of coastal space were shaped by the COVID-19 pandemic.

4.3.2. COVID-19 at the Coast

In spring 2020, under the first phase of UK lockdown restrictions, people were required to stay at home and only exercise outdoors once daily, therefore footfall on the Fylde coast was reported by survey participants to reduce compared to pre-pandemic levels. There was a reduction in the number of reported coastal visits across the sample, including a fall in the average number of visits from four-to-six to two-to-three times a week for the Fylde based residents. As the number of coastal users decreased, some participants also reported increased coastal cleanliness, a positive environmental impact of lockdown measures seen on beaches globally (Zambrano-Monserrate *et al.,* 2020; Soto *et al.,* 2021).

However, as lockdown restrictions eased through May and June 2020 as the UK virus death and infection rates slowed (Aspinall, 2021), people were permitted to travel further from their homes. Easing coincided with a period of good weather, resulting in escalating visitor numbers to the Fylde Coast (BBC, 2020b; Byatt & Sansome, 2020), with survey respondents reporting an increased number of people walking, running, visiting in cars, and cycling. Interviewees expressed surprise at the number of people, with Wendy stating, "*I was actually quite shocked*", and Mick,

"*In the 8 years that we've lived here or going back the 30 years I've know the coastline of Cleveleys, I've never seen it so active*".

The trend was not exclusive to the Fylde, as thousands of people capitalised upon the good weather to travel to the coast across the UK, particularly to the south coast (Morris *et al.,* 2020). Across the Fylde and Blackpool in particular, which, in early June was still reporting one of the highest infection rates in England (BBC, 2020a), this increased busyness presented profound implications for the local participants' experiences in and value of coastal space, driven by heightened fears, reduced perceptions of safety, and increased litter.

Perceptions of Safety

Increased busyness presented new perceived dangers to people's health and wellbeing due to over-crowding and congestion in coastal space. This resulted in an inability to social distance, the practice of maintaining a physical distance between people to limit COVID-19 transmission. In particular, the promenade space, which was so highly valued by the participants pre-pandemic, became a space in which people feared contracting COVID-19. Many local respondents highlighted this changing experience, reflected in comments such as, "[it was] *too busy and unsafe*". For some, this experience in coastal space translated to a decreased enjoyment and increased anxiety, with one respondent reporting "*fear while walking… not a pleasant experience anymore, can't just enjoy the space".* Another stated that they "*will be glad when lockdown is over then I won't feel as at risk when walking on the beach in my local area*".

In some cases, this sense of fear when in coastal space was associated with a lack of knowing. There was a feeling that people do not want to contract the virus, yet there was a sense of unknown regarding who was safe and who was contagious, meaning there was an underlying anxiety when in coastal space for some people. David, a long-term resident of the Fylde, built on this fear, stating:

"*It's not a safe environment really. And we have found that not everyone is signed up to social distancing, whilst you know there are people out there with COVID-19, you don't exactly know where they are*".

Under normal conditions, fear and anxiety in place is often associated with being away from home, in a place in which you feel that you do not belong (Holloway & Hubbard, 2001). Yet, normality and comfort can often be found amongst this unknown based on perceptions of safety and similarity to you, including gender, ethnicity and the way people dress and act (Holloway & Hubbard, 2001). However, in the scenario of a pandemic in busy coastal space, traits that help to distinguish between threat and safety become blurred or no longer apply, because anybody could be contagious, and hence dangerous, without visual signs.

Visitor safety on the busier beaches was also a concern for some respondents. Pre-COVID-19, survey respondents reported several aspects of the Fylde's coastal space that challenged the 'healthy' coastal experience, including anti-social behaviour, litter, and the restrictive nature of the loose and uneven beach sediment for older and disabled people. However, during the pandemic, respondents reported increased coastguard call-outs due to people getting trapped by the incoming tide or being swept out to sea on inflatables. For visitors who are potentially unfamiliar with local hydrodynamic conditions and the dangerous complex multiple intertidal bar landscape (Miles *et al.,* 2019), this can have disastrous consequences, including the drowning of two non-local boys after they were trapped by the incoming tide at St Annes in August 2020 (Calderbank, 2020).

Overall, these examples reinforce the notion of a perceived unsafe post-lockdown coastal space, both in the physical environment, with the seascape being more than a benign visual pleasure, and in the social environment, due to the heightened threat of contracting a life-threatening virus. Such a changing experience directly impacted individuals' sense of place at the coast, disrupting and dislocating (Massey, 1991) people from their everyday normalities, provoking negative emotional reactions and experiences. Individuals negotiated this change in multiple ways, carrying implications for people's daily coastal routines and sense of value attached to coastal space.

Increased Litter

As busyness increased on the Fylde coast, so did litter (BBC, 2020a; BBC, 2020b; Jobling, 2020), a pattern also experienced on beaches globally post-lockdown (e.g. Mghili *et al.,* 2022; Nigam *et al.,* 2022). Most Fylde based interviewees reported a litter increase in coastal space post-lockdown, notably 'fresh' litter dropped onto the beach from the day's activities. Mick, who collects litter daily, reported an increase in COVID-19 related personal protective equipment (PPE) litter, stating "*it's mostly these face masks that are showing up all over the bloody place*". A survey participant correlated the increased litter with increasing beach users:

"*There's been a substantial increase in the number of people using the beach since the easing of lockdown and with it a huge increase in litter too. People [have] careless attitudes and total disrespect for the environment... their litter has an impact, the beach is still useable but it's not the same when you can't move more than a few feet without seeing litter left by some careless muppet*".

Consequently, litter is an undesirable characteristic of the COVID-19 coastal experience and source of anger for some participants (Shellock, 2019). Increased litter provoked negative emotional reactions, impacting the restorative quality of the blue space environment and hence the mental health benefits gained from exposure to it (Wyles *et al.,* 2016). Alongside the societal impact of litter, which is both a disliked and depreciative behaviour at the coast (MacLeod *et al.,* 2002; Wyles *et al.,* 2014), a recognition of the broader detrimental impact of litter on the marine environment (Wyles *et al.,* 2017) also fuelled this anger, which left Mick fuming: "*we all know about marine life and other creatures; we're poisoning the bloody planet".* COVID-19 related PPE litter is a particular stress on the marine environment, since it can contribute to the entanglement of marine life (Zielinski & Botero, 2020; Mghili *et al.,* 2022).

Implications for Routine and Value

For some respondents, the changing coastal experience caused them to avoid coastal space completely. A retired Fylde based survey participant reported –

"*I have actively avoided the coast since the lockdown was eased due to... the volume of people from out of town*".

Another respondent proclaimed – "*I haven't been near as it is too busy, people aren't social distancing, people are leaving their rubbish and I don't want to catch the virus*".

Paradoxically, busyness can normally provide feelings of increased safety due to reduced vulnerability to crime for aging adults in green and blue spaces (Finlay *et al.,* 2015). Yet here, under pandemic conditions, perceived overcrowding in coastal space translated to feelings of reduced safety and reduced access. There is a conflict between the desired coastal activities of locals and visitors (Bell *et al.,* 2015), causing some respondents to seek alternative safer and less stressful spaces for exercise and leisure to mitigate the mental and physical health implications of busier coastal space.

More commonly, local people adapted their routines to accommodate the changing coastal experience during the pandemic and evade potentially dangerous human contact. Respondents reported visiting the coast earlier or later in the day to avoid peak periods of congested beach and promenade space, a trend replicated across beaches globally (Botero *et al.,* 2020, cited in Zielinski & Botero, 2020). A female Fylde based survey respondent asserted –

"*I have visited late at night. If I visited in the day I have avoided narrow walkways as people aren't social distancing... it makes me angry and anxious so have only been a handful of times over 11 weeks*".

Steven reported "*we tend to go out very early morning. Whereas normally, I'd be on the coast midday, or anytime really... if it wasn't COVID-19, I would be up there more I think*". Yet, despite the changing experience, the flexibility of local respondents to visit coastal space during quieter periods highlights a benefit of their coastal proximity compared to visitors, as they can visit the coast in a safer, more spacious, and personal environment.

However, such adaptive strategies are not new, as residents of Cornish coastal blue space have been observed to change their routines to visit quieter blue or green spaces during peak tourist periods (Bell *et al.,* 2015). Yet, a perceived reduction in safety was associated with the exceptional busyness during the pandemic along the Fylde, which in non-pandemic conditions may not have provoked such significant mitigating measures. As such, the pandemic has changed the nature of everyday spatial interactions for many participants. In some cases, this has been a minor routine change, yet for some, the former mental and physical health value and experience in coastal space shifted to one which was inaccessible and unsafe. In response, over 10,000 people signed a petition calling for a localised lockdown in Blackpool in June (BBC, 2020a), whilst Visit Fylde Coast, the local tourism website, changed its name to 'Don't Visit Fylde Coast' to discourage visitors (Figure 4.3; VFC, 2020). Whilst these measures may not have had the desired effect of limiting busyness, it does highlight the deep-rooted sense of danger that the increased busyness posed to the local population, their sense of place and their 'own' coastal experience.

Figure 4.3. *Poster encouraging people to stay away from the Fylde coast during the pandemic (VFC, 2020).*

To some extent, the implications of a busier coast perpetuated feelings of resentment towards visitors during the pandemic. For example, increased litter was often attributed to visitors –

"*They are the people that annoy us, annoy the local people for defacing this beautiful spot you know with all their rubbish*".

There was a sense of othering of 'tourists', whereby they are not perceived to respect the coastal environment to the same extent as locals. These behaviours disrupted the status quo of what was deemed acceptable in coastal space, behaviours which are shaped by the dominant local voice. Consequently, a 'transgression' may have been committed, whereby visitors are 'out of place', since their actions and practices fell out of line with the normal way of doing things (Cresswell, 2004, p.27). Transgressions can result in moral panic from the dominant social community (Holloway & Hubbard, 2001), in this instance disrupting place attachment and provoking negative emotional reactions (Devine-Wright, 2009; Kearns & Collins, 2012) such as anger, distress or policy change to protect normality (Holloway & Hubbard, 2001). Therefore, the Blackpool petition exemplifies local people seeking to protect their normality: their routines, their environment, and their 'healthy' coastal space.

However, many of the interviewees expressed sympathy with the visitors during this period, particularly for those without access to a green or blue space. Glen affirmed,

"*You can't resent it. Especially if you've got small children and you live in a small flat or a terrace that doesn't have anywhere for the children to play outside, you can fully understand why you'd come to the beach*".

Other interviewees echoed this feeling when asked if a pandemic experience without access to the coast would have been different. Responses drew upon an urban experience, with Brian saying,

"*In the cities I think it would have been dreadful because you couldn't go anywhere, you're trapped*"; sentiment supported by Wendy, who stated -

"*It would have been horrific without that coast to be honest. If I would have been stuck in here, I would have been claustrophobic*".

Consequently, despite people's changing coastal experiences and routines, the coast maintained a unique mental health benefit for many participants throughout the pandemic period, predominately because of the sense of escape that immersion within coastal space provides. The sense of escape, a key driver of the health benefit of the coast pre-COVID-19, was rekindled by participants placing their bodies within coastal space to remove themselves from the everyday stresses of the pandemic and maintain a sense of normality and mental clarity. A female Fylde-based survey participant recalled that during the pandemic "*it's* [the coast] *a place you can forget what's going on for a bit*", whilst Annie remarked,

"it's been quite important for me to get up there, and it just lifts my spirits. And I think for mental health and mental wellbeing that's quite important".

The sense of mental and physical escape from COVID-19 on the Fylde was once again driven by the locality's physical characteristics. Described by a retired Fylde based survey participant, the "*openness of the beach and the never-ending horizon*" provides space in which you "*don't feel enclosed"* or "*trapped*" during the pandemic, the perfect antithesis to the 'lockdown'. This notion of escapism at the coast during the pandemic implies that the coast itself is fundamentally different to other spaces, in that it can provide a source of refuge from crisis that other spaces cannot. For example, a Fylde-based survey participant reported that:

"*we've really felt a difference in not visiting, and our one visit yesterday made such a positive impact. My 4-year-old said it was his 'best day ever since the bad germs came'*".

There is a "*difference*" here, one that permits escapism and mental clarity, consistent with the finding that coastal space offered a disconnect from everyday life and trauma in normal, non-pandemic conditions.

Furthermore, the changing coastal experience and increased sense of escape at the coast during the pandemic caused many Fylde respondents to reflect on the extent to which they took the mental and physical value of the coast for granted. For example, a survey participant reported,

"*I really thank God we live so near to the beach and feel it has kept me sane during this worrying time."*

Annie resonated with this- "*when they said you can only go for one walk a day, that made me appreciate that one walk more, and made me realise how lucky I am that I can walk to the coast any time of day that I wanted".*

Steven also reported an increased value of the coast– "*for people living locally at the coast, it's suddenly become a more valuable asset… whereas people living inland… they don't have the same open freedom as we have on the coast, do they? They don't have the same expansive views and things, so I think we could take that for granted yeah… and I do appreciate it more*".

In restricting people's access to and freedom at the coast, the pandemic has re-framed how some participants perceive their relationship to the coast. This has resulted in an increased awareness and appreciation of the benefits that the coast offers to their daily lives, and in doing so, has contributed to 65% of the Fylde survey participants expressing an enhanced desire to protect the coastal environment more long-term.

4.3.3. A Changing Sense of Place

The concept of place is an underlying theme throughout this case study, particularly people's 'sense of place', encapsulating emotional attachments, encounters, and experiences in coastal space. The first section of the discussion reflected upon how people value and experience the Fylde coast, with a sense of place emerging from the desire to be immersed within a mental and physical health benefiting environment for locals and visitors alike. Immersion rekindled emotional experiences and memories, particularly for many of the older adults, whilst a deep place attachment was also felt by some of the residents through routine access to the coast.

Yet, as the second section of the discussion explored, the foundations that supported this sense of place along the Fylde coast were undermined and disrupted during the COVID-19 pandemic. The period witnessed increasing busyness, litter and a perceived reduction in safety, factors that contributed towards a changed coastal experience of reduced mobility and separation from coastal space and daily routines. People's sense of place changed too, as this detachment from coastal space provoked negative emotional experiences and place contestations, as some locals sought to protect their coastal place from transgressing 'others'. However, this defence of the local sense of place translated to a legacy of increased environmental appreciation, and a reframing of the local sense of place. Consequently, through a physical and emotional dislocation from coastal space during the pandemic, local people found an increased value of their sense of place on the Fylde Coast.

Such findings underline the importance of incorporating the social value of coastal blue space within coastal management. There is a requirement for management to account for the factors that detrimentally impact people's coastal experience, their sense of place, emotional value, and coastal attachment in specific coastal settings. For instance, forward planning and management of the overcrowding and increased litter on the Fylde Coast during the pandemic may have helped to protect local people's diverse experiences in and value of coastal space, minimising the risk of such factors disrupting people's everyday coastal encounters, and their health and wellbeing opportunities derived from this (Bell *et al.,* 2015). However, there is also the need to ensure that these health benefits are preserved for everyone to obtain value from, particularly for demographic groups who have uneven or limited access to the coast (Brown, 2020). The question of balancing people's sense of place alongside increasing public access to the coast is well beyond the remit of this study but presents a critical direction for future management and blue space research.

Overall, the study findings represent the start of long fallout from the impacts of the pandemic at the coast. Questions remain around the long-term impact on place attachment and the coastal experience, and how these findings are comparable in other coastal settings or for other age groups.

4.4. Conclusion

Concurring with the current understanding of the physical and mental health promoting properties of immersion within coastal blue space, it was found that the value of the Fylde's coast to local people and visitors was rooted in the health benefits of routine exposure to it. Participants encountered emotional, mental, and physical benefits, facilitating, in some cases, connections to memories, nostalgia and a sense of coastal place. The Fylde's coastal setting drove these benefits, from the promenade's accessibility, to the escape within physical openness of the macrotidal beach and vistas, and immersion within the sensory environment.

However, this health value was distorted for local respondents by the COVID-19 pandemic post-lockdown in summer 2020, contributing to a changed coastal experience of reduced safety, fear, increased litter, and disrupted routines, instigated by a busier, less safe coastal environment. Yet, there were positives to be found. Coastal space still provided a sense of escape from the pandemic, permitting a sense of normality and mental clarity amongst an unprecedented and stressful situation. Many participants also expressed an increased appreciation of coastal space as a result, translating to an enhanced willingness to protect the Fylde's coastal environment. Consequently, the findings demonstrate a unique opportunity to foster a sense of environmental stewardship in the wake of a changing value of the coast because of the implications of the pandemic; with public engagement and citizen science schemes well positioned to capitalise upon this.

Moreover, the findings also highlight the importance of coastal management to account for not only physical spatial change, but also the multifaceted human needs, values, and experiences associated with coastal 'places' (Newell & Canessa, 2017). This is crucial to safeguard the value of coastal blue space for residents and visitors long-term, and to also demonstrate the broader social benefits of coastal investments. Whilst the findings are specific for the local sample and geography, the conclusions may hold true in similar coastal settings, for example those with an aging population, promenade space or a macrotidal environment. It is also evident that the pandemic may widen social, economic and health inequalities faced by UK coastal communities. As a result, it is paramount that future research explores the pandemic's broader long-term implications, and recovery from such impacts, for coastal residents and communities.

Chapter Five

Chapter Five: Collaboratively Designing Coast Watchers

This short chapter introduces the collaborative approach undertaken to design Coast Watchers, a participant-focussed citizen science project at Rossall on the Fylde Coast. Building on Chapter 4, which elicited coastal values and concerns and situated the research in place, this chapter brings together various stakeholders to seek alignment between local coastal interests, concerns and needs that could be addressed through the Coast Watchers project. Convergence of interests, concerns and needs was found for the issue of beach litter.

Chapter 5 contributes towards ***Objective Two****: Informed by coastal values and concerns, characterise the extent to which a citizen science project can be collaboratively designed to provide both participant- and scientific-focussed outcomes.*

Two research questions are presented to understand this:

3. *To what extent can a collaborative design process account for different stakeholder's interests, concerns and outcomes in the design of a citizen science project to understand coastal change on Rossall Beach?*
4. *Is a collaborative process able to address the overarching 'science-centric' critique of citizen science by fostering a participant-focussed citizen science?*

5.1. Introduction

Citizen science describes the active involvement of people working in partnership with scientists to undertake research and generate new knowledge (Bergerot, 2022). Projects in citizen science can take various forms depending on the context and purpose (Section 2.3.2). Most often, projects are 'contributory', where citizens contribute or 'crowdsource' data to a project designed by scientists (Shirk *et al.*, 2012; Tweddle *et al.*, 2012; Hyder *et al.*, 2015; Robinson *et al.*, 2018). Whilst contributory projects have allowed for the proliferation of science to mass audiences and presented opportunities for data collection on spatial and temporal scales previously unachievable for lone researchers, including at the coast, such projects have invited several critiques. Notably, contributory citizen science is often seen as a one-way, passive, or even top-down form of public engagement, potentially perpetuating, rather than bridging, the perceived gap between science and society (Section 2.3.7). In this work, a top-down approach fails to support the two-way exchange and appreciation of diverse knowledge forms necessary to build community resilience (Adekola *et al.*, 2020; Potter & Fitton, 2023).

As a result, there is a need for a paradigm shift towards a more participatory and participant-focussed citizen science model (Section 2.3.9). This shift should offer participants the opportunity to engage in roles beyond data collection and provide a deeper understanding of their experiences and outcomes from involvement. To achieve this, the Coast Watchers project is developed using a collaborative approach that shifts the emphasis of project design from an exclusively top-down, scientist-led practice to one that values and balances input from a plurality of voices. As such, a collaborative model gives citizens a greater role in most, if not all, stages of the research process with scientists, from project development and question identification to knowledge creation, implementation, and dissemination (Shirk *et al.,* 2012; Tweddle *et al.,* 2012). By collaborating, stakeholders come together to share ideas, coastal concerns, interests, needs and outcomes, shaping the questions explored and data collected through Coast Watchers. Ultimately, the chapter seeks to characterise the extent to which a plurality of perspectives can be accounted for within a citizen science scheme, such that it provides valuable outcomes for science, coastal management, and crucially, participants.

Findings from Chapter 4 present a clear rationale for developing a citizen science project on the Fylde Coast. In particular, the deep held values and connections to coastal space, including place attachments (e.g. a sense of place, childhood experiences, nostalgia) and wellbeing benefits (e.g. sensorial immersion, sense of escape, mental and physical health benefits), could represent important intrinsic motivations for people to participate in citizen science at the coast. Moreover, the changed experiences in and appreciation of the coastal environment during the COVID-19 pandemic, driven in part by the perceived increase in busyness and litter, was seen to increase a sense of coastal stewardship. Notably, 60% of survey respondents reported an increased desire to protect the coastal environment. Such desire could translate into a heightened willingness to volunteer, participate and learn, with some participants expressing an increased motivation to learn about the coast, including coastal processes (33%) and wildlife (30%).

A citizen science project, with its focus on engaging people in monitoring, data collection and knowledge sharing, could capitalise upon this opportunity to foster an increased sense of environmental stewardship and desire to learn about the coastal environment. Consequently, a collaborative process that gives potential participants a voice in shaping the focus of Coast Watchers may help to align motivations, attract participants, sustain engagement, and ensure the project provides local relevance, value and impact.

5.2. Methods

To facilitate a collaborative process that permits a two-way sharing of information between stakeholders and the researcher within the context of pandemic restrictions, online meetings and workshops were undertaken. Meetings were used to engage with organisational stakeholders who were likely to have interests in the phenomena studied in Coast Watchers, and any data or outcomes arising from it. Three separate online meetings were held early 2021 with organisational stakeholders including a LA coastal engineer (1 participant), a LA Countryside Service representative (1 participant) and a local coastal community group chairperson (1 participant). All participants were recruited and contacted directly. The meetings identified possible outcomes that Coast Watchers could contribute to, including local coastal management needs, community engagement objectives and data or knowledge contributions.

For potential Coast Watchers participants, two online workshops were held in March and April 2021 using Microsoft Teams. The workshops were promoted through social media, the Visit Fylde Coast website, and email, with some individuals identified based on their prior interests and contacted directly by the researcher or local stakeholder. Consent was obtained from registered individuals prior to joining. Attendance was lower than anticipated, with just seven people out of 26 registered attending the first workshop, and five in the second workshop. Although demographic information was not collected, most participants were older and retired. Both workshops featured a short presentation, facilitated break-out rooms and a final group discussion.

The first workshop introduced the Coast Watchers project (what it is, who is involved, its aim; Figure 5.1), with emphasis placed on building a Coast Watchers community and giving people the opportunity to meet virtually during the pandemic. Break-out room discussions were prompted by questions including:

- *What is your attachment to and interest with the Fylde coast?*
- *What brings you to the group?*
- *What changes do you notice at the coast on a daily, monthly or even yearly basis?*

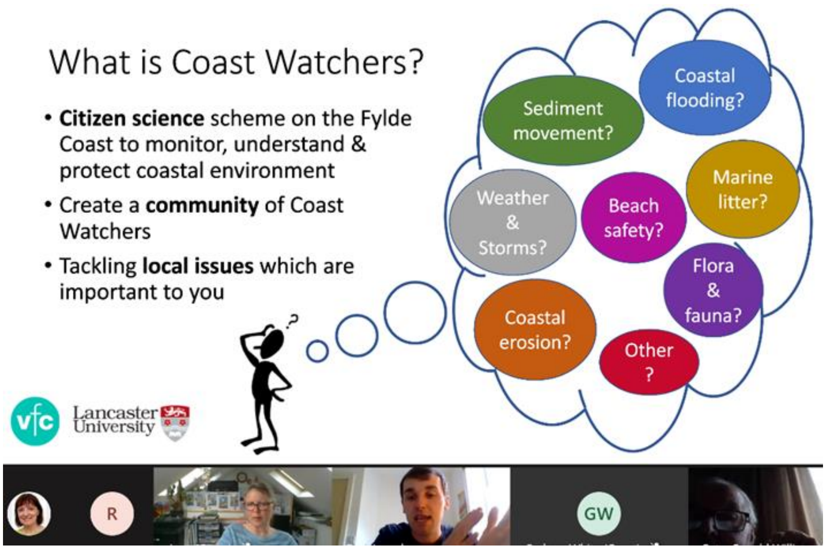

***Figure 5.1**. Screenshot from workshop one.*

Workshop two built upon the first by introducing the concept of citizen science and the collaborative approach. The focus of the workshop was to gather people's coastal interests and concerns that they would like to learn more about and possibly explore through Coast Watchers. Again, attendance was low, with just five attendees. Discussion was stimulated by the following questions:

- *What are your main interests and concerns in the coastal environment?*

- *If you were managing your local coastline, what would you change, or want to understand more about?*

A virtual whiteboard was used to interactively capture group discussions, thoughts and ideas. Discussions from all meetings and workshops were collated and synthesised afterwards, helping to elicit and identify overlap between different stakeholder's coastal interests, concerns and needs that could be explored through the Coast Watchers project.

5.3. Results

Workshop participants presented an array of interests and concerns relating to the Fylde Coast environment. Contributions were summarised into four main themes (Figure 5.2). Beach safety, which became a heightened concern during the pandemic, was once again raised as a significant concern, with discussion about how it could be improved through warning systems and information boards. An interest in understanding beach flora and fauna was also expressed, particularly regarding the temporal and spatial variation of different species deposited on local beaches. Beach morphology, particularly gaining a better understanding of sediment movement, was also highlighted as a topic of interest, with a concern again raised about potential implications of changing beach morphology on beach safety. Lastly, the issue of beach litter was raised. An issue which came to the fore during the pandemic, participants expressed an interest and curiosity in better understanding where the litter is coming from and its ultimate impact on the local environment.

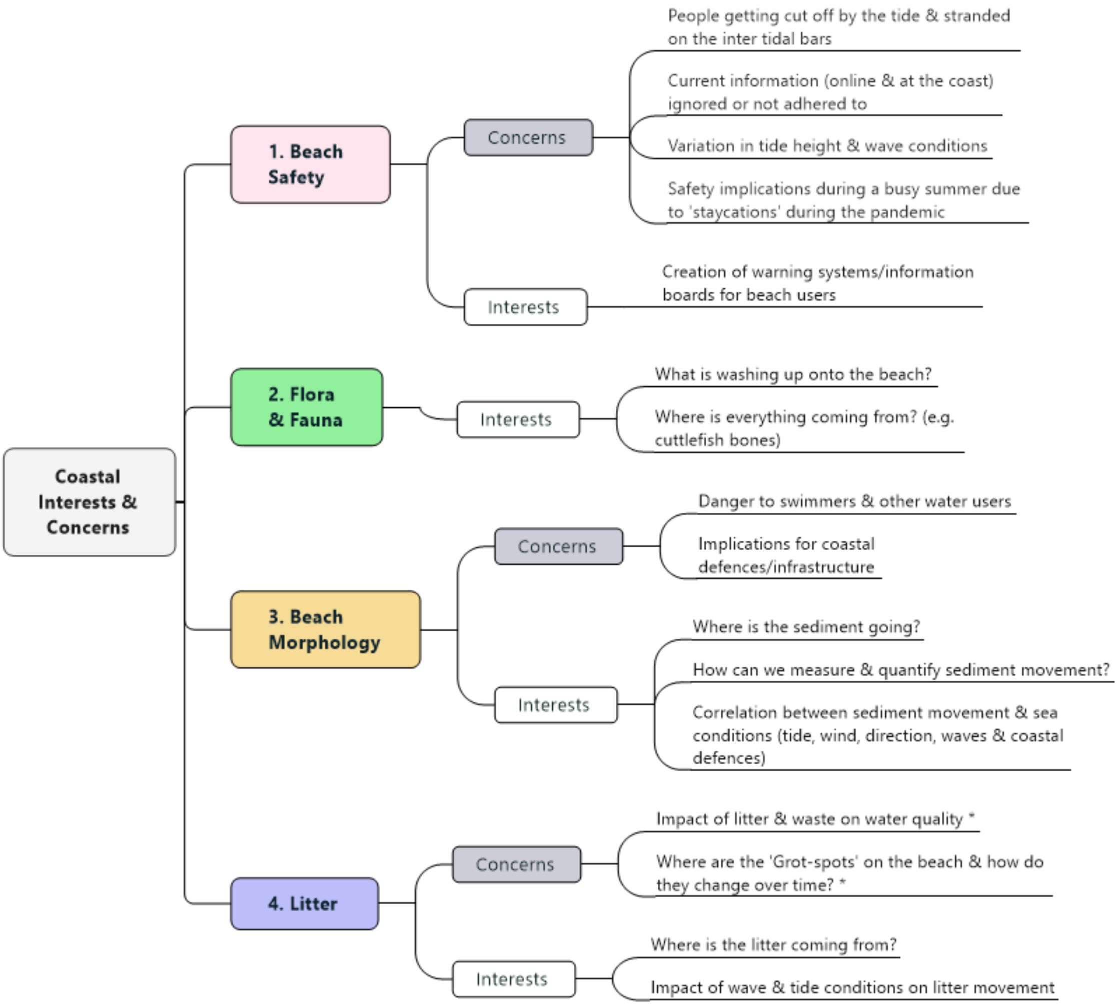

Figure 5.2. *Interests and concerns about the local coastal environment expressed by workshop participants. *Concern expressed by an organisational stakeholder.*

Organisational stakeholders, who will not necessarily participate in Coast Watchers, but could benefit from it, expressed four main outcomes that could be derived from a local citizen science project (Figure 5.3). Firstly, it is possible that any data collection could provide a meaningful contribution to the overall coastal monitoring efforts on the Fylde Coast, particularly if the current understanding of the phenomenon under investigation is low. This could include collecting beach morphology data in radar 'shadow zones', areas where radar monitoring efforts are blocked by physical structures in the environment (e.g. groynes); or better understanding the movement and impact of litter on the beach. Secondly, engagement outcomes were noted, namely the importance of sharing, not just collecting data, alongside the need to engage people in better understanding coastal processes. For the coastal community group chairperson, the importance of a project to positively promote the area was mentioned. LA stakeholders also discussed broader coastal management outcomes, including gaining an understanding of why people value the coast and enhancing two-way communications and resilience-building discussions with residents.

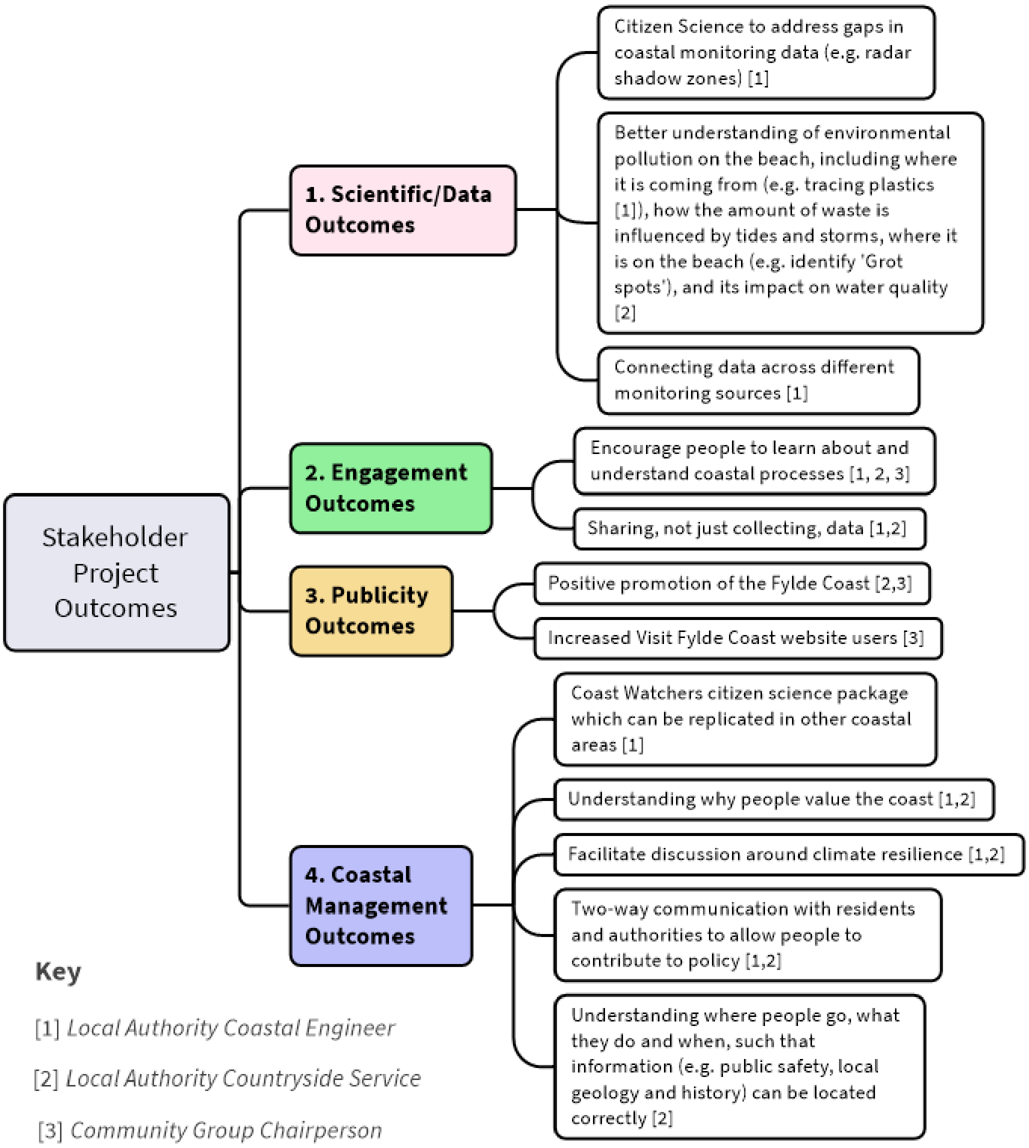

***Figure 5.3**. Organisational stakeholder's desired outcomes from Coast Watchers.*

5.4. Synthesis

The stakeholder workshops and meetings identified four phenomena in the coastal environment (beach safety, flora and fauna, beach morphology, and beach litter) that are locally relevant, interesting and valuable to explore through a citizen science monitoring programme. These phenomena could also provide a broader purpose and benefits for local coastal management, data and engagement needs. Whilst it is unfeasible for Coast Watchers to account for all interests, concerns and outcomes within a single project, there are similarities and overlaps between them which can guide the research focus (Figure 5.4).

Of these four phenomena, beach litter presents the most feasible opportunity to align the focus of Coast Watchers with stakeholder interests, concerns and project outcomes. Beach litter, as highlighted in Chapter 4, is a significant problem and concern for people on the Fylde Coast, as litter was seen to detrimentally affect people’s place experiences and negatively impact the marine environment (Section 2.3.5). Consequently, collecting and removing beach litter aligns with people’s local concerns and motivations to protect the coast, whilst the opportunity to engage in a blue space may afford personal health and wellbeing benefits for participants. As a result, the project may prove more appealing and relevant to prospective local participants, potentially increasing and sustaining participation.

There are also several beach cleaning groups in the local area, ready-made audiences who may be willing to add citizen science monitoring to their regular activities. Such monitoring could help to achieve wider engagement and learning outcomes, building people’s understanding of the role of coastal and anthropogenic processes affecting litter quantities, movement, and spatial and temporal distributions. Importantly, encouraging people to interact with, and not just collect, the data may also help build the community’s ability to contribute to future coastal management discussions. Moreover, monitoring beach litter could also help to inform and benefit coastal management, as work could identify the sources, pathways, ‘grot-spots’ and possible environmental implications of litter on the beach.

	Motivation	Interest / Concern	Project Outcome	Citizen Science Feasibility
1. Beach Litter	Increased desire to protect the coastal environment in the wake of the pandemic.	Beach litter a key concern & disruptor of place experience during pandemic. Interest in exploring the sources and pathways of litter, and its impacts on the environment.	Identification of beach 'grot spots' to inform future management. Better understanding of environmental pollution on the Fylde coastal environment. Direct link to a factor shaping people's value of the coast.	**High.** Direct overlap between local concern and monitoring opportunity. Citizen science commonly applied to beach litter monitoring. Community groups already collecting beach litter on the Fylde coast – opportunity to integrate citizen science.
2. Beach Morphology	Appetite to learn about coastal processes in the wake of the pandemic.	Interest in understanding sediment movement and drivers.	Complements gaps in existing coastal monitoring efforts. Engagement benefits, with people learning about coastal processes.	**Medium.** Overlaps and benefits of monitoring beach morphology, but pilot SfM project on Rossall faced numerous challenges (e.g. Lusty, 2019). Common remote sensing citizen science methods do not lend themselves well to non-contributory projects.
3. Flora & Fauna	Appetite to learn about coastal wildlife in the wake of the pandemic.	Interest in understanding the different species washing up onto Rossall Beach over time.	No formal flora or fauna monitoring undertaken by the Local Authority – could address this gap.	**Medium.** Abundant citizen science projects monitoring marine biodiversity globally, but possibly not of significant concern to local people, compared to litter and beach safety, to warrant a new project.
4. Beach Safety	Improve beach safety.	Beach safety a key concern during the pandemic, when a busier coast exposed its dangers. Development of warning systems and information to improve beach safety.	Improved siting of safety information for ranger service.	**Low.** Whilst a key concern, limited opportunity for organised data collection. Creation of warning systems, whilst potentially a novel idea, is reliant upon technical expertise rather than collective citizen science effort.

Figure 5.4. *Identifying the feasibility of conducting a citizen science project to monitor different phenomena on the Fylde Coast, based upon the overlap between stakeholder motivations (from Chapter 4), interests, concerns and project outcomes.*

Given the overlap between different stakeholder's interests, concerns and outcomes for the issue of beach litter, the stakeholders were able to contribute to the project's design to a large extent. This overlap was perhaps fortuitous, as it is recognised that in some instances, issues, concerns or needs may not align between different stakeholders. This was a problem encountered by Hart (2021, p.193) when developing a coastal citizen science project on the South Coast: 'The importance of issues to coastal managers (e.g. coastal erosion) may not be aligned to those of the wider community... a main concern for people at Bournemouth was litter.' In instances where little or no overlap between stakeholders exists and the emphasis is on a participant-focussed citizen science, it may be best to prioritise the issues and interests of participants, with broader stakeholders (e.g. LAs) considered secondary, as an engaged and motivated public is required for successful citizen science.

Yet, such a conclusion may only be relevant for other place-based projects. For instance, it is recognised that Coast Watchers may be described as a 'Place Based Community Action' project (van Noordwijk *et al.,* 2021), since the localness of the issue in question may attract place-connected participants, who are motivated to benefit their local environment and community. For projects that are not location-specific, such as 'Mass Participation Projects' (van Noordwijk *et al.,* 2021), which may aim to engage people across much larger spatial scales (e.g. global), tailoring the project to the motivations, interests and concerns of a specific audience would be inappropriate, if not impossible. One factor is the resource and time demanding nature of involving multiple stakeholders in the design of a project (Bracken *et al.,* 2015). However, for such place-based projects, it is argued that it is time well spent, as the project is more likely to appeal to a targeted audience, match their interests and carry greater impact (Koedel *et al.,* 2024).

It is acknowledged that the low turnout in the workshops is a limitation here, as, whilst overlap could be found between stakeholders, it is uncertain if overlap would have been found to the same extent if the attendees were more numerous and representative of the wider population. It is unclear why turnout was low, particularly compared with the number of registered participants, although it could be a result of insufficient advertising, barriers presented by the method (e.g. online workshops and their timing), or a general lack of interest to participate. Although the scope was restricted by the pandemic context in this research, it would be valuable for future work to collaborate with a greater diversity of potential participants, including children, families, and working individuals. However, it is posited that the pandemic offered a useful framing for people to reflect on challenges, issues and concerns they perceive in the local coastal environment.

It is also recognised that, given the widespread practice of beach cleaning in the local area, some of the workshop participants may already have had a beach cleaning interest. But, engaging with people or groups who may already be actively involved at the coast (e.g. volunteer beach cleaners) can have its benefits. For instance, it can help to overcome the practical constraints associated with forming a new group, including financial costs, advertising, recruitment, insurance and governance structures.

5.5. Conclusion

This short chapter has developed a participant-focussed citizen science project by offering local stakeholders a role in collaboratively designing the Coast Watchers initiative. By aligning the interests, concerns, needs and outcomes of different stakeholders, the chapter has demonstrated how a collaborative model can, by involving multiple voices in two-way discussions and knowledge sharing, address the overarching ‘science-centric’ critique of citizen science. Here, community members expressed coastal concerns and interests that ensures Coast Watchers is locally relevant and has the potential to attract and sustain engagement. Input from wider organisational stakeholders helped to shape the project’s outcomes, ensuring Coast Watchers contributes to broader coastal management, data integration and community engagement needs.

Although participant-focussed, the researcher(s) maintains an important role in balancing and identifying overlap between different stakeholders to design a feasible project that carries scientific credibility beyond the local context. In this case, beach litter emerged as a unifying issue that could be feasibly researched through the Coast Watchers initiative and deliver broader learning, management and scientific outcomes (e.g. contribution to the field of marine litter citizen science; Section 2.3.5). Overall, the collaborative process has further grounded Coast Watchers in place and created a foundation for long-term engagement. Chapter 6 explores the extent to which both science- and participant-focussed outcomes were realised in practice.

Chapter Six

Chapter Six: A Participant-focussed Citizen Science Project to Explore Marine Litter

Thus far, this thesis has sought to design a participant-focussed citizen science project called Coast Watchers on the Fylde Coast. The project has been contextualised in place, including an exploration of people's coastal values, experiences and concerns (Chapter 4). A collaborative approach to citizen science built upon this, bringing together a plurality of voices to identify overlap between motivations, interests, concerns and outcomes, to ensure Coast Watchers caries a local relevance and impact (Chapter 5). Beach litter has arisen throughout these chapters as a key local concern, one which warrants sufficient interest to further understand through citizen science.

Chapter 6 presents the process of and outcomes from conducting Coast Watchers to survey litter on the Fylde Coast, specifically Rossall Beach. The chapter introduces the survey approach and summaries the key scientific findings from a year of monitoring, including the types, amounts, distributions and potential drivers of litter on Rossall. Crucially, the work explores citizen science through a participant-focussed lens, whereby people's motivations, experiences and outcomes are investigated. Results suggest that marine litter citizen science can foster learning, awareness and environmental consciousness for participants.

Altogether, the chapter provides a novel investigation of both science- and participant-focussed outcomes from citizen science. The chapter addresses ***Objective Three:*** *Identify the outcomes of citizen science for both adding to our understanding of coastal change and delivering benefits for participants.*

Two research questions are investigated in this chapter:

3. *What contribution(s) can Coast Watchers make to our understanding of the types, distributions and processes affecting marine litter accumulation?*
4. *To what extent can a marine litter citizen science project also account for, and better understand, participant experiences, outcomes and benefits?*

6.1. Introduction

Coastal and marine ecosystems are threatened by a myriad of anthropogenic pressures (Section 2.2). This includes the growing issue of marine litter, which threatens the natural integrity and health of marine and coastal environments and affects people's coastal experiences (Chapter 4). Managing the problem demands a global effort to eliminate the input and increase the removal of litter from the marine environment. Research and monitoring, which can help to understand litter abundance, sources, transport pathways and distributions across the marine environment, are needed to inform effective management strategies. However, achieving long-term monitoring of marine litter across large spatial scales can be expensive and difficult, particularly for lone researchers (Nelms *et al.,* 2022). Consequently, with its ability to mobilise large numbers of people to collect data across large spatial scales, citizen science is increasingly used to monitor marine litter (Section 2.3.5; Kawabe *et al.,* 2022).

One reason for the growth in marine litter citizen science projects may be the strong public interest and concern about litter. Notably, authors remark: 'the current environmental climate has made plastic litter a major environmental issue with the general public' (Williams & Rangel-Buitrago, 2019, p.649), whereby 'beach litter is perhaps the element of the marine plastics problem that is most directly experienced by the general public who use our coasts' (Turrell, 2018, p.315). There is an everyday 'visibleness' and relevance of litter to coastal communities, particularly beach litter, which perhaps generates greater potential for engagement than for other less 'visible' challenges in the marine and coastal environment (e.g. climate change, species loss, habitat destruction) [16]. Given this interest, community groups have long collected and removed litter from beaches (e.g. through beach cleans), although data from such efforts is often not collected, not digitised, difficult to access or erroneous (Jambeck & Johnsen, 2015).

To ensure people's efforts carry a greater value for managing marine litter, scientists and organisations have sought to involve people in more formal and official marine litter citizen science projects. However, despite the increasing public involvement in these projects, they are typically designed and evaluated with a science-focussed lens. For example,

[16] Although litter is an issue for the public, global studies have shown that local response efforts may not be related to the magnitude of the problem, whereby 'large litter quantities do not guarantee adequate responses from the population or government bodies' (Kiessling *et al.,* 2017, p.92).

reviewing 85 marine litter citizen science publications, Kawabe *et al.* (2022) reported that most projects are contributory in nature, with 80% of projects *only* involving people in data collection and just 2.3% involving people in a co-designed project. Moreover, 90% of projects failed to report on, or assumed, the project's impact on the participants, with just two projects exploring both science- and participant-focussed outcomes. Concurring, of the 38 marine litter citizen science studies reviewed by Severin *et al.* (2023a), only four assessed impacts on participants.

Such a contributory and data-focussed emphasis of marine litter citizen science validates the underlying critiques of citizen science emphasised throughout this thesis – that, in general, citizen science projects relegate participants to passive data collectors and fail to effectively engage with their experiences and outcomes (Section 2.3.7). Where participant experiences have been explored in the literature, the emphasis is typically on school students or educational programmes (e.g. Eastman *et al.,* 2014; Hartley *et al.,* 2015; Yeo *et al.,* 2015; Wyles *et al.,* 2017; Locritani *et al.,* 2019; Wichmann *et al.,* 2022; Severin *et al.,* 2023b) and confined to studies on educational and pro-environmental behaviour benefits from participation (Severin *et al.,* 2023a) – perhaps reflecting the emphasis on young people.

These global studies indicate that marine litter citizen science projects and education interventions can improve children's knowledge of litter sources, transport and deposition (Locritani *et al.,* 2019), and lead to greater levels of concern about, and understanding of the causes and impacts, of marine litter (Hartley *et al.,* 2015). Citizen science can also positively impact traits of Ocean Literacy, including litter-reducing behaviours (Severin *et al.,* 2023a), although other studies have shown no significant effect on children's pro-environmental behaviours (Wichmann *et al.,* 2022). Similarly, whilst one study found an association between beach cleaning and improved wellbeing (mood) for students (Wyles *et al.,* 2017), another found no similar correlation (Severin *et al.,* 2023a). Comparatively, studies on adult participants appear uncommon, with authors acknowledging the 'infancy' of the research area (Wyles & Ghilardi-Lopes, 2023). This presents a significant gap and opportunity to conduct a marine litter citizen science project that better acknowledges, reports on and assesses both science outcomes, and crucially, adult participant outcomes, including impacts, benefits, experiences and health outcomes (Wyles *et al.,* 2017; Kawabe *et al.,* 2022; Severin *et al.,* 2023a; Severin *et al.,* 2023b).

This chapter address this gap. The thesis has already begun to design a participant-focussed citizen science project by involving potential participants in collaboratively designing Coast Watchers based upon local interests, concerns and possible outcomes. This collaborative process highlighted the issue of marine litter as the focus of research on Rossall beach on the Fylde Coast (Figure 6.1). This chapter continues the collaborative citizen science approach through a process of 'co-production' to answer research questions and produce context-specific knowledge about the issue of marine litter (IOC, 2021). Whilst the chapter contributes to an understanding of marine litter distributions and dynamics, emphasis is placed on the participant's experiences and outcomes from engaging in citizen science. The work adds to the limited research understanding of the growing practice of beach cleaning (Power, 2022), offers a novel investigation of both science and participant-focussed outcomes from a collaborative marine litter citizen science project, and consequently contributes to a paradigm shift beyond a science-centric understanding of citizen science (Vann-Sander *et al.,* 2016).

Figure 6.1. *Rossall Beach within the context of the Fylde coast (Inset). Note: the study site is indicated by the dashed red box.*

6.1.1. An Overview of Processes Impacting Marine Litter on Beaches

The abundance of litter on a beach is a product of several factors. Wind is a key driver of litter transport and deposition on beaches, with beaches orientated towards prevailing winds, or exposed to a combination of greater winds and waves, tending to accumulate more litter (Critchell *et al.,* 2015; Hengstmann *et al.,* 2017; Asensio-Montesinos *et al.,* 2021). High winds are also capable of moving litter debris along the sea floor (Renchen *et al.,* 2021), possibly an important transport method for larger, non-buoyant litter items. Buoyant plastics are transported in the sea in the direction of the prevailing wind, migrating away and spreading out from their source (Critchell & Lambrechts, 2016; Chen *et al.,* 2020). Other physical properties of plastic also influence litter loads, including its sinking rate and degradation rate into microplastics (Critchell & Lambrechts, 2016). Anthropogenic factors also affect litter abundance, including the amount of litter entering the system (Critchell &

Lambrechts, 2016), influenced by proximity to urban areas, population density and the amount of littering by coastal users (Prevenios *et al.,* 2018).

Once transported onto the beach, marine litter can accumulate and remain ashore as standing stock, with backshore vegetation (Brennan *et al.,* 2018) and strand lines[17] common accumulation sites (Costa *et al.,* 2010). Although strand lines may be present on UK beaches for months, they are not permanent litter sinks, as litter may be eventually moved by the interplay between tidal, wave and wind processes (Turrell, 2018). Again, wind is important for redistributing litter on the beach, transporting it into the backshore area above the strand line or offshore, depending on its size, density and type (Heo *et al.,* 2013). Depositional patterns may also be affected by structures on the beach. Groynes can impact local hydromorphological processes, including trapping longshore sediment transport and exacerbating localised rip currents (Komar, 1998). Consequently, structures may shape litter transport and accumulation, potentially inhibiting alongshore litter transport (Asensio-Montesinos *et al.,* 2021) or trapping litter in cavities in rock structures (Aguilera *et al.,* 2016; Pinheiro *et al.,* 2019). At some point, litter may depart the beach, being resuspended seawards when winds are blowing offshore and the water level reaches the strandline (Turrell, 2020), or lost landwards of the beach (Brennan *et al.,* 2018).

6.2. Methods

To understand both science- and participant-focussed outcomes from the Coast Watchers project, a mixed methods study was conducted. The study followed the four broad stages of a citizen science project summarised from Shirk *et al*. (2012) and Tweddle *et al*. (2012):

(1) *Question identification* – Question and hypothesis development, informed by Chapter 5.
(2) *Infrastructure, protocol and method development* – Designing the marine litter monitoring approach.
(3) *A 'live' phase of delivery* – One year of marine litter citizen science monitoring.
(4) *Wider dissemination and impact evaluation* – An in-depth exploration of participant outcomes.

[17] Strand lines indicate the location of the maximum tidal extent on a beach, often characterised by a shore parallel accumulation of organic material.

6.2.1. Question Identification

To ensure the monitoring and resulting data carried a practical relevance for the local community, managing authorities, and provides genuine scientific outcomes (Robinson *et al.,* 2018), Coast Watchers aimed to contribute towards an improved understanding of the types, distributions and processes affecting marine litter accumulation on Rossall Beach. A series of sub-questions (SQ) and associated hypothesis were used to achieve this. SQs were informed by stakeholder's interests and outcomes expressed in Chapter 5, including the need to better understand the types, distribution (e.g. grot spots) and impact of marine litter, and from local anecdotal knowledge. Knowledge was sought from informal conversations with members of the Rossall Beach Residents & Community Group (RBRCG), who have organised monthly beach cleans on Rossall beach since 2008 and have therefore built a bank of anecdotal knowledge and hypothesise. However, aside from the number of bags filled, no data are collected from their cleans, offering no quantitative evidence to support or reject their claims. Consequently, providing data through Coast Watchers to quantitively answer local hypothesise, inform management strategies and provide the basis for comparisons between different marine environments, provides a research opportunity. Three main SQs and accompanying hypothesise are posed:

SQa. What are the types and temporal distributions of litter on Rossall Beach?

Hypothesis: Most litter is observed during the summer months because of direct littering by an increase in beach users.

Local knowledge suggests litter increases when the coastal area is busier, as suggested during the pandemic in Chapter 4. Thus, it is assumed that most litter, and hence the associated 'grot spots' will be found during the summer months.

SQb. What is the distribution of litter across the beach and is this impacted by the groyne coastal defence structures?

Hypothesis: Litter accumulates around groynes asymmetrically, suggesting that litter is affected by the same longshore processes as sediment.

Rossall beach hosts various coastal defence structures to protect the coast from flooding and erosion, including shore-normal groynes. It is proposed that the alongshore spatial distribution of litter across the beach will be uneven, whereby more litter will be deposited to the south of the groynes due to a prevailing northward longshore transport.

SQc. To what extent do waves and Combined Sewer Overflow (CSO) events affect litter accumulation?

Hypothesis: Increased wave energy is associated with higher beach litter loads, whilst the presence and abundance of sanitary waste are influenced by the timing of CSO events.

The literature suggests that the wind-wave regime is a key controlling factor for litter quantity (Section 6.1.1). This work specifically focusses on waves. Local anecdotal knowledge also suggests that anthropogenic factors may also affect accumulation of litter, including proximity to tourist hotpots (e.g. Blackpool) and CSO events.

6.2.2. Infrastructure, Protocol & Method Development

Citizen science monitoring was conducted under the Coast Watchers label by adding a formalised citizen science data collection activity to RBRCG's monthly beach cleans. Therefore, Coast Watchers was integrated into an existing and established project infrastructure with the support of a local coastal stakeholder, whereby the project was promoted as an opportunity for existing and new beach cleaners (RBRCG undertake extensive advertising and have an established volunteer network). An online Coast Watchers Facebook group was also created to build the community, recruit additional participants and share data, observations and findings.

To ensure Coast Watchers provided scientifically rigorous and useful data, marine litter monitoring protocols were adhered to. Protocols include implementing a sample width of greater than 10 m to avoid observer bias (e.g. whereby only litter hotspots are observed; van Emmerik *et al.,* 2020). A standardised sample length of 100 m that accounts for all litter on the beach from the water's edge to the maximum tidal extent is preferable to enable comparison between beaches (Nelms *et al.,* 2017; Turrell, 2018). The mass of the litter items collected should also be recorded (Nelms *et al.,* 2017). Learning from other citizen science studies and Lusty's (2019) pilot citizen science work at Rossall, the monitoring method should be easy to conduct, engaging, repeatable and provide longevity. Survey frequency and complexity also needed to be carefully managed to avoid volunteer exhaustion (Falk-Andersson *et al.,* 2019), whilst the project's findings should be easily communicable to ensure participants feel their time was well-spent (de Vries *et al*., 2019).

Whilst adhering to these protocols, answering the research SQs on Rossall Beach demanded a novel approach to beach litter surveying. Whilst collecting and recording litter over a standard 100 m wide sample would suffice for understanding the amount of litter on the beach over time (SQa), exploring spatial distributions requires an insight into the alongshore location of litter (SQb) – something that cannot be done easily in a single sample area. Exploring the influence of the groynes on litter transport and distributions through space and time also demands a non-standard collection protocol, as litter needs to be sampled either side of the groynes separately (SQb). External wave and climate data, alongside an inference of the source of litter, were also needed to understand the effects of waves and CSOs on the types and amounts of waste on the beach over time (SQc).

To answer each of these sub-questions together, a 155-metre-wide survey area, spanning a rock and wood groyne, was designed (Figure 6.2). The survey area was sub-divided into six sample areas, 20 m either side of the two groynes, and two 37.5 m sample areas in between. Litter was collected, recorded and weighed separately in each area, thereby indicating litter distributions across the width of the beach, and to understand whether groynes affect that. It was also anticipated that the cross-shore distribution of litter (i.e. differences in the type or amount of litter from the sea wall to the shoreline) could be surveyed using quadrats along a shore normal transect. However, after piloting the method with Coast Watchers participants, it was deemed too time consuming and arduous to implement over the macro-tidal environment, and may have resulted in participant fatigue, reduced data quality, and poor participant retention (Zettler *et al.,* 2017; Falk-Andersson *et al.,* 2019).

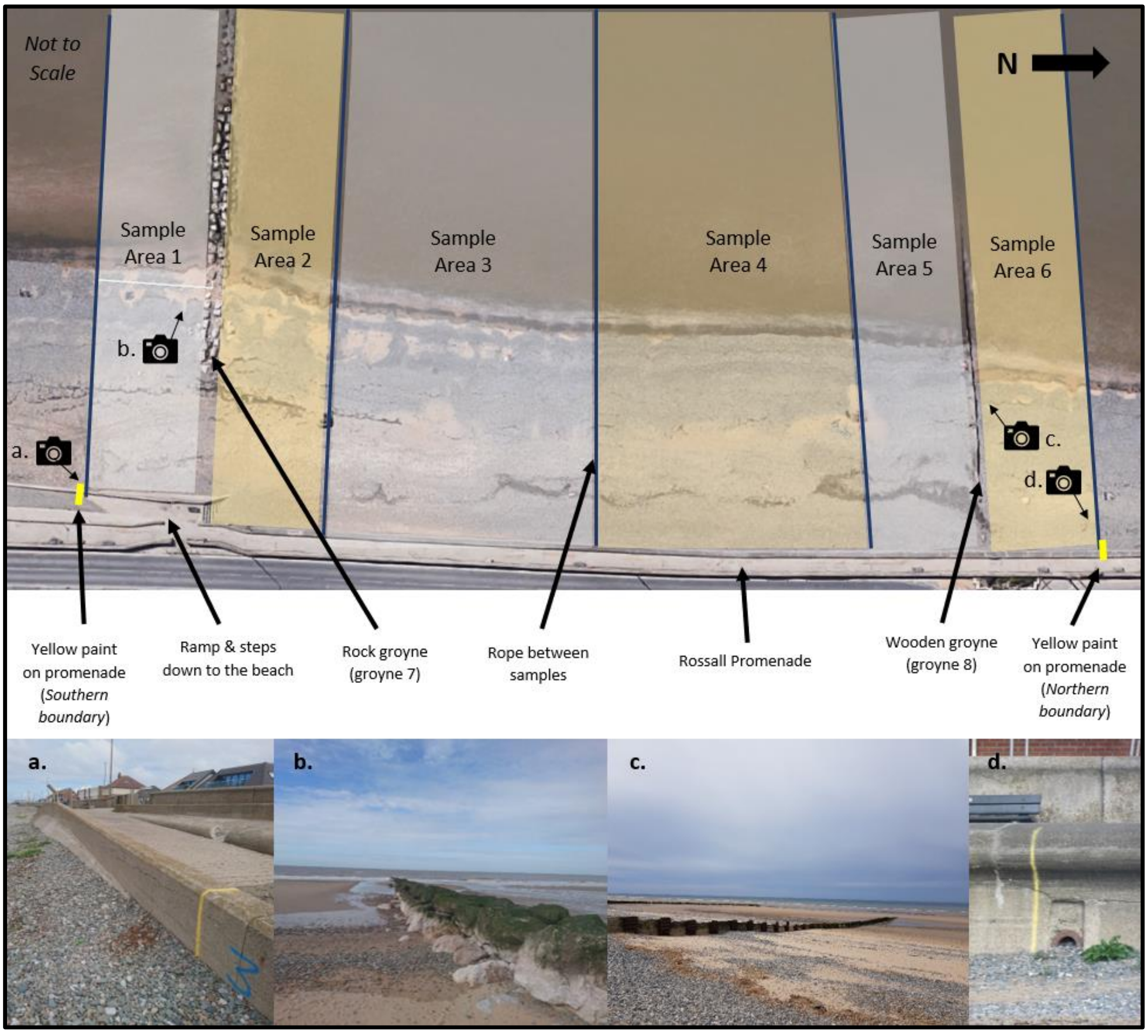

***Figure 6.2**. Monitoring protocol on Rossall Beach. Photographs of the (a) southern boundary, (b) rock groyne seven, (c) wooden groyne eight, and (d) northern boundary.*

Boundaries between sample areas were GPS-located, ensuring they could be easily demarcated at successive survey sessions, whilst the outer boundary of sample areas one and six, the most southernly and northernly boundaries respectively, were marked on the sea wall. Marked boundaries are important for ensuring no litter is removed from the survey area between monitoring events, thereby ensuring only natural factors influence the litter load. Failure to prevent litter removal outside of the sampling window, for instance by LAs, lone volunteers, or collective beach cleans, would limit accumulation of litter on the beach, alter the beach load and provide a biased reflection of litter amounts (Ryan *et al.,* 2009; Nelms *et al.,* 2017). Consequently, the boundary markers provided a reference for other beach cleaners to avoid collecting litter in the survey area, with posters (Figure 6.3) and emails to local beach cleaners also used to convey this information.

Figure 6.3. *Poster encouraging people to participate in Coast Watchers and to not collect litter from the sample area outside of survey events.*

6.2.3. Live Phase

Surveys were repeated monthly for a year from August 2021 to July 2022 (12 in total). Prior to the first survey, the beach was cleaned by volunteers on 19th July 2021, to ensure that litter recorded at the first survey in August reflected litter accumulated over the previous month. Monitoring events were advertised online, with a group of up to 12 participants involved per month. If new to the litter surveying, participants were trained how to conduct the survey. Participants worked in pairs to survey a single sample area, adhering to the following method:

1. *One person finds and collects litter from the sample area, the other person uses the recording form to categorise it (Figure 6.4).*
2. *Starting on the upper beach, the pair walk along the beach parallel to the sea wall, collecting litter that is visible from a standing height, for instance anything larger than a cigarette butt, or approximately 2.5 cm (Cheshire et al., 2009).*
3. *The pair survey their whole sample area, collecting all visible litter.*
4. *Finally, prior to disposal, the weight of litter collected in each sample area is recorded.*

Sample Number: ____________ Date: ____________ Volunteer Initials: ______________________

Category	Tally	Sum
Plastic		
Plastic Bags		
Plastic Bottles		
Plastic Caps		
Plastic Food Packaging Including crisp packets, food wrappers & packaging.		
Plastic Fragments Including unidentifiable pieces of plastic & broken fragments		
Plastic Straws & Cotton Buds		
Polystyrene & Foamed Plastic		
Plastic Other Including toys, cigarette lighters, household items & other plastic items		

Category	Tally	Sum
Glass		
Glass Bottles		
Glass Fragments		
Metal		
Aluminium Cans		
Metal Other		
Other Materials		
Cigarettes		
COVID-19 PPE		
Fishing Net & Rope		
Paper & Cardboard		
Rubber		
Sanitary		
Textile		
Wood & Cork		

Other (*Please Specify*)

Overall Total Items: ____________ Weight of Collected Items (kg): ____________

Figure 6.4. *Litter recording form.*

The recording form consisted of 21 categories across four main material types: plastic, glass, metal and other materials (e.g. any unidentifiable material). Categories were derived from informal conversations with local beach cleaners about common litter items on Rossall, and from the literature, including cigarettes, which have been used as an indicator for increased beach usage in some global studies (e.g. Santos *et al.,* 2005; Chen *et al.,* 2020). Unlike the GBBC recording form, which includes 101 litter categories, a simpler version was preferred. Local feedback suggested that the GBBC survey is overly complex and time-consuming, making a lower resolution of 21 categories more suitable for balancing positive volunteer engagement, ease, speed of surveying and data richness. Informal feedback was sought from participants throughout the project to help improve and update the recording form to best reflect the litter materials surveyed and increase its ease of use.

Aside from the litter collected, photographs and supplementary details were recorded monthly, including weather conditions, wave climate, beach morphology, plant and animal life, volunteer numbers and other beach activity. Post-event, data were digitised and analysed to indicate trends, averages and changes over time. To interpret litter sources and processes driving changes over time, rainfall data from Blackpool (Met Office, 2019) and wave data from Cleveleys wave buoy (NNRCMP, 2024) were obtained. CSO data were also sought from United Utilities (UU) and EA, although, despite freedom of information requests, data were not provided. Instead, CSO event data within the Cleveleys area were sourced from Surfers Against Sewage (SAS), who publish CSO events voluntarily declared by UU.

6.2.4. Wider Dissemination & Impact Evaluation

Given the participant-focussed nature of Coast Watchers, effort was placed on disseminating results with participants and evaluating their outcomes from the work, including through infographic posters and social media. But, to really understand and articulate the benefits of marine litter citizen science beyond the contribution to data collection and scientific knowledge, participant's experiences and outcomes were explored qualitatively. The value of measuring the short-term impact of citizen science projects on volunteers before and after participation is stressed in the literature (Kawabe *et al.,* 2022; Severin *et al.,* 2023a), for instance through pre- and post- event surveys (e.g. Wichmann *et al.,* 2022; Wyles & Ghilardi-Lopes, 2023). However, in this study, where participant longevity over the 12-month survey period is uncertain, a pre- and post-event survey may yield a low response rate. Moreover, conducting a survey before people participate would require making assumptions about potential benefits and outcomes. This approach might result in seeking expected benefits rather than allowing benefits to be self-reported by participants. Consequently, interviews were conducted at the end of the survey period, allowing participants to reflect on the whole process, which has been shown to enable an in-depth, rich insight into the outcomes for people from marine litter citizen science activities (Wyles & Ghilardi-Lopes, 2023).

Interviews were advertised to Coast Watchers participants via email and a private Facebook group. Eleven participants self-selected themselves and were subsequently interviewed online using Microsoft Teams. Informed consent was obtained prior to the interviews (Ethical approval: FST20144). Interviews were semi-structured and based on 27 questions (Appendix B), although conversations regularly deviated from the question structure to account for individual responses and discussion. Question themes included motivations for involvement, learning outcomes, changed behaviours, and thoughts about future citizen science opportunities. Questions also provoked responses about participant's sense of coastal place, and whether their thoughts towards or interactions with the beach environment changed through the practice of surveying.

The interviews also captured the qualitative elements of 'doing' citizen science, including methodological reflections, best practice, and the extent to which the participants identify themselves as citizen scientists. Interview recordings were anonymised, transcribed and thematically coded by hand, with NVivo software used to categorise and group themes for ease of analysis. Finally, similarities and differences between the themes were identified manually. Interviews were supplemented by participant observations documented immediately after each survey session, providing a portfolio of personal experiences, reflections, observations and participant interactions. Overall, these methods provide a participant-centred evaluation of marine litter citizen science, ensuring the participants contribute to, and are not excluded from, the project's findings, outcomes and legacy.

6.3. Results & Discussion

Results and discussions are separated into science-focussed and participant-focussed outcomes.

6.3.1. The types, Distributions & Processes Affecting Marine Litter Accumulation on Rossall

SQs a, b and c are considered in-turn, outlining the contributions of Coast Watchers to our understanding of marine litter types, temporal and spatial distributions, and processes affecting marine litter accumulation.

6.3.1.1. SQa. What are the Types & Temporal Distributions of Litter on Rossall Beach?

Over the year, volunteers collected and removed 22,540 litter items weighing over 200 kg from a 155 m survey area on Rossall beach (Table 6.1). On average, 1,248 litter items were collected per 100 m, 304% more items than the national average of 309 items per 100 m across 214 English beaches in the 2022 Great British Beach Clean (GBBC; MCS, 2022). Plastic items were the most common material collected on the beach, constituting 77.2% of litter collected (17,398 items). The proportion correlates well with other European research, with plastic accounting for 77.1% of beach litter in a Spanish study (Asensio-Montesinos *et al.,* 2021), 82.7% in Germany (Hengstmann *et al.,* 2017) and 67% across England in the GBBC (MCS, 2022).

Table 6.1. *Litter types and totals collected per survey, colour-coded to indicate when more items were collected (red) compared with fewer items (green). *Estimated weight.*

	Category / Survey Date	16/08/2021	19/09/2021	18/10/2021	15/11/2021	13/12/2021	10/01/2022	25/02/2022	14/03/2022	11/04/2022	09/05/2022	13/06/2022	11/07/2022	Total	Average Per Survey	% of Total
Plastic	Plastic Bags	1	6	17	43	43	73	78	12	126	10	9	17	435	36	1.9
	Plastic Bottles	9	3	24	12	13	9	32	11	10	1	7	0	131	11	0.6
	Plastic Caps	222	73	241	117	191	137	167	91	77	46	69	28	1459	122	6.5
	Plastic Food Packaging	161	87	417	367	1090	641	1101	768	1070	632	611	244	7189	599	31.9
	Plastic Fragments	499	220	379	248	1087	407	853	438	218	164	425	157	5095	425	22.6
	Plastic Straws & Cotton Buds	49	24	85	82	109	52	72	61	34	37	33	14	652	54	2.9
	Polystyrene & Foamed Plastic	23	39	36	150	125	97	15	64	44	105	49	46	793	66	3.5
	Plastic Other	184	48	229	201	320	115	253	28	57	123	44	42	1644	137	7.3
	Plastic Total	**1148**	**500**	**1428**	**1220**	**2978**	**1531**	**2571**	**1473**	**1636**	**1118**	**1247**	**548**	**17398**	**1450**	**77.2**
Glass	Glass Bottles	0	4	0	1	2	1	1	0	0	0	0	0	9	1	0.0
	Glass Fragments	10	6	5	56	53	17	35	31	23	29	9	35	309	26	1.4
	Glass Total	**10**	**10**	**5**	**57**	**55**	**18**	**36**	**31**	**23**	**29**	**9**	**35**	**318**	**27**	**1.4**
Metal	Aluminium Cans	0	2	3	5	3	1	0	2	4	1	0	2	23	2	0.1
	Metal Other	12	21	7	14	11	11	8	7	12	4	14	3	124	10	0.6
	Metal Total	**12**	**23**	**10**	**19**	**14**	**12**	**8**	**9**	**16**	**5**	**14**	**5**	**147**	**12**	**0.7**
Other	Cigarettes	9	13	0	0	4	0	0	1	4	11	4	11	57	5	0.3
	COVID-19 PPE	7	1	6	2	17	7	15	2	8	0	3	5	73	6	0.3
	Paper & Cardboard	21	14	49	25	31	6	5	11	18	5	19	4	208	17	0.9
	Rubber	7	7	26	16	19	13	12	38	19	1	11	2	171	14	0.8
	Textile	12	9	8	36	8	39	36	26	15	9	2	2	202	17	0.9
	Wood & Cork	15	15	23	45	49	13	3	13	7	2	8	5	198	17	0.9
	Other	5	7	33	35	22	5	18	15	15	3	42	8	208	17	0.9
	Other Materials Total	**76**	**66**	**145**	**159**	**150**	**83**	**89**	**106**	**86**	**31**	**89**	**37**	**1117**	**93**	**5.0**
	Sanitary	**20**	**16**	**21**	**128**	**217**	**126**	**694**	**280**	**168**	**115**	**56**	**65**	**1906**	**159**	**8.5**
	Fishing Related	**45**	**34**	**178**	**102**	**201**	**109**	**268**	**223**	**151**	**219**	**65**	**59**	**1654**	**138**	**7.3**
	Overall Total Items (count)	**1311**	**649**	**1787**	**1685**	**3615**	**1879**	**3666**	**2122**	**2080**	**1517**	**1480**	**749**	**22540**	**1878**	
	Weight of Items (kg)	**8.9**	**11.4**	**29.4**	**27.3**	**35.6**	**16.6**	**41.3**	**16.5**	**16.3**	**5.66**	**9.05**	**4***	**221.86**	**18.49**	

Plastic food packaging (7,189 items; 31.9% of total litter) and plastic fragments (5,095; 22.6%) were the most numerous sub-categories of plastic (Figure 6.5), although their often degraded and fragmented appearance made distinguishing between the categories difficult. Plastic bottles represented just 0.6% of total litter (131), the fewest plastic sub-category, although plastic bottle caps were more numerous (1,459; 6.5%). Sanitary items, such as wet wipes, nappies and sanitary towels, constituted the second most numerous material category across the year (1,906; 8.5%), considerably higher than the 2.9% reported from the GBBC (MCS, 2022). Fishing related materials, including all wire, netting and rope offcuts, ranked the third most collected category (1,654; 7.3%). Various other materials, including glass, metals and textiles were also found on the beach, although in fewer numbers, constituting just 7.1% of the total litter collected.

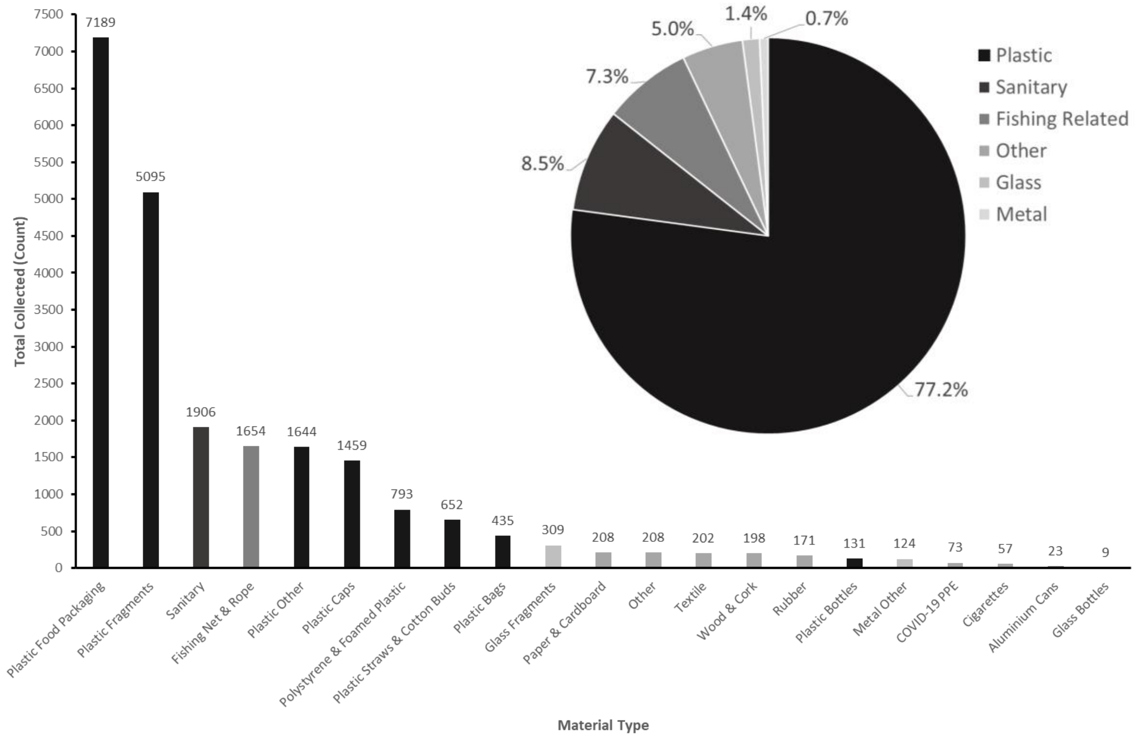

Figure 6.5. *The number of each material category collected on Rossall beach. Inset, the proportion of different materials.*

The amount of litter collected over the year followed a seasonal distribution (Figure 6.6). Litter loads peaked over the winter months and receded gradually through autumn, spring, and summer, when the lowest loads were surveyed. Whilst the greatest litter loads were surveyed over winter, January 2022 was anomalous to this trend, with the amount of collected litter ranking fifth behind March and April 2022. Plastic items were consistently prevalent on the beach over the year, although considerable variation was observed, with just 500 plastic items found in September 2021, compared with 2,978 items in December 2021. Many plastic items were fragmented and discoloured, indicating they were sea-borne and had been resident in the marine system for extended periods (Kawabe *et al.,* 2022). Consequently, most plastic items were 'untraceable', as they were difficult to directly attribute to a source or age. The consistent presence of plastic straws and cotton buds on the beach (averaging 54 per survey) supports the suggestion that most plastic was sea-borne. This is because these items were frequently found despite legislation banning their sale or supply in 2020 and 2021 (DEFRA, 2020c) prior to the surveying. Given the ban, it is unlikely the items originated from direct littering or other terrestrial sources, suggesting they may have come from offshore, entering the marine system before the ban. Plastic bottles and bags also support the sea-borne nature of litter, as they were found in greatest abundance during the winter months when tourism and beach usage would be lowest.

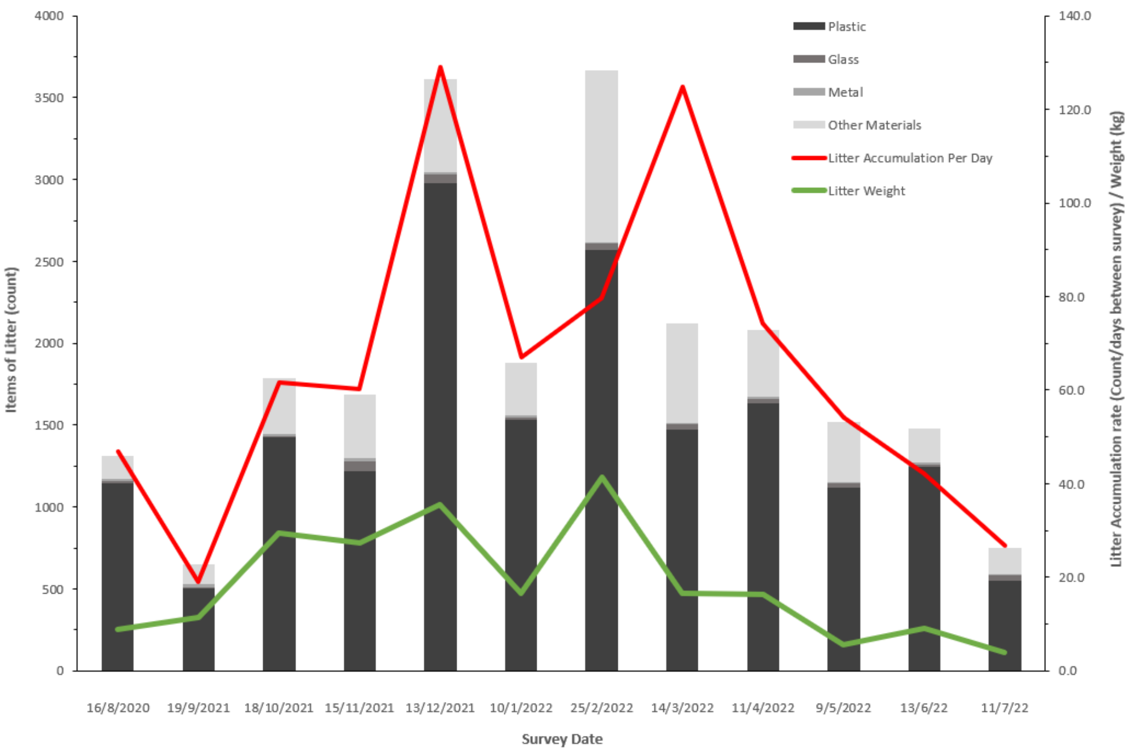

Figure 6.6. *Total litter collected per survey, showing the seasonal distribution of litter over the year – with loads peaking over winter in December and February. Litter loads are separated into material type, whilst the litter weight and accumulation rate are plotted over the top. Accounting for the litter accumulation rate (total litter/number of days since the previous survey), discrepancies are observed between the accumulation rate and total litter observed in February and March 2022. Delayed by poor weather, there were 46 days (average 30 days) between January and February's survey, resulting in a long accumulation period and reduced accumulation rate. Comparatively, a high litter accumulation rate was observed in March, despite the survey occurring just 17 days after the previous survey. Note: although the bars are evenly separated, the time between the survey events is uneven.*

Comparatively, directly littered items (i.e., items left by beach users) appeared to comprise just a fraction of items collected. For example, cigarettes, an indicator of tourist activity and beach usage (Santos *et al.,* 2005), were found just 57 times (0.3% of total litter) over the year. In fact, just three cigarettes were collected per 100 m on average over the 12 months, compared to a national average of 26 per 100 m (MCS, 2022), perhaps reflecting the decreasing prevalence of cigarettes on British beaches (Williams *et al.,* 2014; MCS, 2022). The suggestion that most litter was sea-borne directly contradicts the hypothesis that *most litter is observed during the summer months because of direct littering by an increase in beach users*; on the contrary, litter amount and weight was lowest over the summer. Such findings contrast with results from a long-term UK study that suggests public littering is responsible for over 30% of litter found (Nelms *et al.,* 2017).

The findings are also an interesting contradiction to the increase in 'fresh' and COVID-19 related litter (face masks, PPE etc.) reported on Rossall beach in summer 2020 during the COVID-19 pandemic (Chapter 4). Although a year after that summer when swathes of visitors flocked to the coast, COVID-19-related litter made up just 0.3% of litter collected in this study, whilst directly littered items were evidently low. The fact that so few items could be attributed to direct littering suggests that (a) those responsible for the reported increase in litter in 2020 have not returned, (b) behaviours have changed, or (c) the source was not beach-user related. Irrespective, findings here suggest that beach users on Rossall do not drop litter on levels comparative to other beaches in the UK or to the amount washed in from the Irish Sea.

6.3.1.2. SQb. What is the Distribution of Litter Across the Beach & is This Impacted by the Groyne Coastal Defence Structures?

Over the study period, an average 13 ± 7 litter items were collected per metre width of beach. For the first four surveys (August - November 2021), litter distributions were largely uniform across the beach, averaging 9 ± 3 items m^{-1}. In December 2022, when the first 'peak' in litter load was observed (23 ± 9 items m^{-1}), this uniformity was distorted, with litter being concentrated in sample areas one, three and six (Figure 6.7). The second 'peak' in litter amount in February 2022 (26 ±18 items m^{-1}) witnessed an increase in sample area two (63 items m^{-1}), the greatest litter amount collected in any area of the beach across all surveys. Post-February, the number of items per metre across the beach fell below average (11 ± 9 items m^{-1}), although the amount of litter in sample area two remained comparatively high.

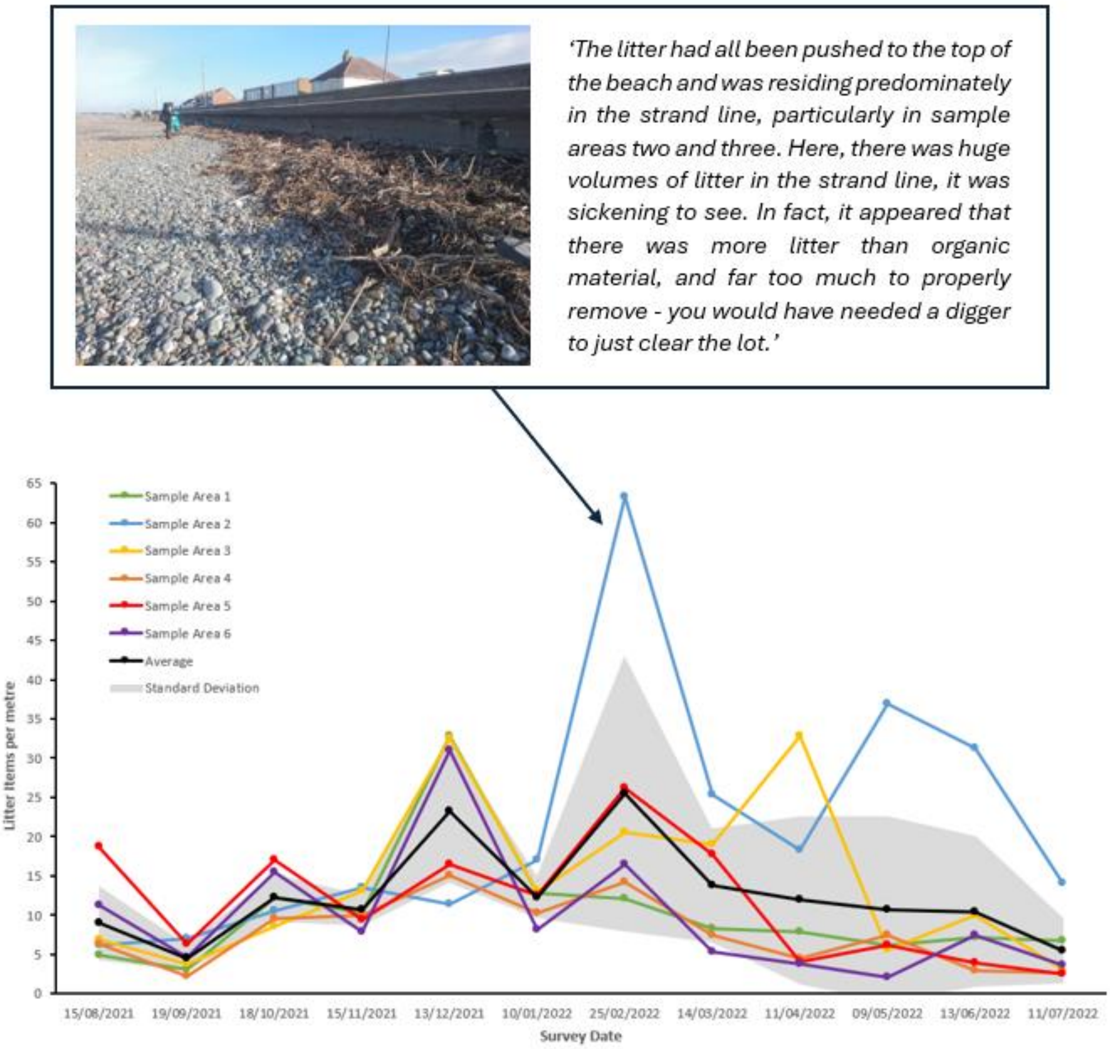

Figure 6.7. *The spatial distribution of litter across the six sample areas over the year. The greatest abundance of litter is seen in sample area two in February 2022, attributed to a mass deposition of organic material after a succession of high energy wave events. Above, a photograph of, and corresponding participant remarks about, the organic material in sample area two.*

Litter abundance in sample area two cannot be explained by a prevailing northward longshore transport pathway of litter, since the sample area is located on the sheltered northern side of rock groyne seven. Comparatively, sample area one, located on the exposed southern side of groyne seven, exhibits over 50% less litter on average over the twelve months than its neighbouring sample area. The hypothesis expected more litter would have been observed in sample area one, as the groyne would have intercepted the northern longshore movement of litter, although this was evidently not the case. For sample area five, located to the south of wooden groyne eight, only moderately more litter (12 ± 7 items m^{-1}) was found than in sample area six to the north of the groyne (10 ± 8 items m^{-1}). Comparatively, a greater disparity in litter was exhibited between sample areas three (14 ± 10 items m^{-1}) and four (8 ± 4 items m^{-1}), which have no groyne structure between them. Consequently, over the sample period, there was no evidence to suggest that litter conforms to a net northwards longshore transport pathway, or that the groyne structures had any impact on the alongshore distribution of litter.

Instead, spatial and temporal variability in the alongshore distribution of litter may be better explained by the cross-shore wave processes, as the position and abundance of material in the shore-normal strand line appeared to have a greater effect on litter distributions. Field observations suggested most litter was confined to strand lines, although the strand material was not uniformly distributed over the beach. At times, multiple strand lines were present, whilst the density of strand material, and hence amount of litter within it, varied within and between the sample areas. As such, any changes in the location or density of strand, driven perhaps by changes in beach topography or nearshore wave patterns, impacted litter distribution. For example, in February 2022, abundant strand material was deposited on the northern side of groyne seven, predominantly in sample area two. With the strand material came a sudden accumulation of litter, predominantly degraded plastic fragments and food packaging entangled amongst the organic debris. The textured surface of the strand line may also have trapped windblown litter, preventing the offshore or landward redistribution of litter.

With the survey method only allowing for the collection of visible litter, large volumes of litter remained buried within the strand line. Consequently, the strand line, which persisted in-situ for months, became a litter source as the organic material decayed and exhumed litter, artificially increasing the amount of litter in sample area two surveyed thereafter. Unlike other areas of the beach that did not exhibit such dense strand material, it may be that sample area two had a lower departure rate, rather than a higher deposition rate, of litter. However, according to Turrell's (2018) definition of a 'litter sink'—an area where the removal rate is less than the deposition—sample area two cannot be considered a litter sink. Nevertheless, such areas may be deemed 'grot spots,' as they were disproportionately littered compared with the overall beach.

Field observations also highlighted the importance of wind for manipulating deposited litter. Lighter plastic fragments and food packaging were commonly seen being transported across the beach, particularly from the intertidal area into the strand line or vegetation on the upper beach. Vegetation, particularly during the spring and summer months when plants were mature and abundant, accumulated such windblown litter between their foliage (Figure 6.8).

Figure 6.8. *Plants can trap windblown litter, particularly in spring and summer. This Cakile maritima (sea rocket) accumulated around 15 litter items amongst its foliage in August 2021*.

6.3.1.3. SQc. To what extent do waves and CSO events affect litter accumulation?

The amount and distribution of litter on Rossall Beach seems to vary seasonally. Given the limited evidence for direct littering, it is proposed that monthly beach litter load is a function of other environmental conditions and anthropogenic inputs, including the wave climate and CSOs.

Wave Climate

The hypothesis suggests that increased beach litter load is a result of increased wave energy. Visual comparison of total litter with offshore significant wave height (Hs) supports this (Figure 6.9), as peak litter loads in December 2021 and February 2022 follow sustained periods of high Hs over the two months (mean Hs 1.29 m and 1.33 m respectively). Over those two months alone, the storm alert threshold (Hs > 3.8 m) was exceeded 32 times (Table 6.2), 31 instances more than for the rest of the study period combined, suggesting that storms can impact and increase the amount of litter deposited on beaches (Asensio-Montesinos *et al.,* 2021). Comparatively, Hs was lower during the spring and summer months, coinciding with reduced litter collection. This was evident in September 2021, when the survey that recorded the least litter overall followed a period of the second lowest average Hs (mean 0.41 m). Positive correlations, but not necessarily causations, are found between total collected litter and mean Hs on different time scales (Figure 6.10). Strongest correlation (Pearson Correlation Coefficient 0.82) is observed between total litter load and mean Hs one week prior to the survey, suggesting the abundance of marine litter surveyed monthly is perhaps impacted most by the wave climate during this period.

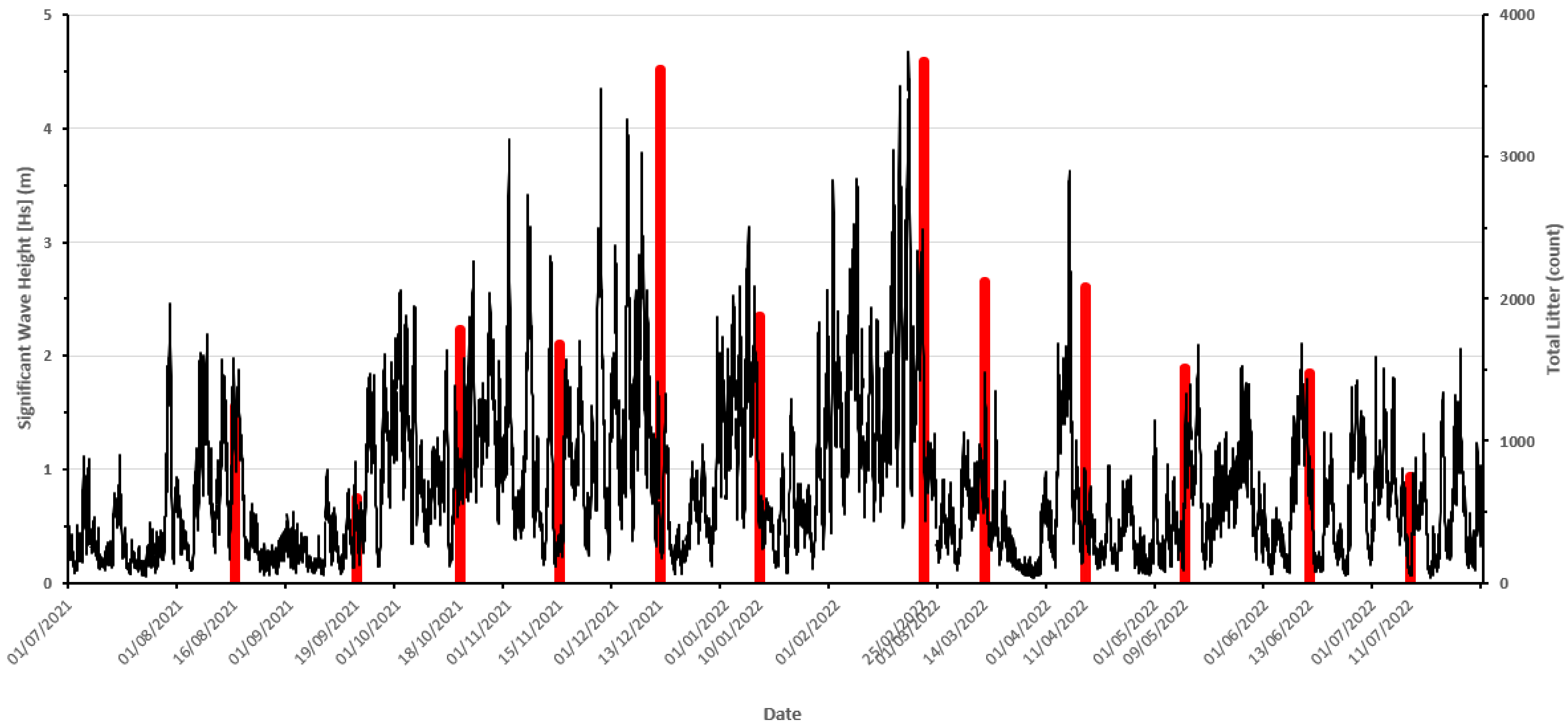

Figure 6.9. *Offshore half hourly significant wave height at Cleveleys Wave Buoy recorded against total litter per month (red lines). Note: Significant wave height data between 6/11/21 – 23/11/21 is from the Morecambe Wave Buoy, during a period when the Cleveleys Wave Buoy was undergoing maintenance.*

Table 6.2. *Summary wave statistics for each inter-survey period. Note: * denotes data from the Morecambe Wave Buoy.*

Session	Inter-survey Period (*Survey Date*)	Days Since Previous Survey	Whole Inter-survey Period: Mean Significant Wave Height (m) [std dev]	Hmax (m)	Number of times storm alert threshold surpassed (Hs > 3.8m)	One Week Prior to Survey: Mean Significant Wave Height (m) [std dev]	Hmax (m)	Number of times storm alert threshold surpassed (Hs > 3.8m)	Day Prior to Survey: Mean Significant Wave Height (m) [std dev]	Hmax (m)	Number of times storm alert threshold surpassed (Hs > 3.8m)
1	19/07/21 - ***15/08/21***	28	0.66 [±0.53]	2.46	0	0.94 [±0.47]	2.19	0	0.49 [±0.23]	1.02	0
2	15/08/21 - ***19/09/21***	34	0.41 [±0.36]	1.98	0	0.37 [±0.20]	1.07	0	0.47 [±0.32]	1.07	0
3	19/09/21 - ***18/10/21***	29	1.05 [±0.54]	2.58	0	0.87 [±0.41]	2.05	0	0.96 [±0.18]	1.29	0
4	18/10/21 - ***15/11/21***	28	*1.13 [±0.63]	*3.91	*1	*0.70 [±0.53]	*2.39	*0	*0.49 [±0.26]	*1.01	*0
5	15/11/21 - ***13/12/21***	28	*1.29 [±0.81]	*4.35	*5	1.63 [±0.73]	3.79	0	1.03 [±0.43]	1.77	0
6	13/12/21 - ***10/01/22***	28	0.97 [±0.67]	3.13	0	1.59 [±0.63]	3.13	0	1.24 [±0.49]	1.94	0
7	10/01/22 - ***25/02/22***	46	1.33 [±0.88]	4.68	27	2.29 [±0.95]	4.68	26	2.62 [±0.38]	3.11	0
8	25/02/22 - ***14/03/22***	17	0.70 [±0.29]	1.39	0	0.82 [±0.22]	1.32	0	0.90 [±0.16]	1.19	0
9	14/03/22 - ***11/04/22***	28	0.63 [±0.63]	3.62	0	1.27 [±0.78]	3.62	0	0.38 [±0.13]	0.63	0
10	11/04/22 - ***09/05/22***	28	0.40 [±0.24]	1.43	0	0.41 [±0.23]	1.05	0	0.37 [±0.19]	0.69	0
11	09/05/22 - ***13/06/22***	35	0.81 [±0.46]	2.11	0	1.00 [±0.56]	2.11	0	1.20 [±0.26]	1.79	0
12	13/06/22 - ***11/07/22***	28	0.71 [±0.44]	1.99	0	0.77 [±0.39]	1.80	0	0.22 [±0.11]	0.43	0
	Average	30	0.84 [±0.54]	2.80		1.05 [±0.51]	2.43		0.87 [±0.26]	1.33	

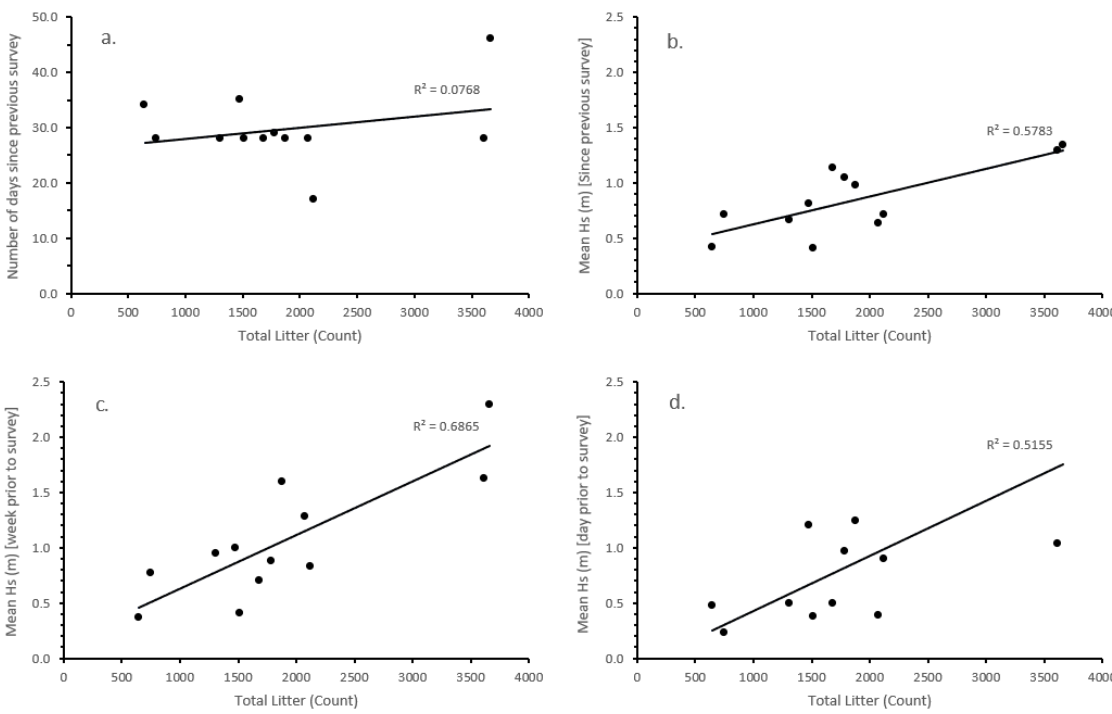

Figure 6.10. *Positive correlations are observed between total monthly litter load and [a.] the number of days since the previous survey (Pearson Correlation Coefficient 0.28), [b.] Hs for the whole inter-survey window (Pearson Correlation Coefficient 0.76), [c.] one week prior to the survey (Pearson Correlation Coefficient 0.82) and [d.] one day prior to the survey (Pearson Correlation Coefficient 0.72).*

The wave climate may also influence the type of litter on the beach. The transport and deposition of plastic items like food packaging, which were observed in high numbers over the winter months, may have been aided by their characteristic buoyancy, permitting them to be washed ashore in high wave energy conditions, as also found by Asensio-Montesinos *et al*. (2021). However, limited evidence could be found to determine a source of such litter. Notably, prior to starting this work, discussions with local beach cleaners suggested that much of the litter on Rossall is sourced and transported north from the tourist hotspot of Blackpool. It has already been demonstrated that, because litter did not appear to accumulate asymmetrically around the groynes, litter may not conform to a northwards transport pathway. Moreover, just one item, a plastic coin pot, was collected on the beach that could be directly attributed to Blackpool (Figure 6.11). This is not to say that litter does not derive from areas south of Rossall, but instead emphasises the difficultly of determining the litter source, and hence providing the evidence base, to thoroughly test the hypothesis.

Figure 6.11. *Coin pot collected on Rossall Beach in June 2022, directly traced to a Blackpool amusement.*

Combined Sewer Overflows

Sanitary waste may be one category of litter that can be more easily attributed to an anthropogenic source. Sanitary waste constituted 8.5% of total litter surveyed on the beach, although the number of items surveyed per month varied across the study period, with a large disparity between the mean average number of sanitary items (159 items) and the maximum recorded in February 2022 (694 items). This discrepancy between the average and maximum could be explained by the timing and duration of CSO events, when excess untreated sewage is discharged into the marine environment during intense precipitation (Metcalf *et al.,* 2022). Consequently, it is hypothesised that the abundance of sanitary waste will be directly related to the timing of CSO events from local CSO sites. This includes Anchorsholme CSO, located approximately one mile south of the study area, which discharged 56 times for a combined duration of 523.92 hours in 2021 alone (UU, 2023).

Over the study period, nine CSO events were reported in the Cleveleys area, some of which may have been from Anchorsholme. All these events were reported between July - October 2021 and June - July 2022, occurring in the aftermath of rainfall events, but not after all rainfall events. However, few sanitary items were observed on the beach following CSO events, with only 15.2% (290 items) of the total recorded sanitary waste collected after a reported CSO event. Instead, it was during a period of no reported CSO events (October 2021 - June 2022) that most sanitary items were surveyed on the beach. Notably, the February 2022 survey, which recorded the highest number of sanitary items (694 items; 36% of the total), occurred after a three-month period with no reported CSO events, whereby a 440% increase in sanitary items was found compared to the November 2021 survey, when the last reported CSO occurred (Figure 6.12).

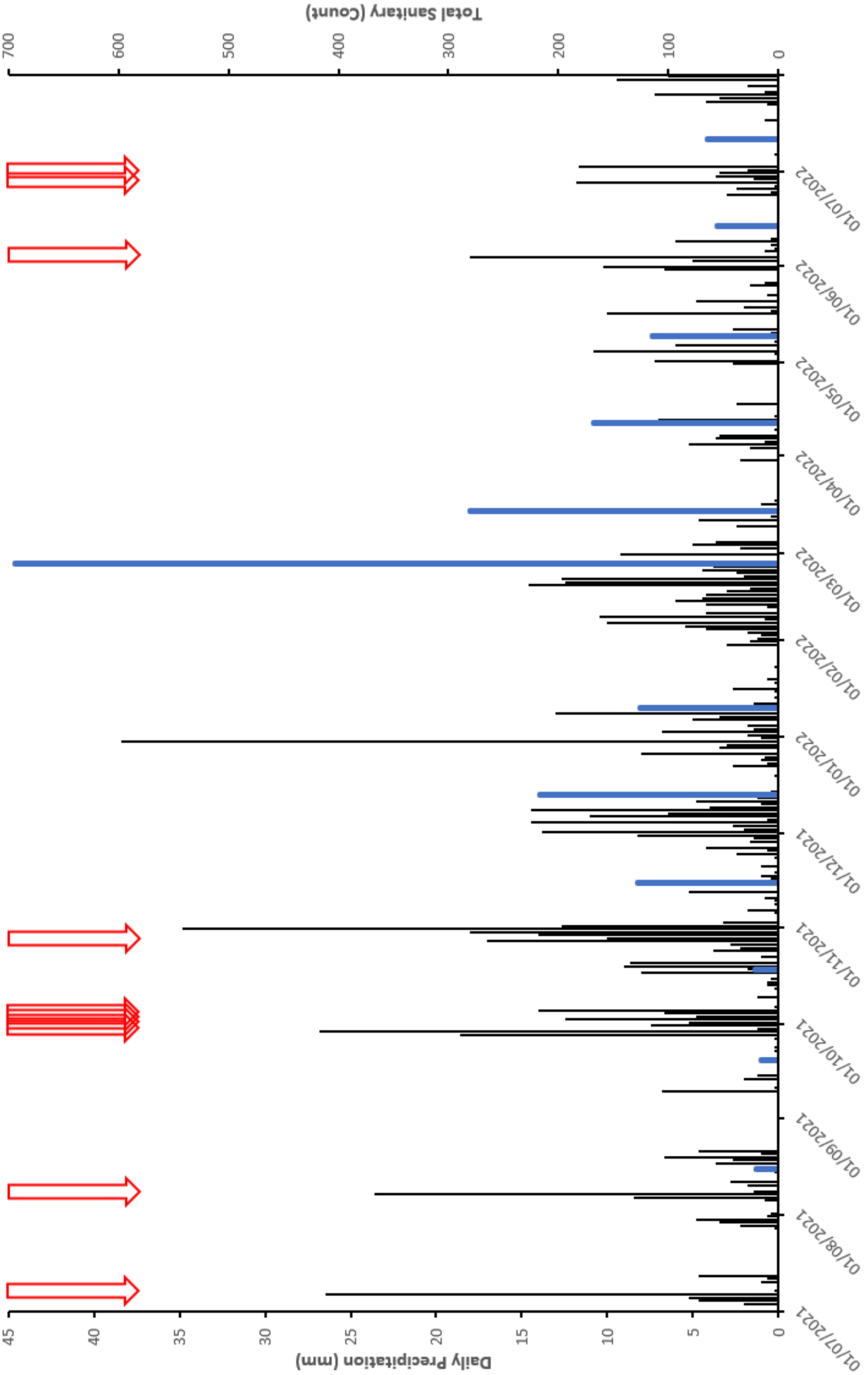

Figure 6.12. *Daily precipitation amounts (black) plotted with total sanitary items collected (blue). The timing of CSO events at Cleveleys are also displayed (red arrows).*

Consequently, findings highlight a mismatch in timing between reported CSO events and the appearance of abundant sanitary items on the beach. Consequently, contradicting the hypothesis, there is no positive correlation (Pearson Correlation Coefficient -0.40) between the timing of CSO events and the amount of sanitary waste surveyed on the beach (Figure 6.13). Several plausible, but unsubstantiated, factors could be at play here. Given the lack of positive correlation, the sewage waste was perhaps not derived from local CSO sites and instead derived from another CSO location unaccounted for in the analysis. Alternatively, the mismatch between reported CSO event and sanitary abundance may suggest the occurrence of unreported CSO discharges throughout the study period. Lastly, assuming the sewage waste surveyed on Rossall was locally sourced, surveyed waste may instead be products of previous discharge events that reside offshore until certain onshore transport thresholds are met, defined as 'legacy sewage discharge' (Metcalf *et al.,* 2022).

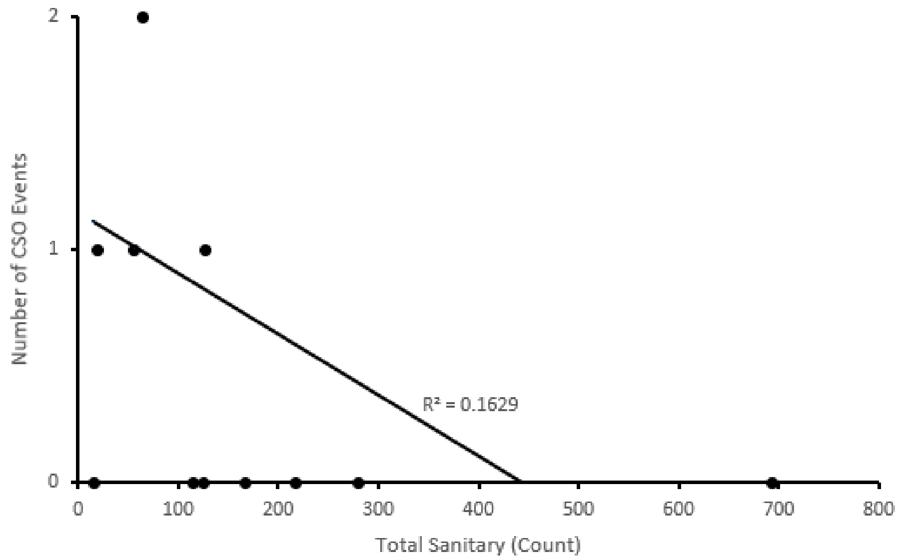

Figure 6.13. *No correlation is seen between the total sanitary items collected per survey and the number of reported CSO events since the previous survey (Pearson Correlation Coefficient -0.40).*

Yet, the mere presence of such waste on Rossall, irrespective of precipitation patterns or when the initial CSO event occurred, combined with the possibility that the waste may reside in abundance in the marine environment long after it has been discharged, raises significant long-term water quality and health implications. This is because sewage waste deposited on beaches, particularly wet wipes, have been found to be harbourers of harmful bacteria including E. coli (Metcalf *et al.,* 2022), with sewage discharge alerts correlated to sickness reports in outdoor swimmers (Slack *et al.,* 2022). For Rossall, although 'explosions' of sanitary waste were witnessed in the winter (e.g. February 2022), it is likely that the risk to public health will be greatest over the summer months, when beach usage is likely to be highest. For instance, through May to September, 272 sanitary items were found on Rossall, an average of over 54 per survey, or one sanitary item per three metres of beach. Consequently, it is likely that summer beach users will encounter such waste and be exposed to bacteria and possible sickness risk, whilst, as indicated by Tudor & Williams (2006), beach users may also choose to engage in recreation elsewhere if they confront a polluted beach. Such findings tie into the broader and ongoing public discourse around CSO regulation and their resulting water quality issues (e.g. Slack *et al.,* 2022), highlighting the need to both tackle sewage waste at source, including reducing the number and volume of CSO discharges, and for authorities to be responsive and remove sanitary waste when it is identified on the beach.

6.3.1.4. Summary of Science-focussed Outcomes

This 12-month marine litter citizen science study helped to test several questions and hypothesise on Rossall Beach. Key findings include:

- Rossall exhibited three times more litter than the national average. The majority of this was sea-borne plastic waste, with little evidence to suggest a high proportion derives from direct littering.
- Shore normal groyne structures had little impact on the deposition or distribution of litter. Instead, the density and location of strand lines was a more important determinant of litter distribution, having the potential to create local 'grot spots' of concentrated litter amounts. Identifying and focussing clean-up efforts in 'grot spots' may have a greater benefit for reducing total beach litter than dedicating equal time and effort across the whole beach.
- Association was found between the wave climate and litter quantities, with periods of high wave energy corresponding to greater litter loads on the beach. Consequently, the wave climate is a primary driver of litter deposition on the beach and a secondary factor influencing the long-term beach litter load, as organic

material stranded under high-energy conditions affects the amount of litter surveyed in subsequent months.

- Reported CSO discharges, although a likely source of sanitary items, were not found to have an immediate effect on the measured sanitary load on Rossall. However, the presence of sanitary waste on the beach carries water quality and beach user health implications, reinforcing widespread calls for improved CSO discharge regulation.

6.3.1.5. Method Limitations

Whilst citizen science has afforded new insights into the dynamics of marine litter on Rossall Beach, several practical considerations and limitations must be recognised. Firstly, surveying provides a generalised, not absolute, reflection of the total beach litter load. As identified in other studies, a proportion of the beach litter load may be masked by seaweed and natural debris or buried under sediment (Asensio-Montesinos *et al.,* 2021). Given the survey protocol only permitted visible, surface litter to be collected and recorded, 'hidden' or masked litter remained uncollected, leading to the total litter load being underestimated. As seen post-February 2021, the uncovering of masked litter from a decaying strand line can affect the amount of litter surveyed on the beach thereafter. Moreover, sightability bias may mean some litter types are subconsciously preferred, overlooked or are difficult to detect using the naked eye due to their size (Nelms *et al.,* 2017). Litter material types may also be incorrectly categorised on the recording form, a task made increasingly difficult by the fragmented and decayed state of some litter, a challenge noted by participants: '*It wasn't always clear as to what the litter was. A lot of it was so eroded'*, and '*there is the recognition of the inconsistencies and how you're going to measure things. Is this a plastic fragment? Is it a food wrapper?'*

There may also be uncontrollable biases impacting data quality. For example, estimating an average weight of litter items may be skewed by the presence of several heavier items, including tiles, wood, bricks or large plastic items (Hengstmann *et al.,* 2017). Litter may also have been removed from the survey area by lone beach cleaners or environmentally conscious members of the public outside of the survey events, thereby preventing a true representation of the litter accumulation over the inter-survey period. Whilst every effort was taken to limit litter removal between the survey events, including posters, boundary markers, and emails to local beach cleaners, it is acknowledged that such lone cleaning cannot be prevented. To the author's best knowledge, it is believed that no significant cleaning activities occurred on the beach between surveys, although it is recognised that some litter will have been 'lost' to such human activity. Consequently, it is reportedly important in such coastal citizen science studies, where the site boundaries are difficult to define or see, that participants feel ownership over the site (Cigliano *et al.,* 2015). Such ownership, in this case to preserve the study's scientific integrity, was demonstrated by one local beach cleaner in the following anecdote:

Barbara, seeing me at the end of the table, stood up and marched over. *'Do you know'* she exclaimed passionately, *'I was watching these two men on the beach out of my window, and I thought I haven't seen them before. And you know, they were litter picking in the sample area! So, I thought I'll go and tell them that they aren't allowed to litter pick there - anyway, I saw that Andy had already left his house to go and tell them!'*

Lastly, beach litter surveys only provide a 'snapshot' of the total litter present in the marine environment. Other methods like benthic sampling and flotation sampling are required to fully account for litter quantities stored or in dynamic flux within the marine system (Cheshire *et al.,* 2009), although funding, technical and pragmatic reasons make such methods an unrealistic addition to citizen science litter monitoring in Coast Watchers. Similarly, without tagging and tracking litter, something not done in this study, conclusions on the source and transport pathways of most litter collected cannot be drawn. A more thorough investigation is required to explore the amounts, sources and movements of litter within the wider Irish Sea system, something which could benefit from the large-scale capability of citizen science.

6.3.2. Participant Experiences, Outcomes & Benefits from Marine Litter Citizen Science

Across the 12-month survey period, 123 people were involved in Coast Watchers (Figure 6.14), devoting a total of almost 185 volunteer hours to the project. Volunteers were primarily retired locals, although some attendees were tourists, students, or employees from local organisations. Of these participants, 11 were interviewed after the last beach litter survey session in July 2022. Interviewees were predominately female (8) and retired or not working (8), although the sample also included one student and two people in employment.

Figure 6.14. *Coast Watchers participants (i) at a training briefing and (ii, iii) undertaking a survey.*

Participants expressed a variety of motivations for their involvement in beach cleaning and litter surveying. Over half of the respondents reported environmental reasons as key motivators for their involvement, stimulated by personal passions for the coast, the need to maintain beach cleanliness to support the environment, or, for two participants, the impact of experiencing the negative implications of litter on the beach and marine system. Seven participants also spoke about the wider societal benefits of beach cleaning as a motivator for them, including contributing to keeping the beach litter free for others, whilst a sense of 'giving back' was important for some retirees. Motivations also went beyond environmental concerns, with wellbeing, social and intrinsic motivations all present, including possible learning possibilities and opportunities to meet and interact with others. Several participants also drew upon the mental and physical wellbeing benefits from their participation, describing the fresh air, exercise and therapeutic benefits experienced when beach cleaning. But, as Wyles *et al.* (2017) suggest, it is unclear whether it is the activity of beach cleaning itself, or being in the coastal blue space environment, which is more important for promoting such wellbeing effects.

These motivations for engaging with beach cleaning are well documented in the literature (Wyles *et al.,* 2017; Power, 2022), although a final motivator, time, was also important here. Time, expressed in terms of personal capacity and convenience to attend sessions, was seen as both a motivator and enabler of participation for many of the retired interviewees. Perhaps this was dictated by the scheduling of the survey sessions on Monday mornings, which restricted the sessions to a primarily retired or non-working audience. Young or employed people could only attend during holidays, whilst tourists only typically attended on an ad-hoc basis.

6.3.2.1. Marine litter citizen science builds heightened awareness for the types, amounts and patterns of litter in the local coastal environment.

Participants expressed enjoyment from the project. Remarking on his experience across the year, Ian said, "*I've enjoyed it all. You know sometimes when it's absolutely blowing a hooley and it's piddling it down with rain you think what am I doing this for, but I still enjoy it*". Alice supported this opinion, expressing "*I never get bored and never think I've had enough of this. It's different every month and you find new things and it is exciting*". Whilst this sense of enjoyment is clearly a positive outcome for participants, it is key to understand the extent to which undertaking a citizen science process, compared to the act of beach cleaning only, presented any additional outcomes or benefits for the participants. Some participants had a beach cleaning background[18], therefore were well-positioned to reflect upon, and reach a consensus that there is a difference between the two approaches. It was apparent that the process of surveying was more 'interesting' for many participants, including for Maggie, *"I get that you wander around and pick litter up, but I actually find it more interesting to do the*

[18] An acknowledged, but unexplored, aspect here is the extent to which people already involved in beach cleaning activities have a high underlying awareness of causes and consequences of marine litter compared with non-volunteers (e.g. Rayon-Viña *et al.,* 2019; Severin *et al.,* 2023a). In such cases, their pre-existing awareness may 'dampen' any awareness building benefit of added citizen science activities.

actual surveys… I think I've only done one of the litter picks. And I thought, no this isn't for me". John pondered that he found sessions *"very informative, very relaxed and very interesting"*. This sense of interest seemed to stem from the fact that the surveying seemed to offer something 'extra' which could not be attained from beach cleaning alone, sentiment that two participants mused: *"I think if it was a case of: here's your litter picker, go pick some litter, see you next month, it wouldn't be the same at all"*, and "*just picking up stuff and throwing it in the bag on the beach, you kind of feel as though you're missing out on something*".

This difference appeared to be rooted in the opportunity to build subjective awareness about marine litter (Wyles *et al.,* 2017; Locritani *et al.,* 2019), stimulated by the process of recording and thinking about the types of litter collected, beyond just putting litter into a bag. Karen remarked,

"With the other [beach cleaning] group, you're literally just popping whatever into the bag and not really giving it much thought. Whereas with your group, you are kind of looking for anything old, anything interesting, and anything that we think you might be interested in, so it definitely makes you more aware of what you're actually putting into the bag".

The process of surveying litter was mentally engaging, an active process that afforded reflective and educational experiences and provoked questions and awareness about the types, amounts, patterns and drivers of litter observed on the beach over time. Maggie commented,

"*it shows what sort of things are coming up on the beach. Rather than just picking it up and putting it in a bag… it's actually showing what sort of things and whether there's some sort of pattern [like] when we've had a storm"*.

Alice built on this, stating, *"Writing it down and logging it, it does make you think. Before I was just chucking it in the bag and didn't really pay much attention. It was just piece of litter, put it in the bag. But now you're thinking, gosh, we're seeing a pattern of more sanitary waste or cigarette butts, what does that mean?… it makes you more aware of what you're picking up, doesn't it? You know, if we've only picked up one piece of glass, but 20 pieces of sanitary, you're realising where the problem is coming from"*.

It is evident that there is an apparent self-reported learning and knowledge benefit from the process of citizen science surveying for the participants, something observed in other studies (e.g. Haywood *et al.,* 2016; Peter *et al.,* 2021), manifest in practice through various educational and experiential outcomes. By stimulating a heightened consciousness for the types and quantities of litter entering the marine environment locally, participants could formulate their own conclusions based upon observations made across multiple surveying sessions. John, a long-term resident in the area, demonstrated this finding: *"I think [I am] more aware of the type of litter and rubbish that is on the beach, the quantity of it. Both have now become measurable to me, whereas before they were totally immeasurable",* allowing him to have *"reached a conclusion, if you will, for the rubbish on the beach at Cleveleys, where it's likely to have come from [and] how long it's likely to have been there for"*. As a result, the value of data collected during the project transcends scientific interest, as participants also find value in the data to increase their understandings of litter dynamics in their local coastal environment.

6.3.2.2. The process of surveying litter can provide transformative learning outcomes and change pre-conceptions that beach users are the main source of litter.

It was perhaps the source of litter that provoked the greatest interest and learning outcomes for many interviewees. Participants recognised that much of the litter they surveyed was not freshly dropped by beach users, evidenced by the fragmented state, apparent oldness, and lack of whole litter items on the beach. John remarked: *"I can't remember ever finding a whole lemonade bottle, a whole plastic bottle or a whole glass bottle. We found the odd can. So, we're not finding evidence, if you will, of deliberate littering"*. Instead, participants attributed the Irish sea as the predominant source of litter over the year. For Eric, witnessing this and observing the length of time which litter may reside for in the marine environment was a source of surprise and learning for him:

"We've seen now from monitoring how things come ashore, and we've found crisp packets that are ten years old and what have you... there must be some offshore depository somewhere for this waste. And it gets churned up and comes back in again, and that's disturbing and worrying. And I don't think most people are aware of that. That was an eye opener for me".

Eric's response was not in isolation; five other participants expressed surprise or greater awareness that the sea, compared with beach users, is an important source of litter. Helen pondered: "*I was quite surprised that there's less litter dropped than the amount of litter that* *comes in on the tide"*. In fact, this finding directly contradicted some participants initial expectations that most litter is derived from direct littering from beach users, an erroneous perception that has been observed in other studies (e.g. Rayon-Viña *et al.,* 2019). Helen summarised well her changed perceptions: "*It was just the anticipation of it, you think holidaymakers are here again and we're going to get loads more litter. And actually, you don't"*.

Maggie affirmed this shift in attitudes:

"I obviously used to go on day trips to the beach and I used to see the rubbish and think, oh you know there must have been a lot of people here the other day and they've left all this rubbish knocking about. And now I know that it's not all that... I never even understood the fact that it actually can lie out at sea for months, years, whatever, and it's when we have storms you get this stuff coming back in".

Consequently, the process of surveying beach litter enables participants to gather evidence and form conclusions that directly contradict their initial expectations, a finding in commonality with Locritani *et al.* (2019). In this instance, some participants carried a pre-determined mindset that they would find a correlation between summer beach users and greater litter loads. But this was not found in the study. Instead, winter periods, when beach usage would have been lower, were seen to have a much greater influence on the amount of litter observed (Section 6.3.1.3). As such, the experiential opportunity offered by the citizen science surveying helped to change and challenge some individual preconceptions, presenting a powerful and transformative learning environment that leads to greater understanding about the sources and dynamics of marine litter.

6.3.2.3. By connecting participants to the impact of litter on the coastal environment, citizen science can foster a heightened sense of environmental consciousness and empowerment.

Surveying enabled participants to learn about more than just the types and sources of litter; it offered a heightened awareness of the wider environmental impacts of litter, a finding also reported from a microplastic citizen science project (Jones *et al.,* 2024). For Kelly, despite working in the environmental sector and having an awareness of the marine litter problem, the experience of witnessing litter on the beach through surveying proved to be emotive:

"I'd always known plastic was a problem from being in the conservation world, but seeing it on a local beach, just the abundance and the impact it would have, that surprised me, it shocked me... you see it first-hand. Whereas usually you see it in pictures, or maybe a journal or article. But then looking at it [litter on the beach], you think of all the pictures of the pollution incidents, the birds with plastic rings around their beaks. So that visual imagery is just so much more powerful when you see it in person".

This element of surprise was also apparent in Helen's encounters with marine litter during the surveys. In fact, her participation in the work elevated her sense of environmental consciousness, shifting the nature of her experiences in coastal space. She reported,

"It's just been a real eye opener and whenever I walk around now, especially on the coast, you know, I'm very conscious of what's around me. Whereas before it was just, you know, you see litter and you think it's just one of those things, but now I'm seeing it as an impact on the marine life and things like that. And it has kind of never been a conversation in my head before".

This heightened consciousness did not end with litter's impact on wildlife for Pam, since she has also become more aware of the social implications of litter for beach users. Reflecting on the difference between litter picking and surveying, she reported that this was an important aspect of her experiences in the project:

"You would go along and you sort of say, gosh, there's a lot of rubbish here and that will be it. Whereas now, you go along and you say there's a lot of rubbish, what impact is that having on the wildlife, on the views of people that come to visit, on the plastic and the life cycle of the plastics and all that sort of thing? You definitely start thinking in a slightly deeper way".

There is also the sense here that the experiential opportunity afforded by the citizen science process presented an increased a sense of curiosity for exploring and noticing litter on the beach. Five participants, including John, commented on this:

"If I go on the beach now, I do tend to have a poke around and just have a quick look what there is. Just to see whether there is anything major or which I would find interesting... it does make me look more, to see what rubbish is there and what quantity there is".

Consequently, for some participants, surveying has left a legacy beyond the immediate learning outcomes. Surveying has shaped their place interactions with the coastal environment and built an increased consciousness of the impact of anthropogenic activities on the local marine environment, a similar finding to Haywood *et al.* (2016) in another coastal citizen science project. Such a legacy has also translated to a sense of action for two participants, who reported that the sessions effected their waste management practices, including a reduction of single-use plastics. Megan revealed:

"Probably from the first session, certainly by the second session which confirmed it, I was like, yeah, I want to take the environmental welfare a lot more seriously to kind of combat what I'm seeing right now on the beach cleans".

These shifts in place interactions may have been driven by exposure to the environmental impact of litter on the beach and the negative feelings and emotions it stirs, possibly generating a sense of individual empowerment – a variable previously observed in coastal citizen science (Dean *et al.,* 2018). This was certainly found in Helen's experiences, who reflected on the broader impact of the work on her life. She commented that she is:

"Feeling really empowered environmentally because if somebody asked me about environmental issues before, I kind of wouldn't have much of an opinion, you know what I mean? It's something other people did, who were much smarter than me and have a lot more intelligence than I have to understand all the stuff". She continued: *"I felt part of something you know, if everybody just did a little bit like we were doing then what a difference it would make".*

Consequently, whilst beach cleaning itself can be considered a pro-environmental behaviour (Wyles & Ghilardi-Lopes, 2023), the practice can have 'spillover' effects (Wyles *et al.,* 2017; Severin *et al.,* 2023a) that encourage other pro-environmental behaviours (Wyles & Ghilardi-Lopes, 2023) and willingness to conserve and protect the environment (Koss & Kingsley, 2010). But, a limitation of the method is acknowledged here, that without prior information about the interviewees, it is impossible to determine if their behaviours changed because of their involvement in Coast Watchers, or if those changes would have occurred regardless (Wyles & Ghilardi-Lopes, 2023).

For Helen, her involvement in citizen science has actively removed a perceived barrier between science and her interaction with it, a powerful outcome that suggests citizen science can help overcome disconnects between science and the public, fostering opportunities for learning and empowerment. Helen continued, claiming *"this is a whole new world that has just opened up really. There's just so much to see, so much to do and find out about. It's been great, it's been a real education".* In this sense, the process of beach litter surveying is more than just collecting and recording litter, it is perhaps a steppingstone for broader engagement with other coastal issues and challenges. Informal conversations with participants also reinforced the sense that beach cleaning is a ‘way in’ to engage further with the coastal environment. This perhaps culminates in a shift for how citizen scientists engaging with beach cleaning are perceived. They are environmentally attached people (Power, 2022) who are active participants in managing the coastal environment, and therefore should be empowered to share their voices and contribute to coastal management decisions affecting them, and the coastal environment they work to protect.

6.3.2.4. Citizen science participants can play a role in disseminating findings and recognise the value of citizen science data collection for building knowledge and enacting change.

Participants played an important role in dissemination. Four participants reported that they share findings with their social circles: “*any opportunity that I can get to kind of share what I'm doing… I'm telling everyone who will listen”,* whilst another participant remarked: “*you’re learning - you can then impart that information on to other people and raise awareness”*. Ian echoed this theme of awareness raising,

“I bore my friends and family mercilessly with it now every time I've been on a beach clean, I tell them what I've seen and what we've caught and what we've done. And if that sort of raises their awareness and perhaps makes them think before they drop a can or a bottle, or don't put it in the bin or something and let them think where it ends up, then that's something at least anyway”.

This willingness of participants to share information with others highlights the capacity of citizen science to not only influence the learning and outcomes for the immediate volunteer group, but to also shape learning outcomes and sense of awareness for a wider audience. This finding stresses the importance of recognising citizen scientists as more than passive data collectors or crowdsources of information in citizen science projects. Instead, they play important roles in multiple stages of citizen science projects, including dissemination in this case – something that has perhaps been overlooked or undervalued in previous studies. The finding also underlines the need for researchers to share findings in an accessible and meaningful way, for instance through infographics (Figure 6.15), such that participants can understand their contribution, learn, and ultimately disseminate findings with others. Pam noted:

"What is more interesting I think, is when you do the survey and then you get your feedback and you get a little bit more idea of the trends... I think it builds a picture up and you can then impart that information".

Figure 6.15. *Infographic posters summarising findings from the monthly surveys. Posters were displayed on Rossall promenade and shared via social media.*

Alongside learning and dissemination outcomes, value was also found in the data itself, as participants recognised the importance of data to answer anecdotal hypothesise and contextualise the changes and patterns of beach litter over time. Pam commented that the surveying:

"Gives some purpose to what we're doing... it's great that people are out there collecting the rubbish, but if it's not being somehow recorded and we're not having some means of recording it, then we can't make comparisons, we can't build up those pictures".

Ian also drew upon the scientific value of surveying to enact change: "*If you're armed with numbers and data and conclusions from that, you can make a much better case for perhaps getting things changed. And that's the reason I think behind it".* As a result, participants were aware of the need for and benefits of citizen collected data and the wider influence that it can bring, both on a local and national scale. Such an influence was recognised in late 2021, when Coast Watchers data contributed towards a successful government consultation to ban certain single use plastics (DEFRA, 2023). Moreover, one participant also used the data to evidence their own activism to demand a less-polluted marine environment. An interesting paradox is presented here. On one hand, citizen science "can increase trust and reduce conflict around resource management" in coastal spaces (Cigliano *et al.*, 2015, p.82), yet, on the other, it can highlight resource management failures – which could perhaps decrease trust towards, and increase conflict, with managing authorities. In this case, Coast Watchers has perhaps been more effective at achieving the latter, whereby sanitary waste data has been used to campaign for better environmental management, perhaps at the expense of building trust between parties.

Despite this, findings suggest that trust and positive relationships can be built between the community and academia through citizen science, driven in-part by the role of the researcher. In Coast Watchers, the researcher's role went beyond simply organising, delivering and disseminating findings from the project; instead, they became an integral part of the participant's experience. Interviewees reported that interacting with the researcher helped to build their awareness, supported their ability to identify litter types, and fostered their interest and enthusiasm. Karen remarked, "*I think your enthusiasm is quite infectious really, you know, you seem really motivated… it's just nice to see. So I really enjoyed joining your group*". Again, communicating in an engaging and understandable way seems to be important in facilitating these positive experiences, as reported by Helen:

"*I think you're quite an inspiring person because I talk to you and immediately I think oh this is interesting, because you tell a tale in a very interesting way and make people believe that they can be part of it. Whereas you know if it's a bit too high brow and a bit too techy and you use a lot of words that people don't understand, they kind of switch off*".

Ethnographic reflections indicate that positive outcomes from participant-researcher interactions were fostered by the development of friendships and trust. Over time, emotional connections formed, with participants confiding in the researcher about personal matters, including the tragic passing of a volunteer before a survey session. Interactions became more frequent and involved sharing news articles, photographs, commenting on findings, asking questions and attending additional talks and engagement events led by the researcher. Consequently, communicating with the public in a way that is likeable, prioritises listening, builds rapport, and is mindful of language, may help to promote positive attitudes towards science and scientists (Dudo & Besley, 2016).

6.3.2.5. Citizen Science?

In this citizen science project, many of the participants had the opportunity to be involved in more than data collection, including designing (Chapter 5; not all interviewees were involved in this stage), data collection, results dissemination, and interactions with myself as a researcher. In this sense, the participants were 'doing science' (Ballard, 2008) to a greater extent than in many contributory or crowd sourced citizen science projects, although the extent to which participants consider themselves to be, or identify as, a citizen scientist is unknown. To investigate, interviewees were asked, *'to what extent do you identify as citizen scientist?'* The overriding response from participants was that they do not identify themselves as citizen scientists. Helen replied, "*I don't see myself as a scientist, I just see myself as a local person who's concerned about what's going on",* sentiment Karen echoed: *"a citizen scientist, my goodness me! Probably not very much, no! I mean literally if I can just do my bit you know, I'm happy with that*". Similarly, John echoed this lack of identity but drew further upon Karen's sense of contributing and playing a role, "*science was never my strong point, but... I would like to think that I have played a worthwhile role in determining the end result of the of the findings of the survey*". Furthermore, for Eric and Ian, who both had careers in scientific disciplines, the methods involved in this project limited their ability to identify as citizen scientists. Eric explains:

"It's not a point I would have considered, and it's a point I would be very cautious about. Coming from a scientific background, you're much more rigorous in the way that you apply science, and to be fair, because of what you're working on, you've got to make more sweeping assumptions than somebody working on the chemical plant".

Ian's response picked up on that theme,

"I think my involvement is nothing more at the moment than just ticking a few boxes on the beach. So yeah, it is citizen science to some extent, but I don't think I could put it on my CV. Let's put it that way. I'm not that much of a citizen scientist."

Although the methods employed were more demanding for participants than in some citizen science projects, which may only require participants to take and submit single photographs, it is likely that the process was not sufficiently demanding or rigorous to warrant being termed 'science' by these participants. In this case, the metrics determining whether a citizen science project is defined as 'citizen science' are set by the researcher. Consequently, for the project to be truly collaborative in nature, the metrics and definition should perhaps be set by the participants themselves, where the benefits and outcomes for participants from doing citizen science are at the heart of how it is defined and measured. For instance, a participant-focussed citizen science could be measured not by its data contribution, but by feelings of contributing to tackling an environmental problem, or extent to which learning outcomes are attained. This sense of learning was also an important factor for how two respondents perceive citizen science, with Pam commenting, "*if I think about it on a basic level, then yes I am [a citizen scientist], because a scientist is all about learning, isn't it?*" Alice's reply followed a similar theme,

"I've not got degrees or qualifications in science, but I think you're constantly learning with doing the beach cleans. You're constantly learning about the wildlife and the plastics, what things are made of and what impact they have and whether they'll degrade or not".

All interviewees reported some form of positive learning outcomes from the work, therefore it is apparent that identifying as a citizen scientist is not a pre-requisite for harnessing the benefits derived from citizen science work. Put simply, the outcomes gained from doing citizen science do not require the participants to feel like they are 'doing' citizen science. Further, responses from two other participants reflected a lack of prior knowledge about what the term citizen science is. Megan responded, *"that's the first time I've heard that term, so probably not, but I like the sound of that"*, whilst Maggie declared: "*I don't know. That sounds very exciting, doesn't it?"*. Such responses are interesting, considering the project was advertised to potential participants as being 'citizen science', therefore, perhaps the term was overlooked or unimportant for these participants when deciding whether to be involved.

Overall, it is apparent that the participants do not identify themselves as citizen scientists. As such, the label of citizen science may not play an important role in the participant's experience of the project, with a sense of learning and contributing being more important factors in shaping participant identity than the notion of being a 'citizen scientist'. This lack of identity does not appear to limit any of the outcomes derived from the work for the participants. Instead, perhaps the term citizen science is most useful for the scientific community, providing credibility (Lin Hunter *et al.,* 2023) and a common language to associate data, findings and outcomes from such projects with, rather than providing a term that carries any significance for participants.

6.3.2.6. Monitoring Beach Ecology & Morphology

Litter surveys ceased after one full year of monitoring, a result of practicalities beyond the project's control. The Wyre Beach Management scheme commenced in Autumn 2022, which restricted beach access and caused substantial sediment disturbance on the upper beach, altering beach morphology, burying litter and disrupting its 'natural' flux. As a result, it was not viable to plan further surveys, although there was strong desire expressed by many participants to continue with the project and volunteer in similar future activities. For Helen, failure for the project to continue would have resulted in frustration,

"I'd be disappointed if something didn't carry on because it sparked so much interest in so many people, it would be really difficult for somebody to say, well, [you're] finished now, that's it, bye bye, thanks very much. That's the end of that."

Therefore, it was important to both sustain and build upon this public engagement with the coastal environment, ensuring the project provided longevity for the participants and was not perceived as a short-term data collection activity. One area of interest expressed by six of the interviewees, and a theme highlighted in the collaborative workshops and in prior local engagement events, was a desire to learn more about flora and fauna on the beach, including monitoring the changing patterns of species abundance. For Eric, this interest may in part be attributed to his increased exposure to marine life when surveying marine litter: *"The other take away for me and the benefit you get from it [litter surveying] is [that] I hadn't appreciated how much life there was off the coast here"*. Consequently, Coast Watchers was extended beyond litter, leading to a collaboration with Lancashire Wildlife Trust to co-lead five citizen science events in 2023 on Rossall Beach. These events monitored both flora and fauna, and morphological changes, aiming to build participants' understanding of the beach environment and develop their skills (Figure 6.16).

Figure 6.16. *Coast Watchers participants (i) using a dumpy level to survey beach profiles, (ii) exploring intertidal marine organisms and (iii) together as a group.*

6.3.2.7. Summary of Participant-focussed Outcomes

As well as offering insights from the citizen science data, this work sought to capture participant experiences and outcomes from engaging in the project, a participant-focussed perspective commonly overlooked in other citizen science studies. Findings indicate that:

- Marine litter citizen science, compared to the act of beach cleaning alone, offered participants a greater opportunity to build awareness about the types, amounts, patterns and sources of litter in the local coastal environment. As a result, citizen science can change underlying preconceptions about the environment – in this case that beach users are responsible for most of the litter on Rossall.
- For some participants, the project carried wider 'spillover' effects – shaping their place interactions, increasing their willingness to undertake pro-environmental behaviours and leading to a sense of empowerment for future learning.

- Participants can play an effective role in communicating science by disseminating findings and sharing learning within their own social networks. Citizen science projects should better acknowledge the variety of roles that participants can play beyond data collection.
- The researcher can be an important part of participant's experiences and could help to foster positive relationships between science and society. Researchers should seek to replicate such meaningful engagement by designing citizen science projects that involve regular participant-researcher interactions.
- Citizen science participants can experience positive outcomes and benefits from their involvement, even if the participants do not identify as citizen scientists.

6.4. Conclusion

This chapter presents a novel investigation of scientific and participant-focussed outcomes from Coast Watchers, a collaborative marine litter citizen science project. Over the course of a year, volunteers conducted litter surveys on Rossall Beach, revealing that the beach harboured three times more litter than the national average for English beaches. Consistent with global findings, most of this litter was plastic, likely washed ashore from the sea. Interestingly, there was limited evidence to suggest that much of the waste originated from direct littering from beach users. Instead, the study highlights the wave climate as a likely driver of litter accumulation, with seasonal variations in litter loads correlating with fluctuations in offshore wave heights. As a result, more litter was observed during the winter months when wave activity peaked.

There was no positive correlation between the occurrence of reported CSO discharges and the presence of sanitary waste on the beach. However, the detection of such waste, coupled with its potential health risks, underscores the urgent need for stricter CSO regulations. The project also identified 'grot spots' - areas on the beach with disproportionately high levels of litter - that appeared to be linked to the accumulation of organic material in the strand line. These findings offer valuable insights for addressing the issue of marine litter, supporting the development of local litter management strategies, providing comparison for global studies, and informing policies aimed at regulating the production and use of materials persistently littered in the marine environment.

For participants, positive outcomes from the project stemmed not only from the data collected during the citizen science surveys but also, and perhaps more importantly, from their involvement in the citizen science process itself. The process afforded valuable experiential learning opportunities, increased awareness of the impact of litter on the marine environment and challenged preconceptions about its source. Wider 'spillover' effects were also observed for some participants, including the adoption of pro-environmental behaviours, a heightened sense of environmental empowerment, and an active role of participants in disseminating and sharing their learning amongst their social networks. These outcomes were expressed despite participants not identifying as citizen scientists, suggesting that whilst the term may be useful for the academic community, it holds little intrinsic value for participants. Instead, the place-based experience and direct interaction with a researcher appear to be of greater significance to participants overall experience.

The positive outcomes experienced by participants also help to justify the significant effort invested in grounding and collaboratively designing the Coast Watchers project within the local context. By ensuring that the research focus, data collection, and outcomes were meaningful and relevant to participants everyday lives, the project not only deepened their understanding but also transformed how they experience and interact with the coastal environment. Consequently, valuing local knowledge, needs and concerns through a collaborative design process may have supported greater long-term engagement and participation, and created a platform from which further engagement with the coastal environment has been achieved. Given these findings, it is recommended that future citizen science projects, particularly those with a place-based focus, move away from purely contributory designs. Instead, they should actively involve potential participants in the project's design phase. This shift can enhance the relevance and impact of the project, ultimately leading to greater and more sustained community engagement.

The findings may also suggest that, in its ability to promote learning about coastal change, promote community collaboration, and integrate different forms of local and scientific knowledge in its design, citizen science can make meaningful contributions towards building community resilience at the coast. Notably, its capacity to build understanding and learning could correspond to an increased capacity and empowerment to participate in decision-making processes. Again, this reinforces the need to view citizen scientists as more than data collectors; they can be project designers, disseminators, and active, informed participants in managing coastal change.

Overall, this work has helped to address the shortfall of research considering participant-focussed outcomes from marine litter citizen science. Whilst it is important to note that marine litter citizen science projects cannot resolve the problem of marine litter alone, nor should it be viewed as a 'panacea' for promoting pro-environmental behaviours (Wichmann *et al.,* 2022), the findings from this study reinforce its positive value for the beach environment and for those involved (Wyles *et al.,* 2017). Future work could assess whether the findings from this case study hold true across larger citizen science audiences, and collaboratively design citizen science projects using novel methods to better understand the sources and movements of litter in the marine environment.

Chapter Seven

Chapter Seven: From Data Collection to Decision-making

Up to this point, this thesis has designed a place-based citizen science project at Rossall on the Fylde Coast, informed by an in-depth exploration of people's coastal experiences, values and concerns during the COVID-19 pandemic (Chapter 4), and a collaborative design process (Chapter 5). Marine litter was found to be a significant concern and formed the basis of a year's worth of citizen science monitoring through the Coast Watchers initiative (Chapter 6). The initiative presented learning opportunities for participants, something that may contribute towards community resilience, whereby more informed citizens can better contribute to and have a voice in decision-making processes. In Chapter 6, it was reported that one Coast Watchers participant used the citizen science data to support their own activism.

However, if empowered citizen scientists, or wider coastal communities generally, are to have formal, regular and normalised roles and voices within coastal management decision-making processes – a fundamental aspect of the emerging FCERM resilience paradigm - then organised channels and opportunities need to be available to support people's participation. Chapter 2 observed decades of intent to normalise the public's role in FCERM processes, although the persistence of several barriers and challenges restricted a role in practice. It perpetuated a disconnect between the strategic intent to engage people in FCERM decisions, and the capacity for this to be undertaken in practice.

But, with the publication of the latest national FCERM Strategy in 2020, a document that outlines a renewed intent for public participation, there is an opportunity to explore how this disconnect and associated challenges could be overcome and better understand how, when and where communities can participate in practice. Chapter 7 investigates this, contributing to ***Objective Four****: Evaluate the roles and responsibilities that people have, and could have, within a resilience-based management of their local coastal environment by exploring the extent to which public participation within decision-making is achieved, and the space, challenges and opportunities for people within a future participatory coastal management.*

The chapter expands the research focus beyond Rossall and the Fylde Coast to include coastal communities and coastal practitioners around the NW coast to address the following research questions:

4. *How is coastal management conducted and what are the rationales for community involvement in it?*
5. *What are the roles and responsibilities for people and communities within coastal management in the North West; when and where can they contribute and what challenges do they encounter in practice?*
6. *What does the future hold for a collaborative and participatory coastal management under a resilience paradigm?*

7.1. Introduction

Coastal communities globally are on the 'frontline' of climate change challenges (Arnall, 2023). To manage challenges in England, the National FCERM Strategy outlines a headline vision for: 'a nation ready for, and resilient to, flooding and coastal change – today, tomorrow and to the year 2100' (EA, 2020, p.6). Not only does this vision signify a shift away from traditional resistance, defence-based approaches, it marks a new management paradigm of resilience (Section 2.4; Van Der Plank *et al.,* 2022). The transition to resilience demands more than the adaptation of physical coastal systems. Building the resilience of a 'nation' of coastal communities is increasingly being seen as critical, whereby people's voices are heard, and they can better prepare for and adapt to coastal risks (EA, 2020) and become more effective agents in FCERM decision-making (Potter & Fitton, 2023). Consequently, there is an apparent decentralisation of coastal management from national to local levels (McGinlay *et al.,* 2021), whereby communities better understand, and become more empowered and responsible to influence the decisions that affect them (Deeming, 2008; Blunkell, 2017; EA, 2020; Van Der Plank *et al.,* 2022).

Such public involvement in decision-making can be characterised as 'public participation' (Section 2.4). However, despite over two-decades of effort to 'normalise' public participation in FCERM (Kelly & Kelly, 2019a), the ability of communities to have a meaningful voice or involvement in decision-making or resilience building remains limited (Section 2.4.4). Numerous challenges, including readiness, power dynamics, and socio-economic issues, were seen to limit the extent of participation in practice (Section 2.4.5). However, it is perhaps the continuation of top-down, 'DAD' (Decide, Announce, Defend) and consultation-based engagement practices in FCERM that has rendered public involvement minimal and perpetuated conflict (Famuditi *et al.,* 2018; Bradshaw *et al.,* 2021; Bradshaw, 2022).

Consequently, to enable greater public participation in FCERM, there is a pressing need to overcome this disconnect between strategic intent and participation in practice. This chapter seeks to evaluate the roles and responsibilities which people have, and could have, within a resilience-based management of their local coastal environment by exploring the extent to which public participation within decision-making is achieved, and the space, challenges and opportunities for people within a future participatory coastal management. The work focusses on a place-based case study of NW England (Figure 7.1), a coastal area vulnerable to climate change risks, including flooding (Section 2.2; Prime *et al.,* 2015).

The research involved a series of interviews with coastal management practitioners and community members to explore existing coastal management practices, the roles and responsibilities that communities have within this, and the perceived rationales for, benefits of and challenges blocking, public participation in practice. The chapter considers the extent to which engagement messages embedded within the National FCERM Strategy (EA, 2020) have translated to local scales, for instance whether coastal practitioners have put participation into practice, whether tools or resources have been made available to support them in this process, or whether coastal communities are even aware of it. Crucially, the work offers possible future directions to achieve a more collaborative coastal management, where communities have a role, and their voices are heard. Overall, this chapter addresses the significant gap in the literature regarding the roles and responsibilities that stakeholders, including communities, could have in risk management activities (Morrison *et al.,* 2018). The chapter contributes to the growing demand for research that explores opportunities to collaborate with communities in building resilience and adapting to coastal change by making decisions together (EA, 2024a).

Figure 7.1. *Local Authorities around the North West Coast of England within the context of Great Britain (Inset). All interviewees reside or work within these LAs.*

7.2. Methods

A qualitative research study involving a series of in-depth interviews with eleven purposely sampled participants was conducted in winter 2023. Interviews were undertaken with six coastal practitioners and five coastal community actors to elicit similarities and differences in the understandings, roles, opinions and readiness between different stakeholders. Geographically, all participants were from the NW coastal region, residing and working within Lancashire, Cumbria and Merseyside. The majority (5) of coastal practitioners (including coastal managers, engineers and officers) worked for LAs, with the remaining practitioner involved in large scale coastal management project. Four LAs were represented in this study.

Defining 'community actors' is difficult amongst the huge range of organisations, individuals, agencies and publics who hold an interest in coastal management (Ashbaugh & Sorensen, 1976). In this research, 'community actors' are any member of the public with a vested interest or stake in coastal management activities. Here, that includes people involved with parish councils, a coastal community committee member and a coastal resident's group chairperson. Community actors resided across three LAs in both rural (3) and urban (2) coastal settings. Three were retired, two were in employment. Community actors were sourced from locations of contrasting SMP policies for the medium-term epoch (20-50 years, 2025 – 2055), including HTL (1), MR (3) and NAI (1). For the three interviewees living in an area with a MR policy in the medium-term epoch, this management approach represents a shift from the previous HTL policy in the short-term epoch (0-20 years, 2005 – 2025). All interviewees were contacted directly by the researcher via email, using personal networks built during the research process. It is acknowledged that these interviewees represent a narrow band of community roles and responsibilities, with no perspective from coastal landowners, farming or business stakeholders.

Interview questions were tailored for the practitioners and community actors, although each interview consisted of 25 main questions (Appendix C). All questions were designed around the core research questions associated with Objective Two, exploring themes of engagement practices, community roles, national FCERM Strategy, readiness and power. Although the conversations were structured around this set of questions and themes, all interviews were semi-structured in nature, with discussion allowed to meander and be prompted by off-script questions to follow up on interesting themes and topics. Interviews were conducted both in person [4] at a location of the participant's choice (including place of work [3] and home [1]), or online via Microsoft Teams [7], and lasted between 60 and 90 minutes (average 70 minutes). The study received ethical approval (FST-2023-3939), whilst informed consent was obtained from all participants before their involvement.

Interviews were recorded and transcribed before the first round of manual thematic coding, an initial open-minded exploration of the data to tease out themes, quotes and ideas. Coding was undertaken thematically to derive themes, ideas and concepts from the interview data that help to support, challenge and explore the research questions. Codes were then reviewed, grouped, and categorised using NVivo software, which was used to interpret commonality, differences and connections between and across the interviews. Grouped codes were then visualised and mapped by hand to form a coherent narrative before returning to the literature to further explore key themes and new ideas.

7.3. Results & Discussion

Interview results are discussed across three sections, each responding to a research question in turn. The discussion starts by outlining the day-to-day activities of coastal practitioners, providing a window into the possible roles and responsibilities that people could support and engage with in a collaborative coastal management. Rationales for involving people in coastal management are also presented. The discussion then explores whether public participation materialises in coastal management practice, and whether any challenges exist. The third and final parts capture participant's perceptions of the 2020 national FCERM Strategy in theory and practice and provide recommendations and opportunities to advance a participatory coastal management.

7.3.1. How is coastal management conducted and what are the rationales for community involvement in it?

Practitioners primarily described coastal management as an engineering-focussed practice of managing and minimising coastal risks, including identifying, understanding, and addressing risks for the benefit of people and property. Their responsibilities could largely be categorised into three main activities (1) understanding and planning (e.g. understanding risks, strategic planning, sourcing funding), (2) practical works (e.g. delivering FCERM schemes, maintenance of defence assets) and (3) reactive works (e.g.

flood and pollution investigations). Evidently, if people are to engage with coastal management, it is unfeasible for them to be involved in all management activities. In most cases, delivering practical and reactive works demand high financial resource and technical expertise, neither of which would be expected to come from the community. However, if a resilient FCERM calls upon people to have greater responsibility for managing and preparing for their own flood risk (DEFRA, 2020b), then there are clear opportunities for involvement in at least, as defined here, stage (1), understanding and planning.

Community respondents reflected on the importance of having an awareness of, a 'say' in, and ability to question, local decisions. Such involvement was seen as crucial to build decision legitimacy and alleviate conflict, something reported by a Parish Councillor, "*if you don't try and bring people along as you're going through the process, it's going to create schisms*", [Community Actor 4] and widely recognised in the literature (e.g. Edwards *et al.,* 1997; Hegarty, 1997; O'Riordan & Ward, 1997; Begg *et al.,* 2018; Famuditi *et al.,* 2018; Hemmerling *et al.,* 2022). Building decision legitimacy and reducing conflict was further underlined by one practitioner as a key rationale for engaging communities: "*it's not only feasible, it's absolutely essential, it's necessary. Otherwise, it's a game of conflict, it's a game of communities saying they don't like and they don't want*" [Practitioner 2]. Similarly, for other practitioners, a rationale for community engagement and involvement was found in its ability to progress projects, helping to "*smooth the whole process*", whereby:

"*It's so much easier to progress with a project if you're building something and putting something in place if you have engaged with that community and brought them along right from the beginning*" [Practitioner 5].

Central to this was the perception that engagement and relationship building leads to an increased understanding and acceptance of practical constraints, trade-offs, and why the decision is being made, even if it is not the decision wanted. A practitioner reported:

"*You will get a result that may be accepted more readily even if it is not the result the Community want. And that's the important bit that often gets missed, is that they will have a sense that the decision was legitimate, and they will have an a much deeper understanding of it*" [Practitioner 2].

Managing the impacts of the climate crisis on coastal communities were also important rationales for engagement. Three interviewees explicitly correlated climate change with the need for more engagement, seeing engagement as important to build relationships and assurance, and help decisions to be made more quickly in a time of crisis. One practitioner leant on this sense of urgency, speaking of the need for proactive and timely engagement and collaboration with communities to work through and manage the social, economic and political challenges from climate change:

"*I think there are some huge challenges that we're sleepwalking towards; all of the news around climate change is rather anxiety inducing and depressing. All of the latest stats and information from the scientists are saying it's happening faster; it's going to be worse than we expected. And this is going to give us really, really big challenges in terms of how we react to coastal flooding and erosion, and how we build resilience towards that. And I think increasingly, communities are going to realise that they are clamouring for support in defending and protecting their communities. And there is not enough money to go round and it's going to get very political and very challenging*" [Practitioner 2].

However, one LA employee's response suggested that, for LAs, the rationale for engagement is not necessarily a subjective matter, as they are obligated to involve, or '*serve*' the public: "*As a local authority, we are accountable to the public—that's who we're here for*" [Practitioner 3].

Based on the rationales for engagement presented here, engagement can reportedly deliver multiple benefits for the managing authorities and communities and is particularly important at a time of climate crisis at the coast. Practitioners demonstrated an awareness of the value of community engagement in coastal management, although given the lack of public engagement reported in the literature, it is pertinent to investigate whether community participation in coastal management materialises in practice.

7.3.2. What are the roles and responsibilities for people and communities within coastal management in the North West; when and where can they contribute and what challenges do they encounter in practice?

7.3.2.1. Current Engagement Practices

Reported engagement practices do not, in most cases, currently provide people or communities with a significant role or responsibility in the management of local coastlines. For communities, this may feel like a lack of involvement in the decisions that affect them, emphasised in the despondence of one interviewee:

"I certainly don't feel involved in it... I think it's quite shocking really when you think about it. I can't think of any way they're trying to engage us. No, we don't hear anything.... I can't see this mechanism for communicating with communities" [Community Actor 2].

In fact, despite the stated rationales for and benefits of engaging the community in management, four practitioners suggested that the extent of people's involvement in practice is limited. Public involvement was labelled "*minimal*" [Practitioner 4], with one coastal manager noting engagement practices were reduced to: "*what's the bare minimum we can almost get away with"* [Practitioner 6]. Engagement was described as "*fragmentary*" and "*embryonic*", tending to be "*reactive in response to either a threat such as the risk of erosion or a scheme*" [Practitioner 2]. This comment appeared to capture well the state of engagement, which, when it was performed, tended to be limited to during coastal management schemes and works.

Consequently, engagement is typically '*scheme-specific*'; FCERM schemes and projects that are presenting a solution(s) to flood or erosion risks. Such engagement could be described as 'invited' (Yuille, 2023), whereby public feedback is acquired on options presented by practitioners. This engagement process appeared common across different LAs, with feedback seemingly sought early in a project: "w*hen we've got the money and when we've got some ideas about options that could be taken forward. So very early on when we have something to discuss, then we went out and did it [engage]"* [Practitioner 4]. The sense of early engagement was experienced by one coastal resident [Community Actor 5] who's local beach was experiencing a renewal of hard defences: "*there'd already started telling us what they were planning to do, or what they wanted to do, before the actual process started to move along"*. Letters, meetings, social media, and drop in events were all used to provide information and seek community input, which was seen to affect and shape decisions:

"*The project sort went back to the drawing board because they didn't want what we were giving them. So, the project's changed because the community... said no, we won't accept what you're saying"* [Practitioner 3].

Yet, it was also evident that scheme-specific engagement, even when done early, is not necessarily followed through into scheme implementation. Practitioners remarked that engagement can be a top-down and explanatory one-way provision of information:

"*When we're doing something, we will go out, but there isn't that ongoing dialogue, that general stuff. Tweets and stuff will go out, but it's almost a one-way thing, we'll put stuff out and then we don't really monitor what comes back or follow up on it"* [Practitioner 6].

A lack of ongoing dialogue was captured in the frustrations of one resident:

"They're building quite a big compound on a grass field so that rocks can be delivered… only when they started putting the fence up [did] the people that live nearby know about it and could see it happening. I started getting phone calls and questions asked by people that live nearby… just at the minute they're putting a spade in, somebody [from the council] manages to tell me. I'm like 'fuck's sake', I just rolled my eyes in my head and thought – 'typical'" [Community Actor 5].

Engagement may also be too late in the decision-making process, perpetuating conflict: "*they don't agree with what we're doing, in some instances that's probably because they haven't been engaged early enough and not been brought on that journey to understand the decisions"* [Practitioner 6].

Whilst engagement is commonly reported across the NW based practitioners, practices are largely reactive to the needs of a specific scheme. One practitioner even contemplated: "*we wouldn't be doing that [engagement] if we weren't doing the scheme. I think it's just reflective of the resource, we just don't have time for that proper dialogue*" [Practitioner 6]. The extent of public participation in such '*scheme-specific*' engagement practices could be deemed 'consultation' - the lowest level on Arnstein's (1969) ladder - limited to seeking feedback on possible solutions and timed to align with a specific decision-making process. One a practitioner felt that such engagement could not be regarded as '*proper*': "*obviously there's been consultation and things happening in the past, but specifically very little that I would class as proper community engagement"* [Practitioner 1]. This may be a result of the restricted power, responsibility, and relationships with practitioners that people are afforded in these processes.

However, some past examples of a more collaborative and inclusive coastal management were discussed by practitioners. Collaboration was seen to foster relationships between communities and the managing authorities, to the extent that in some instances the public would reportedly defend decisions. One practitioner reported:

"They brought the chap along who was going to chair, and we introduced ourselves and they gave him the floor, and he was [like] 'right, what's the Environment Agency doing about this,

what are they doing about that?' And the chair of the established group just stepped in before any of us could, and [said] 'oh, hang on' and put him right in his place. And it was just wow, what a good job we've done... just seeing that journey and turn around like that. So, it's all about transparency, trust, relationships, collaboration" [Practitioner 5].

Coastal Partnerships were seen to facilitate such collaboration, whereby people would be engaged early to promote 'buy in' and facilitate ongoing dialogue:

"We had... a partnership of all the land managers on the coast. It was, for a while, much more proactive, engaging with the communities and getting people on board. We used to have an annual conference, open to the public... we had a community magazine that we produced, it was much more positive engagement with them, bringing them along the journey" [Practitioner 6].

This sense of collaboration was compounded by another practitioner involved in several Coastal Partnerships. A partnership's function in the 1990's was described as: *"funded to bring people together and develop strategies and action plans to help overcome some of the challenges and conflicts that may have been happening on the coast"* [Practitioner 2] through community meetings and conferences.

However, whilst these collaborative, beyond consultation, approaches were seen to be valuable, with a reflection that they "*achieved more... than nowadays"* [Practitioner 6], there was a sense that they are now a rare occurrence in the day-to-day coastal management experiences and operations for practitioners involved in this study. This was a matter reflected upon by the same practitioner: "*I'm just trying to think of instances where you know, particularly with the Council, where it's been a more partnership approach. There's not many*". Another practitioner, recounting their experiences of bringing stakeholders together in Coastal Partnerships, described the economic reality of undertaking such approaches:

"If you were critical you would call them talking shops. I think are valuable and purposeful, but extremely difficult to fund. And without resources, without somebody facilitating it was really, really hard to keep going... the difficulty is that with tight budgets and tight funding, it is seen as a luxury" [Practitioner 2].

7.3.2.2. Community Roles and Responsibilities in Coastal Management

Although public involvement is mainly limited in practice to consultation on FCERM schemes, several further roles and responsibilities for communities in coastal management were highlighted in the interviews. People can be physically involved in management, volunteering for the benefit of the coastal environment through beach litter removal and citizen science. As explored in Chapter 6, through citizen science, people can become acquainted with and gain a heightened sense of awareness of the coastal environment and challenges facing it. Although the citizen science did not directly enable people to participate in decision-making, this strengthened relationship with the coast may empower people to take a sense of ownership for the coast. Considering the role of a community beach cleaning group, the group's chair described how this ownership can materialise in practice through the emergence of a 'voice' acting in the beach's interest, an indirect effect of their physical involvement which has shaped how the LA manage the beach:

"As the group has developed and grown, the local authority has realised that there is a voice that acts for this beach, there is a community. It has got a voice of its own via us and they've got to be more approachable and amenable in terms of what happens to it and how they look after it" [Community Actor 5].

Physical involvement can also extend to people undertaking their own coastal management. Practitioners reported that individuals can take responsibility for defending their own properties from flooding and erosion (LCC, 2021), whilst landowners can build private defences to protect their coastal frontages (CCC, 2022). Such activities may be subject to adequate skills, funding, consents, and permissions, although an example of individuals moving beach material to protect property on a localised, unofficial basis was described. Coastal management can also be performed beyond the individual scale, with one resident describing that a local community should take collective responsibility to prepare for flooding, whilst three interviewees spoke about people self-organising into action groups to achieve common good.

This was the reality for one community-based interviewee [Community Actor 2], who described a form of 'invented' public participation, where their community have self-mobilised to drive action and get their voices heard. Living in a small coastal hamlet, the community faced a NAI SMP policy for all three epochs. The community mobilised in response to the policy, reporting that "*it forced us to work together and that's how we set up our committee and our constitution is all about fighting off whatever is going to happen with climate change*". Motivated to work together and undertake their own practical FCERM works, the community raised local awareness, sought grants, and generated funds to build both property level flood protection (flood gates) and larger scale coastal protection (sea wall) and have considered alternative NBS (saltmarsh). Engaging with others has enabled the residents to see their challenging situation through an opportunistic lens: "*think of it as a plus that there's No Active Intervention, you're free to go and do what you like now, and you're unique, go and do it!*". But this opportunity has come with a burden of local responsibility, one which has left a lasting toll on community dynamics, a demonstration of the potential societal impacts that SMP policies can have if coordinated engagement efforts are not forthcoming.

Beyond physical involvement, communities can be information sources, sharing knowledge and observations of coastal change and flood risk collected through lived experience (CCC, 2022). Practitioners spoke of the valuable information that communities can share; "*it's so useful building that picture to help you build something that's going to do the job correctly*" [Practitioner 5]. Another engineer supported this sentiment; *"we've got all these maps, all these models, but you actually speak to people that live there and they can tell totally different things. It's totally invaluable"* [Practitioner 1]. Such statements acknowledge the limitations of relying upon models and scientific knowledge alone to find solutions to coastal issues and underline the usefulness of accounting for lay knowledge in such processes (French *et al.,* 2016), whereby knowledge and observations may help 'ground-truth', validate, and add value to models (Starkey *et al.,* 2017; Rollason *et al.,* 2018).

For one resident though, there was a strong feeling that such knowledge is undervalued and unwanted by managing authorities:

"You might be the scientists and you might be ones that have got the qualifications and the in-depth knowledge of all the reports and all the statistics and all the data and everything, but on a day-to-day basis, we are living on this sea front. We're the people who are sitting in the house watching the weather. We're the people that are walking the dogs up and down. We're the people that are collecting the litter. So on a one by one intimate basis, we're the ones that have got day by day knowledge, but it's never requested, it's never asked for... quite honestly, if I were to say to [name of practitioner removed] whilst he's building something on the front, why are you doing that because it's going be a complete waste of time and it's

going to cause XYZ problems? He'd roll his eyes in his head and say, oh, bloody hell she's off again. And you sort of get the feeling that if you try to give advice based on experience that you're a nuisance" [Community Actor 5].

In this instance, the discrepancy between the value practitioners place on local knowledge and the extent to which this value is felt on the ground by this resident may be a consequence of restricted timing and opportunity to provide knowledge. Knowledge provision is possibly limited to consultation periods during FCERM schemes, timed when practitioners want to hear from communities. There are perhaps less opportunities for ad-hoc knowledge sharing, highlighted by the lack of ongoing two-way dialogue between practitioners and coastal communities. For this community member, they may feel that the information shared outside of such official consultation periods may not be valued to the same extent, since for practitioners, it may not be something that they can use to shape a scheme or act upon. Moreover, the use value of local knowledge can have pitfalls in practice, as it may be open to misinformation, as reported by Stojanovic & Ballinger (2009). Such knowledge may invite scepticism, with one engineer stating "*the main challenges are going to be trying to sort the fact from the fiction... one person's perceived reality will be different to someone else's*" [Practitioner 3].

Reporting and acting on coastal issues are further roles communities play in the coastal management. Both practitioners and community members widely reported that people raise coastal related concerns, issues and complaints with managing authorities and councillors. In cases, concerns may stimulate reactive coastal works. However, interviewees suggested that concerns are more commonly associated with access and service provision (e.g. highway flooding, coastal access and toilet provision) than management of flood or erosion risks. Reasons for this are unclear, although could be associated with several factors including the tangibility of visible concerns prompting action (e.g. litter in Chapter 6) compared with long-term flood, erosion and climate risk perceptions and a lack of community skills or funding to engage with coastal defence issues.

7.3.2.3. Challenges & Barriers to Public Participation in Coastal Management

Thus far, the chapter has explored the roles and responsibilities that communities play in coastal management and found that communities have a limited role outside of specific scheme-based engagement and consultation. The discussion turns to explore the factors and challenges that have, and are, precluding a more extensive and collaborative role for communities in coastal management and decision-making processes. Challenges and barriers to participation have been widely demonstrated in the literature, with six broad challenges identified (Section 2.4.5; Kelly & Kelly, 2023b):

1. *Readiness*
2. *Framing, Language & Communication*
3. *Climate Change, Emotions & Mental Health*
4. *Place Attachment*
5. *Power, Politics & Conflict*
6. *Questions of Scale*

(1) *Readiness* and (3) *Climate Change, Emotions and Mental Health* were found to be the principal challenges to engagement in this NW context, and both are considered in greater depth in this discussion. This work also identified an additional, seventh challenge:

7. *Systemic Barriers*

Systemic Barriers amount to the factors restricting the ability of coastal practitioners to engage with communities, even if they are 'ready'. Barriers discussed here include the practical, financial, and engineering constraints in coastal management, as well as the aforementioned 'governance vacuum' (McGinlay *et al.,* 2021) that fails to provide practitioners with the resources, frameworks, or tools required to achieve successful public engagement.

Readiness

Awareness of (non-defence) Shoreline Management Planning

There was the sense that the SMP is not widely known amongst the community, even though it is the principal strategy for guiding future coastal management. One resident claimed that local community awareness for the SMP is "*on a scale of one to ten, one, if you're lucky!"* [Community Actor 5]. Such opinion was shared by a coastal engineer, who had no awareness of the SMP prior to starting the role:

"*I'm an engineer. I live in a coastal village. And until I took this role, I'd never heard of the Shoreline Management Plan. I had no awareness, no awareness et all. I think if people did know, I think the first thing that'd happen in a lot of communities is that there'd be an outcry: 'Why are we not being defended forever?'*" [Practitioner 3]

The final sentence is indicative of how practitioners perceive communities to think about their coastal management, that hard defences can provide complete protection, and that coastal residents expect to be defended in perpetuity, mindsets reported in wider studies (Kelly & Kelly, 2023b; Apine & Stojanovic, 2024; Blunkell, 2024). Practitioners expanded upon this expectation for physical defences: "*people have this idea that a wall is going to protect us for ever and ever, and unfortunately they're not"* [Practitioner 4], and:

"People say, 'I've got my house here, it was fine for 15 years, and now I'm getting waves coming over my front garden and the cliff washed away, and my house is at risk, I expect you to do something'. It comes back to that expectation of people on the authorities and that lack of understanding of that individual in those communities" [Practitioner 5].

This perceived mindset for defence also contradicts an RMA's legal position. As set out in the Coast Protection Act (1949), RMAs have the *power*, but no legal responsibility, to protect property from flooding or erosion: "*do we have a duty and a legal responsibility to build that defence? Bottom line is no, but people don't see that"* [Practitioner 5]. One interviewee working for a coastal parish council noted that it was only through their role that their attitude towards coastal defence shifted:

"Before I sort of took this role on, I would have said you've got citizens that live there, they should be looked after. But I also do feel as though they have chosen to live right on the shore, so there's got to be some... responsibility to sort of look after their own property" [Community Actor 3].

Although mindsets can change through increased awareness and learning in these instances, widespread expectations for continued state-funded defence are reportedly incompatible with the need to engage people in developing non-defence SMP options and adaptation (Kelly & Kelly, 2023b). Given the sample size of this study, it would be amiss to suggest causation between a 'defence mindset' and disengagement from coastal management, yet this scenario does highlight one example where a low community readiness may present an engagement barrier. Increasing SMP awareness should be a priority to overcome this, something that the EA are undertaking with the publication of the

'SMP Explorer'[19] (EA, 2024b) in early 2024, although it is unclear whether this tool is specifically targeted for, or being distributed amongst, communities.

Practitioner Concerns

The readiness of coastal practitioners for a more inclusive decision-making process is also important (Kelly & Kelly, 2023b). Concerns included involving too many voices or opinions in collaborative or co-designed decision-making, something that could derail project timelines, create uncertainty in the decision-making process, or potentially impede on preferred decisions (Blunkell, 2017). One engineer described an open decision-making process as "*probably quite frightening*", adding:

"I think the risk is, but this is probably just me being too traditional in my approach though, [it] could just throw so much at you that you'd be [like], well where on Earth could I be with this? And I'm perfectly willing to accept that this is me being old, programmed to follow a certain approach, because that's what we've always done it" [Practitioner 3].

There was also a concern about the practical realities of involving the public, which can present difficulty for practitioners to deliver their roles and responsibilities effectively: "*We're constrained by time and budgets. When you get somebody else influencing what you're going to do, that can cause all sorts of problems"* [Practitioner 5]. The message was echoed by a fellow engineer: "*The reality it is that* it *[public voices] can be a nuisance. When I'm trying to get a job out and done, and I've got what I think is the right idea, but I'm having a stressful week, it's a nuisance"* [Practitioner 3].

Such issues may be genuine concerns, although another practitioner argues that concerns and fears could be a consequence of negative engagement experiences, or as Practitioner 3 stated, '*traditional*' approaches to decision-making that can trigger conflict (e.g. 'DAD' model; Section 2.4.2):

"I think there is fear from the coastal engineers... that is in part because very often their experience of community engagement is flavoured by the ones that haven't worked well and by the difficult and contentious decisions... things have gone wrong, and they have to go and face a public meeting where people are angry" [Practitioner 2].

[19] The 'SMP Explorer' is an online tool enabling people to find the SMP policies for their local coastline.

The Relationship Between Coastal Management Authorities and Communities

Perhaps the greatest hurdle to engagement readiness is not a lack of awareness or practitioner concerns, which could both be overcome through learning or positive experiences, but a difficulty to engage the community in the first place. For instance, the (lack of) relationship between coastal management authorities and communities is both perceived by practitioners and felt by community actors to be one of low trust and visibility. In which case, irrespective of the managing authorities' intention to collaborate and engage, the engagement may be starting from a negative and untrusting place.

This perception was affirmed by some members of the community. A Parish Councillor, reflecting on reasons for public disengagement from issues, stated that "s*ometimes it's a feeling that people will not really be listened to anyway"* [Community Actor 1], a belief felt by another interviewee: *"you just immediately suspect that they [LA] want to tell you what they're doing, and you've got to be quiet and accept it. And you've got to fight if you don't want it"* [Community Actor 5]. The Parish Councillor suggested that this may "*be a cultural attribute. People have not historically generally been asked to be involved in things"*. Moreover, for one LA engineer, this perception of low trust was already ingrained prior to starting an engagement process:

"My first thought [was], this is going to be a bit hard because the perception is that a lot of people don't trust Council officers. They'll trust the bin men, they like the bin men… but sometimes when somebody from the Council comes down for something, they get a bit suspicious; they think what's all this about. So, from my perspective I was quite nervous about doing it" [Practitioner 1].

Another engineer unpicked this notion of low trust, ascribing it to a feeling that people may not trust that their voice is going to make a difference:

"I've received lots of correspondence to this end over the last few years, where [people say] 'you're asking us what we think, but it doesn't matter what I tell you, because nothing's going to come of it, and you're just going to do what you're going to do anyway'" [Practitioner 3].

These perceptions are perhaps a legacy of top-down 'DAD' decision-making where people have been excluded from or ignored in the debate and may taint any future efforts to encourage public participation.

For another interviewee who is heavily involved in local voluntary coastal management activities, this lack of trust could not be disentangled from a perception of low mutual respect between communities and managing authorities:

"There's this complete lack of respect for what people are prepared to do and... what communities are doing for themselves. Likewise, that translates into a lack of respect for the organisations that are managing them" [Community Actor 5].

Again, this low respect was perceived to be culturally engrained, a factor explored by two participants:

"*You do hear gripes of people saying 'oh the Council never tell us anything'... I think people need to know generally who their councillors are, who to go to and make the whole process more transparent not just for flood risk, but for everything... it is in essence a culture, a political culture*" [Community Actor 1].

"It's endemic throughout the whole country that people always assumed that local councils are rubbish, corrupt, do the bare minimum and basically not fit for purpose. So you've already got this really negative perception that you're starting off from, and a lot of the times they are their own worst enemy because they just don't tell people what they're doing. They're so cloak and dagger about everything" [Community Actor 5].

The last point, that there is a feeling of secrecy in LAs, was one which transcended into coastal management. Some community interviewees suggested that coastal management practices, responsibilities and personnel lack visibility. One interviewee remarked "*my lack of confidence in any one authority having charge of that was I couldn't see anything happening"* [Community Actor 4], and that "*I would have said it was dealt by somebody almost sort of like faceless, somebody that I don't know, that it involves large diggers and plenty of people moving sand and stones about"* [Community Actor 3]. For these participants, this mindset only changed when they were directly engaged by coastal practitioners, something that was instrumental in building one person's understanding of coastal monitoring: "*I would never have credited that everything is so carefully monitored and measured and watched and checked, because there's no evidence of that to the average Joe'* [Community Actor 5]. A low visibility of decision-making was also apparent, even where the community may have high awareness of the decision itself:

"I've kind of noticed with the strategic [sic] management plans, the area that is covered by the plan is huge and it's got something like, I don't know, 200,000 houses in there or something and there's only 38 that aren't hold the line. And we're 34 of them. So how all these things are decided, I'm not too sure?" [Community Actor 2]

Climate Change Intangibility

Results suggest climate change perceptions are a barrier to participation. Although all community interviewees expressed an awareness of climate change, it was not considered to be a motivator for promoting action or engagement with coastal management. Interviewees stressed that people are not perceiving the threat of coastal climate change impacts; they are deemed intangible, distant and not immediate. Interviewees expressed that climate change is *"a big concept to grasp because you're not visually seeing the signs"* [Community Actor 2] and that short-term, day to day concerns are of greater importance (Kelly & Kelly, 2023b): "*human beings aren't equipped at looking at long-term acute issues. We tend to just to focus on the day to day*" [Community Actor 4]. For participants, this sense of intangibility and globality directly correlated to feelings of powerlessness towards managing risks now. A deflated community member stated:

"*When you're talking about something to do with coastal management, you do definitely marry that together with climate change, environmental disasters, all that kind of thing at the moment, which feels bigger than a little community. So, I think that people probably do feel quite powerless*" [Community Actor 3].

Another mused on contradictory, 'business as usual' national policy for building major projects on the coast, unhelpfully downplaying the risk of climate change to the coast and the need for adaptation:

"*It's intangible at the moment, especially when you have such things as proposals for the GDF [Geological Disposal Facility] to be sited right on that coastal plain. You think, well if they're building such an important thing there, or proposing to, then you know it must be alright really*" [Community Actor 1].

There was also a sense that 'others' are experiencing climate change in more tangible ways and therefore are more concerned and are more motivated to engage, for instance nationally on England's East Coast:

"On the East Coast where you get a lot of coastal erosion, people are losing their houses, their land, roads and everything. I think you've got to have something tangible. That's more of an emergency situation on the East coast" [Community Actor 1].

The feeling was also expressed on local scales:

"I actually feel the community's a little bit further around in [place names removed]… I think that they're much more aware of what's going on because it really does come into their front rooms on the regular" [Community Actor 3].

But even for such communities 'further' around the coast, where awareness of climate change implications is reportedly "*massive*", the feeling that 'others' are experiencing climate change impacts more still persists, with the East Coast again highlighted: "*Every week you see somebody's house falling into the sea… these are people that are really having it tough, they can see it right in front of their eyes*" [Community Actor 2].

Consequently, for some participants, this sense of distant risk, both in time and geographic space, translated to a strong theme of apathy towards managing risks now:

"*There's probably a little bit of the 'what will be will be' attitude because you do think of it as something that is so huge that we'll all do our recycling, we'll all do our little bit, we'll try and ride our bike. But sort of like massive wholesale change isn't necessarily within this community's grasp*" [Community Actor 3].

Another commented, "*it's not immediately apparent, and so people are not necessarily going to engage – 'oh well, it doesn't affect me' sort of thing"* [Community Actor 1]. Another said, "*I'm hoping that by the time it's a problem, I'll be dead*" [Community Actor 5], a response that practitioners reported as typical: "*Some of the impacts are that far into the future, you know, particularly the flooding and the erosion – 'meh, I'll be dead by then' – that's a lot of the responses we get from people*" [Practitioner 6]. Other practitioners testified this lack of concern, particularly amongst older residents:

"They're of an age where the real impacts of sea level rise, they won't see. So why should I change what I do when it's not going to affect me? Most of them will have kids and they'll wonder about the next generation, but it's not being able to see things. And we're still making predictions of what's going to happen, but there's things that we just don't know" [Practitioner 1].

This apathetic outlook towards climate change may relate to the intangible nature of its impacts, which are inherently uncertain and difficult to predict in time and space (Visschers, 2018). The slowness of incremental climate and environmental change make climate change difficult to experience personally (Weber, 2010), whilst experiences can be moderated by prior beliefs, including whether the experience is even attributed to climate change in the first place (Sambrook *et al.,* 2021). Such mindsets may be perpetuated by an 'absence of a clear and honest national discourse on climate change and its implications for flood and coastal erosion risks' (Kelly & Kelly, 2023b, p.8). The result is that for many people, climate change is framed as distant, global, non-urgent and non-personal (Van der Linden *et al.,* 2015), precluding action and societal change. At the coast, this could be a significant factor in the lack of implemented adaptation plans, since communities who are unconcerned about long-term climate risks may associate a greater risk from the short-term impacts of doing proactive adaptation (Gibbs, 2016). In this sense, adaptation itself becomes the hazard, a short-term economic, social and political threat that weighs more heavily in the minds of present-day land and homeowners compared to distant and intangible climate risk (Gibbs, 2016).

An important question is raised to consider for individual coastal communities facing non-defence SMP policies: if apathy towards climate change is fed by the sense that risks are uncertain, distant, and removed from one's immediate sense of place, can proactive adaptive action be undertaken without the need for communities to 'experience' climate risks in the first place?

Systemic Issues

Public participation in coastal management is also constrained by the available resources and parameters within which coastal practitioners must operate. Practitioners stated this is particularly relevant for hard engineering solutions, which are restricted by technical (e.g. funding demands a certain number of properties defended to an exact standard), financial (e.g. limited finance), strategic (e.g. alignment of the solution with SMP) and regulatory (e.g. designated habitats) constraints. Practitioners remarked that as a result, there is limited opportunity for communities to influence the decision-making process:

"A lot of what we do on the coast protection is so technical that there's so few options for people to contribute to, that you're almost coming to them with a finished design. And you know, part of that is due to the restrictions we have on site" [Practitioner 6].

Another, reflecting on recently constructed flood defences, said that the funding restrictions meant "*you can only have it if it's that high and protects that many properties, and that's the end of it. When you've got constraints like that, it's very difficult not to have that 'DAD' approach"* [Practitioner 4]. Interestingly, one resident recognised and accepted this as fact, understanding that their potential input into a hard engineered scheme will be minimal:

"When it comes down to doing a job like this, with the knowledge that I've got, I can see that they're not really got much option about what they do… we've not got the engineering knowledge to be able to say this seawall will work better than that one" [Community Actor 5].

Although a practitioner expressed cynicism at this single-solution approach, the consensus was that collaborating with communities on hard engineering works is difficult or even unfeasible, with opportunities for people to only shape aesthetics.

However, perhaps the most significant limiting factor for community engagement in coastal management, and one that is a long-standing issue, is the non-availability of finance to undertake it (e.g. Shabman, 1974). Four practitioners reflected upon this barrier, but it was perhaps best captured by an engineer, who admitted that "*brutally it comes down to the finance, the funding"* [Practitioner 6]. He continued,

"*There's no extra money for engagement… you don't get any plus points if they're [the community] on board or not. You know, the way it is at the moment, it's all about what are you're protecting, what's the cost benefit?… We could do it [engagement]; we just need the resource to do it, that's what it comes down to. I don't think people don't want to do it; it's just [having] the resource to be able to do it and do it properly*".

Funding is not the only resource in short supply to deliver public engagement; time, support, and personnel are also absent. An engineer mused:

"*We'd like to do a lot of things but we're just not able to. It does come down to resources, but it also comes down to time scales as well. We get funding, the time scales to bid for funding are quite restrictive, and the time scales from getting the funding to delivery are* *again restricted... and trying to do everything else that comes along. And it's not just the community engagement aspect, there's a lot of things that we have to do"* [Practitioner 5].

Another, contemplating the lack of resource for engagement, put the timelines of a coastal management project into perspective: "*The scheme we're looking at is £20 to 30 million, we might have half an hour looking at it every couple of weeks. You know this isn't right, but that's just where we're at"* [Practitioner 6]. Given these timescales, and the fact that practitioners remarked that engagement is a time-consuming process, it is unsurprising that engagement is squeezed amongst a plethora of competing and overlapping responsibilities.

Three practitioners also bemoaned the lack of engagement support and training given to coastal practitioners, a factor that one interviewee felt contributed to a limited number of people who are ready to do the engaging. The point was underlined by another practitioner, who reflected on their engagement practices in Our Future Coast:

"I think there's a lack of, in local government especially, good consultation, knowledge and skill. We are very much winging this. I don't have any knowledge; we were never taught it. It's not something that I've ever done" [Practitioner 4].

It is quite possible that the coastal management authorities themselves are not ready for a more collaborative management, a matter described by a practitioner: "*the community may be ready to take part in these processes, but until that is reciprocated by the agencies, it's really hard to get to that place where the communities feel empowered*" [Practitioner 2].

7.3.3. Midpoint Summary

There are roles people can and do play in coastal management, including physical involvement, sharing knowledge, and raising concerns. Communities can, in some cases, self-mobilise into action groups to manage local coastal challenges. However, the opportunities for communities to engage beyond physical involvement and contribute to decisions is largely restricted to specific windows of opportunity, primarily one-off consultation to develop FCERM schemes. As such, the extent to which communities are acting in partnership or collaboration with managing authorities is low, since project by project consultation restricts the possibility for sustained, long-term engagement (Famuditi *et al.,* 2018). Although such engagement may not be described as a traditional 'DAD' approach, since communities were, in cases, able to comment and shape schemes before final decisions were made, it certainly could not be described as a truly collaborative and deliberative 'EDD' model either (Section 2.4.6; Walker, 2009; EA, N.D.). The current approach in the NW is somewhere between these two polarising models, engagement is not absent from coastal management, but it does not give communities any power or responsibility to truly affect decisions and plan for long-term change.

Systemic barriers are at the root of this, with LA's lacking the resources, including time, funding, and training to properly engage, even if practitioner's intentions and desires are to do so. Moreover, certain aspects of the FCERM process appear incongruent to a collaborative coastal management, particularly developing hard engineering schemes, where limited technical options present limited opportunities to engage people in the first place. Community challenges have also been observed, namely low readiness (public expectation on defence, perceived non-awareness of the SMP and lack of understanding of the constraints facing managing authorities) and climate change perceptions (apathy towards an intangible climate change). These challenges highlight instances where community awareness of coastal issues was perceived to be too low to either motivate action or allow communities to meaningfully contribute to management. With the addition of the supposed (lack of) relationship between managing authorities and communities, which bred mistrust and low visibility, there are significant barriers to achieving a more participatory management.

And so, we arrive upon this juncture; public participation is under resourced, lacks statutory power or authority, and is uncertain in practice, yet it remains vital to proactively adapt and build resilience to coastal risks. Without effective public participation now, it could become an additional obstacle, alongside political and economic short-termism (Few *et al.,* 2007; Brown *et al.,* 2023), that hinders necessary coastal adaptation in the future. The final section considers possible opportunities to overcome the challenges and barriers and deliver a more participatory coastal management.

7.3.4. What does the future hold for a participatory coastal management under a resilience paradigm?

7.3.4.1. Does the Solution Lie with the 2020 National FCERM Strategy?

Compared with the 2011 national Flood and Coastal Risk Management Strategy for England (EA, 2011), the 2020 iteration (EA, 2020) marked a step change in public engagement framing. The engagement scope grew in its ambition, from 'communities' in 2011 to 'a nation of people' in 2020 (Blunkell, 2024), whilst the visibility and use of engagement related terms increased (Figure 7.2). The narrative shifted from outlining roles and responsibilities that communities could and *should* play, to a recognition that communities *want* to play. The shift is captured best by the statement: 'People want to have a voice in shaping how resilience to flooding and coastal change is achieved in the places in which they live and work' (EA, 2020, p.95). The statement captures a sense of participation and collaboration, an active recognition that communities want agency and voices in this space[20].

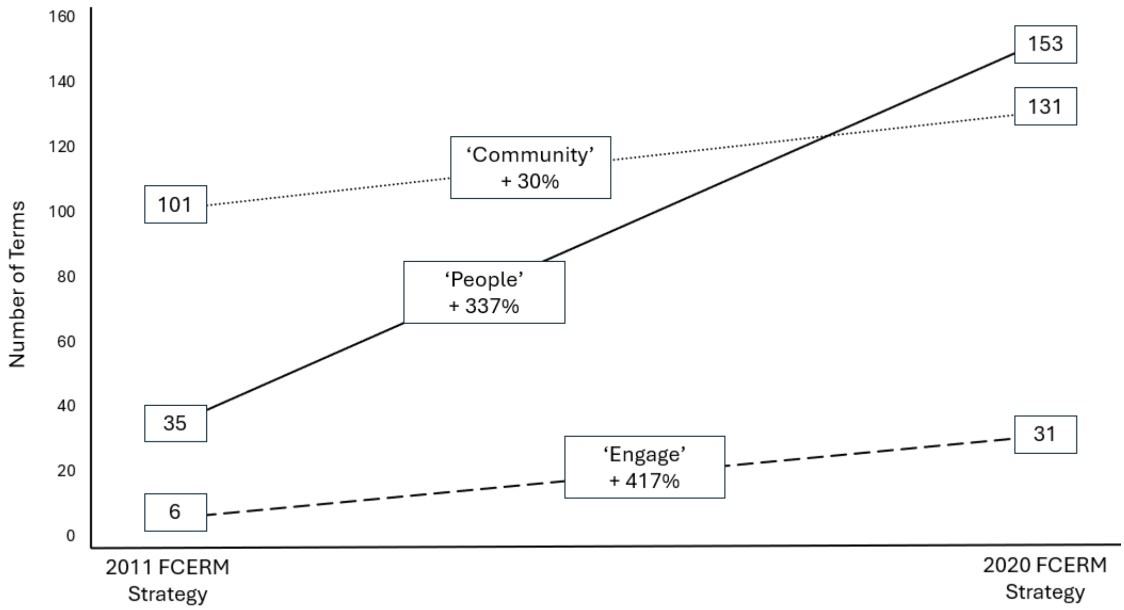

Figure 7.2. *The number of engagement related terms used in the 2011 and 2020 Flood and Coastal Erosion Risk Management Strategies has increased (EA, 2011; EA, 2020). Percentage increases between the two strategies are provided. The terms 'community' and 'engage' are inclusive of 'communities', and 'engaging' and 'engagement' respectively.*

[20] Evidence for communities wanting a voice in coastal management can be traced back to at least 2008, when a community-led organisation called the 'National Voice of Coastal Communities' was established (Famuditi *et al.,* 2018).

Both community actors and practitioners expressed positivity and support towards this statement, with residents finding it '*heartening*' and '*great*'. Having a voice was seen as an opportunity to be heard and involved in shaping decisions that impact them, a central theme of democratic ideology (Nelkin, 1975). For one resident, it was fundamental that this opportunity was from the start:

"It should be to be in that room, not when the decisions have been made or when consultations are done, none of that. But actually to be in that room and say, 'well, you know what, that's fine for you, but I live here, and this is what's happening to us'" [Community Actor 2].

However, positivity was dampened by a feeling that it may not represent anything new, and whether the engagement intent will be lost in the strategy: "*it's really good to put in something like 'community needs a voice', but it is a line, isn't it, in a very long document*" [Community Actor 2]. Pessimism also stemmed from a sense that having a voice may just be used to further increase pressure on the managing authorities and deflect from any personal responsibility to manage coastal risks. An engineer commented gloomily: "*I think some of them might only want a voice as much as 'I want this fixed, what are you going to do about it?'"* [Practitioner 3], a feeling reflected in the responses of two community members. One resident, whilst expressing agreement with the statement, remarked:

"The way that people want to be involved is to shape and have a say in the things that are done for them. People generally want to say to the Council or the Environment Agency, 'you've got to do that because that will protect me!' But there is a flip side to that, and that is what people should do at home, and should take responsibility for, in their own backyard that will also protect them from floods... and that's the bit that people don't want to do" [Community Actor 5].

A question was also raised about *who's* voice would count, as the collective 'public' or 'community' contain a plurality of different perspectives. One resident noted: "*it comes back to that thing about what's a community? This is like a huge issue. We're not all thinking in the same way"* [Community Actor 2]. Failure to account for this diversity, and instead representing communities with a single, homogenous voice could increase conflict (Nursey-Bray *et al.,* 2017).

There was significant scepticism about how this engagement intent will translate into practice given an apparent lack of guidelines about how it will be achieved. Two Parish

Councillors contemplated this ambiguity in practice, stating: "*I know that people want a voice, I know that people want to be able to do something, but it's the how?"* [Community Actor 3]. Another expressed uncertainty about how the strategy will be replicated on the ground, because they *"don't know who owns the problem or the issue... I don't see a government agency heading this up"* [Community Actor 4], perhaps another reflection of the low visibility of coastal management authorities and practices. Moreover, one practitioner stated that the strategy is unlikely to be impactful:

"It'll probably come to nothing because I think it'll probably mean that we spend more time speaking to people and getting what the community feeling is, and then still doing what we've done in the past. That's a concern that it might not work. The idea is quite good, but we've still got to get people's trust more and it's about explaining to them why things can't happen. So, unless it's backed up with better ability to have a two-way conversation and understand both ways it might not work, I think that's crucial" [Practitioner 1].

Another practitioner also conveyed this scepticism, their disbelief stemming from how engagement and 'voice' is portrayed in the strategy:

"I think it's really important that we accelerate this happening in a more meaningful way than the way that we see on page 95 [shows a picture of public engagement in the strategy]. I'm assuming that this was submitted because it was the best picture they had. I'm assuming they didn't really have many other examples... but it is just mansplaining. It is a patronising image of an expert saying this is what we're going to do. Well, for a start, I don't think any of the people in that picture are currently at risk of flooding, I think either it's been staged or they were too polite to say no when somebody said come and have your say. They don't look very agitated, they just look like they're politely listening to what the man has to say... even the caption underneath says: 'Figure 27 [Figure 7.3 here], a community engagement event showing residents learning about their flood risk developments'... it is one-way provision of information. It is giving the residents the information about what is being done for them. It is not them speaking, they don't have their mouths open; they are not having their voice" [Practitioner 2].

Figure 7.3. *Picture accompanying the section of FCERM Strategy stating, 'people want a voice'. The caption reads: 'A community engagement event showing residents learning about their local flood risk and flood scheme developments' (EA, 2020, p.95) One interviewee was particularly critical of this.*

There is a fear that, irrespective of the strategy's intent to engage and provide people a voice, practices will continue business as usual; a top-down consultation 'DAD' approach that consigns people to the lower rungs of Arnstein's (1969) ladder. For Practitioner 2, the possibility of this reality is high, particularly when it seems that not even the EA, as illustrated by Figure 7.3, can depict an engagement process that demonstrates otherwise. Moreover, this possibility is already materialising. LLFAs were required to produce their own local FCERM strategies consistent with the national strategy. For Lancashire, Cumberland, and Westmorland and Furness Councils, the LLFAs in the NW[21], this engagement intent has largely translated, as feared, into an emphasis on increased information provision, including better communication to improve public awareness of climate change effects and flood risks (LCC, 2021; CCC, 2022). The term 'voice' only appears once in context in the Lancashire strategy, and not at all in Cumbria's strategy.

[21] From 1 April 2023, Cumbria County Council and six other district councils were subsumed by two new unitary authorities, Cumberland Council and Westmorland & Furness Council. These new councils assumed the role of LLFA's and are following the FCERM Strategy produced by Cumbria County Council.

Overall, whilst the 2020 FCERM Strategy advocates for community involvement and represented a significant step towards a more collaborative coastal management, the overall impression was of uncertainty; the engagement intent is certainly welcomed, but there are concerns about how it will play out on the ground. For now, perhaps the strategy raises more questions than answers.

7.3.4.2. The Need for an Actions-based Engagement

For some participants, it was hoped that at least some of the barriers to participation (e.g. community readiness) could be overcome through educational and communication activities, including embedding coastal issues into national media and the school curriculum to engage adults and children (e.g. Pollastri *et al.,* 2023). The expectation is to build informed communities who better accept constraints, understand climate change and are therefore better able to contribute to decision-making processes. But, a shortage, or deficit (Lewenstein, 2003), of information is not always to blame for a lack of public involvement, including in coastal flood management (Twigger Ross *et al.,* 2014; Smith & Bond, 2018), whilst provision of information, including climate change information, rarely influences behaviour (Dean *et al.,* 2019; De Meyer *et al.,* 2020). One of the key factors for this may be the lack of agency which people have in such engagement approaches: 'In the absence of agency, awareness and concern do not automatically lead to action. Rather, they can lead to long-term anxiety, apathy or denial' (De Meyer *et al.,* 2020, p.11). Consequently, persisting with a one-way, top-down 'informing' engagement approach may only serve to reinforce the alleged widespread apathetic tendencies expressed by interviewees towards coastal management and associated climate issues; the "*I'll be dead by then*" attitude.

Instead, climate literature encourages engagement to focus on actions, not issues, that can drive beliefs, pro-environmental behaviours, and crucially, agency (Van der Linden *et al.,* 2015; De Meyer *et al.,* 2020). The shift to actions-based engagement was something two interviewees suggested is essential if people are to mobilise in coastal management activities: "*if it's action based, you're coming to people with something that they can physically do and something that they can really get involved in*" [Community Actor 3]. Meanwhile, a practitioner acknowledged:

"By giving people a role and helping people take action, they become empowered rather than disengaged. So, if people can take part in these processes and feel that their voices are being listened to and that they are playing a part, and that they have some agency, they then become empowered" [Practitioner 2].

People can and do mobilise to act and demand transformational change when they feel empowered; national scale social and environmental justice movements (e.g. as listed by interviewees: Just Stop Oil and Campaign for Nuclear Disarmament) are demonstrations of this (Yuille, 2023). For coastal management issues, a community-led movement has been seen on a small, SMP policy unit scale in this research (Section 7.3.2.2). Counterintuitively, in this instance, the community's motivation to participate in coastal management stemmed not from an opportunity for collaboration with authorities, but from the withdrawal of state support for coastal management. A NAI SMP policy challenged the fundamental long-term existence of the community; providing sufficient motivation, or 'cost-benefit', for people to self-mobilise and deliver aspects of coastal management themselves. Moving forwards, it is paramount that any increased role does not solely burden communities with managing coastal change and delivering adaptation, practices must be undertaken collaboratively with all stakeholders.

To enable people to act collaboratively with authorities, engagement should be two-way between managing authorities and communities (Maguire *et al.,* 2011), whereby communities are supported to develop meaningful and sustained roles that build agency. Achieving this requires a reframing of engagement, not as a singular event of convenience (e.g. scheme-specific consultation), but as a long-term process of relationship building, knowledge sharing and collaborative working with those who hold the greatest stake (e.g. landowners, farmers and homeowners at risk). Long-term, actions-based community roles in coastal management could include citizen science (e.g. Chapter 6), co-designing NBS (e.g. Hemmerling *et al.,* 2022), adaptation planning (e.g. Barnett *et al.,* 2014), and deliberative engagement, for instance citizen's jury's (e.g. BCP, 2023).

Such engagement requires authorities to directly interact with people on the ground, a theme that five interviewees saw as an important step in reaching communities, building awareness, increasing the visibility of coastal management actors, and strengthening the relationship between communities and managing authorities. Ultimately, the hope is to create a proactive, actions-based and collaborative engagement that becomes normalised and embedded within coastal management practice, whereby communities and practitioners value mutual collaboration. The hope was expressed by a practitioner:

"*People will see it as a valuable thing to do. So, I think it will add value and it will become more commonplace and the methodology around how it's done will become more defined in terms of when and how that's managed. And people on our side will become more comfortable with that and people will be more open to coming forward and talking about it... once they start seeing that it's acted on and is listened to, the interaction between the proposers and the consultees will strengthen and become a more trusting relationship"* [Practitioner 3].

However, it must be recognised that the space for an actions-based engagement to support adaptation in practice is constrained by a set of broader national-scale social, political, and economic parameters. Many LAs face an unprecedented 'cost of living crisis' (LGA, 2024), with coastal LAs also facing competing economic pressures, including social regeneration and housing needs, which may make the delivery of public participation or climate adaptation difficult (Zsamboky *et al.,* 2011). Funding and delivering non-defence SMP policies longer term is also uncertain (Brown *et al.,* 2023), uncertainty that has left communities uncompensated and picking up the costs in erosion threatened areas (Arnall, 2023; Blunkell, 2024). In fact, the economic burden on communities may only increase, with a greater focus on communities contributing financially to management schemes (CCC, 2022). Consequently, whilst Government strategy may be suggestive of a greater role for communities in building resilience, if this intent is not supported by clear funding and guidance, then the 'quantum leap' (Brennan, 2007, p.596) between existing 'DAD' practice and public participation is unlikely to be bridged.

An example of this could be the development of adaptation pathways, first presented in climate change literature around 2010 (Werners *et al.,* 2021). Adaptation pathways provide anticipated responses to potential social, economic and environmental triggers and opportunities (EA, 2021), something that communities could help develop as part of an actions-based engagement (e.g. Barnett *et al.,* 2014). Yet, in the current context, whereby adaptation goes unfunded and the political and social will is unprepared for non-defence policies, together with climate change uncertainty and intangibility, adaptive action is unlikely to materialise. Consequently, the danger is that the rafter of short-term social, economic, and political blockers prevent community-developed adaptation plans from ever becoming reality, pushing them into a ‘plan and forget’ category (Gibbs, 2016) which potentially alienates communities and perpetuates mistrust.

7.3.4.3. A Reimagined Role for Coastal Partnerships?

Despite the reframing of public participation within a resilience paradigm (Van Der Plank *et al.,* 2022), it continues to encounter many of the same challenges that undermined the sustainability of the Coastal Partnership model two decades ago (Section 2.4.2)—namely, a lack of resources, political marginalisation, and funding shortfalls. This observation suggests that the limited role of communities in coastal management may not be due to a lack of willingness among practitioners to engage with coastal communities—they recognise the benefits of doing so—but rather a broader context that makes implementation difficult in practice.

Consequently, with the decline of Coastal Partnerships in a coastal management role, it could be argued that, particularly in this NW case study, the burden of engagement has fallen almost exclusively on LAs, specifically on coastal engineers and managers. Crucially, unlike Coastal Partnerships, they have the legislative duty to deliver and the statutory authority to act, but critically, they are not engagement specialists. Whilst they may understand the benefits and rationales for public engagement, they are not necessarily trained do it, nor do they necessarily have the support and resources needed to do it effectively. As a result, engagement becomes just another aspect of their extensive day-to-day responsibilities. With the additional funding shortfalls facing LA’s and the perceived disconnect between them and communities, it is unsurprising that engagement has shifted away from the 'talking shop' partnership model and is now largely confined to scheme-specific consultations.

Yet, at a time of SMP epoch transition and within the context of a resilience paradigm, the Coastal Partnership model established in the 1990s is perhaps needed more than ever. Partnerships, in many cases, are already embedded within communities and can deliver stakeholder engagement services (CPN, 2013), whilst they are not laden with the baggage associated with LAs (Stojanovic & Barker, 2008), including issues of trust. As neutral intermediaries, Partnerships could bridge the gap between communities and managing authorities, facilitating fair and open debate on coastal issues (CPN, 2013). To some extent, Government strategies (e.g. EA, 2020) are finally acknowledging these benefits, suggesting that authorities should not only work in partnership, but that Partnerships themselves are primed to capitalise upon opportunities arising from NBS, including public engagement and achieving local flood resilience. In this light, the concept of a Coastal Partnership was perhaps ahead of its time. With the critical caveat that they are properly funded, resourced and supported at a national level, organisations who currently deliver wider public engagement in coastal spaces (e.g. Trusts, Charities and Partnerships) could address many of the engagement challenges outlined in this work, and help to deliver an actions-based engagement that supports communities to adapt, plan, better understand, and manage long-term coastal change (e.g. based on a new engagement model proposed in Chapter 8).

7.4. Conclusion

Within a resilience based FCERM, there is an increased emphasis on the public, and coastal communities, having a greater voice, role and responsibility in decision-making and resilience building activities. Such involvement, characterised here as public participation, is vital if communities are to be prepared for, involved in, and can contribute to the transformational management required to build resilience to coastal climate challenges. This requires a fundamental shift away from what is described as traditional public engagement in coastal management; a top-down 'DAD' approach of consultation that constrains people to the lower portions of participation spectrums (e.g. Arnstein, 1969; IAP2, 2018). Consequently, to increase people's impact on decisions, there has been a national emphasis on improved participation in FCERM. Intent is signalled in the 2020 National FCERM Strategy, by the direction of funding into projects advancing public participation across England, and by calls for research to support community involvement in decision-making and resilience building (EA, 2024a).

This chapter has sought to advance public participation in coastal management by characterising the roles and responsibilities that people currently, and could, have within a resilience-based coastal management. Through a qualitative case study involving coastal practitioners and community members in NW England, the chapter has explored people's experiences of participation, rationales for it, roles and responsibilities held, and challenges encountered in practice. The study observed that public participation in management activities was perceived as being largely beneficial to avoid conflict and bring communities along in decision-making processes, something framed as vital in a time of climate crisis. However, whilst people can and do play roles in coastal management activities, including physical involvement (e.g. beach cleaning and citizen science), knowledge provision, concern raising and informal management (e.g. a community taking management into their own hands), current engagement practices could still largely be framed as ‘consultation’ based activities during FCERM schemes.

Reasons for this were numerous and included issues of readiness, namely a perceived lack of SMP awareness and (lack of) relationship between communities and LAs. Apathy towards intangible climate change impacts at the coast was also perceived to be a significant barrier to participation, whilst systemic barriers in LAs, notably a lack of resource (time and funding) or support for practitioners, were seen to stall capacity to engage, even if intentions were to do so. Therefore, whilst the national FCERM Strategy was viewed as signalling positive engagement intent, the overall feeling was of cynicism towards how it will play out in practice. The work did highlight how a turn to an actions-based engagement, which actively gives people a role in coastal management activities, could foster agency and relationships between authorities. There are opportunities for existing, or new, organisations situated between the public and agencies to play an important role in delivering this.

However, the difficulty of overcoming these issues is recognised. The persistence of political, economic and social barriers stalling required adaptation, and the fact that authorities have been trying to ‘normalise’ public involvement in FCERM decision-making for over two decades (Kelly & Kelly, 2019), are all examples of this. Consequently, for a collaborative and participatory coastal management to materialise that supports communities to build resilience to climate challenges, these barriers must first be addressed on a national scale. Failure to do so will result in the persistence of consultation as the dominant mode of engagement and leave communities in the NW unprepared climate change adaptation.

Chapter Eight

Chapter Eight: Synthesis & Conclusion

8.1. Introduction

This thesis has engaged people in a participant-focussed citizen science project that aimed to build people's understanding and ability to participate in a resilience-based coastal management in NW England. The overall aim was underpinned by four research objectives:

Objective One: *Determine people's values and concerns in coastal blue space, framed during the COVID-19 pandemic on the Fylde Coast, to ground the research in place.*

Objective Two: *Informed by coastal values and concerns, characterise the extent to which a citizen science project can be collaboratively designed to provide both participant- and scientific-focussed outcomes.*

Objective Three: *Identify the outcomes of citizen science for both adding to our understanding of coastal change and delivering benefits for participants.*

Objective Four: *Evaluate the roles and responsibilities that people have, and could have, within a resilience-based management of their local coastal environment by exploring the extent to which public participation within decision-making is achieved, and the space, challenges and opportunities for people within a future participatory coastal management.*

Together, the research provides an in-depth, place-based case study of public participation in understanding and managing a changing coastal environment—one that increasingly requires the active involvement of communities in building resilience to climate challenges. Methodologically, the case study took a mixed-methods and applied approach that sought to provide valuable findings for academia, coastal management practice and coastal communities. This chapter summarises the key findings in relation to the research objectives. A broader synthesis also offers lessons from the COVID-19 pandemic to support engagement, highlights key outcomes from and opportunities to advance participation in Coast Watchers, proposes a new model for involving the public in coastal management decisions, and reflects upon the role of citizen science as a mode of public participation for coastal management. Lastly, research implications and future recommendations for coastal management and academia are offered.

8.2. Key Research Findings

Objective One: *Determine people's values and concerns in coastal blue space, framed during the COVID-19 pandemic on the Fylde Coast, to ground the research in place.*

- ***A 'healthy blue space':*** The Fylde coast carries a unique mental and physical health value for residents and visitors alike, stimulated by emotional connections (e.g. memories and nostalgia), a sense of escape and sensorial immersion.
- ***The perceived value of coastal spaces changed during the COVID-19 pandemic:*** Value was distorted for local respondents during the pandemic post-lockdown in summer 2020. Participants reported a changed coastal experience that included reduced safety, fear of contagion, increased busyness and increased beach litter.
- ***The pandemic led to mitigatory behaviour and personal reflection:*** Whilst some participants altered their coastal routines in response to changing experiences, the pandemic prompted others to reflect on the value of coastal spaces. This led to a reframing of people's relationship with the coastal environment, with many expressing greater appreciation for its health and wellbeing benefits and a stronger desire to protect it.
- ***Place-based research provides key insights to inform the design and possible benefits from local citizen science:*** Grounding the research in place presented an improved understanding of the local community's values and concerns (e.g. busyness, litter, safety), and a sound platform for developing the Coast Watchers citizen science project locally. Notably, given the health and wellbeing value of coastal space, it is likely that citizen scientists could experience several co-benefits from engaging in a 'healthy blue space'.

Objective Two: *Informed by coastal values and concerns, characterise the extent to which a citizen science project can be collaboratively designed to provide both participant- and scientific-focussed outcomes.*

- ***A collaborative design process ensures the relevance of citizen science to different stakeholders:*** A collaborative approach can integrate multiple perspectives in a citizen science project, ensuring that the needs, interests, and concerns of different stakeholders are addressed. By identifying overlaps in these areas, projects can focus on locally meaningful and valuable phenomena (e.g. for both participants and management authorities).

- ***Marine litter is a key issue:*** Whilst stakeholders raised various interests and concerns, beach litter emerged as a significant and feasible issue to address through a citizen science project. This topic not only aligns with local interests and management needs but also connects to the broader scientific field of marine litter, offering potential scientific-focussed outcomes beyond the local scale.
- ***Limitations of scale in collaborative citizen science:*** Whilst effective on this local level, it is uncertain if the collaborative approach used here is replicable for large-scale, mass-participation citizen science projects due to its emphasis on place-based, community-specific needs. There is a research opportunity to apply and test this approach over a large geographic scale.

Objective Three: *Identify the outcomes of citizen science for both adding to our understanding of coastal change and delivering benefits for participants.*

- ***Participant-focussed citizen science projects can yield valuable scientific insights:*** A participant-focussed, place-based citizen science project can still produce significant scientific outcomes, such as insights into marine litter types, distributions, and dynamics (see Section 6.3.1.4 for summary of results) that can be compared across different coastal localities.
- ***Participant-focussed citizen science fosters experiential learning and environmental awareness:*** Involvement in a marine litter citizen science project provided participants with experiential learning opportunities, challenged preconceptions (e.g. about the sources of litter), and increased environmental awareness for some. Future citizen science research should place greater emphasis on evaluating not just the data-driven outcomes, but also the qualitative benefits for participants. Such work could provide a more holistic evaluation of citizen science, recognising and valuing the contributions of volunteers.
- ***Citizen science participants can be more than passive data collectors:*** Citizen science participants can meaningfully contribute to a project in ways that extend

beyond data collection, in this case influencing project design and disseminating findings.

- ***Citizen scientist identity is insignificant to participants' experiences:*** Participants expressed benefits from their involvement in the citizen science project, even though they did not identify as citizen scientists. The term citizen science may hold greater value for the academic community to group and categorise research involving citizens.

Objective Four: *Evaluate the roles and responsibilities that people have, and could have, within a resilience-based management of their local coastal environment by exploring the extent to which public participation within decision-making is achieved, and the space, challenges and opportunities for people within a future participatory coastal management.*

- ***Communities can contribute to aspects of coastal management, but participation in decision-making is limited:*** In a NW context, people and communities can and are involved in aspects of coastal management through activities like beach cleaning, citizen science, knowledge provision, and informal management (e.g. a community taking management into their own hands). However, formal involvement in decision-making is mostly limited to periodic consultations, with little opportunity for sustained collaboration. Consequently, whilst a citizen science project (e.g. Coast Watchers) can build people's knowledge and, in cases, empower citizens, it cannot directly build people's capacity to influence decision-making because of the absence of opportunities and mechanisms for meaningful and sustained public participation in coastal management.
- ***Barriers to participatory coastal management hinder the realisation of a resilience-based FCERM:*** Several barriers prevent collaborative and participatory coastal management from materialising in practice. These include an apparent low awareness of SMPs, perceived weak relationships between communities and LAs, apathy towards coastal climate change impacts and systemic barriers within LAs, including lack of time, funding, and capacity for public engagement. The latter is particularly damaging to the potential for the realisation of a resilience-based FCERM - which promotes the contribution of people's voices in decision-making -

because the existing responsibility for engaging with the public appears to largely rest with LA coastal managers and engineers. Consequently, if LAs do not have the capacity or resources to deliver engagement in practice, nor the necessary training to deliver it properly - even if they recognise the benefits of public participation (Section 7.3.1) - then a more participatory coastal management is unlikely to materialise. Engagement-focused charities, trusts and organisations operating on the coast could assume new roles to help represent coastal communities and facilitate public participation moving forwards, but national government funding and resource is fundamental to make this a reality.

- ***An actions-based engagement could build agency:*** Participants emphasised the importance of an actions-based engagement approach to build a sense of agency, overcome apathetic attitudes towards climate change, and raise the visibility of coastal management practitioners and practices.

8.3. Lessons from the COVID-19 Pandemic and the Coast Watchers Citizen Science Project for Engaging People with Coastal Change

Amongst the plethora of barriers to increased public participation in coastal management highlighted in Section 7.3.2.3, there is an apparent national expectation for continued coastal defence against flood and erosion risks (Famuditi, 2016; Brown *et al.,* 2023; Kelly & Kelly, 2023b). As Day *et al.* (2015, p.302) state, 'there is a culture of affection for, and familiarity with a benign coast, one that is defended and where the defences themselves are seen as being part of the character of the place'. This sentiment was evident in Chapter 4, where the presence of a fixed promenade along the Fylde Coast was integral to people's health, wellbeing and place experiences. The promenade provided accessible space for leisure, exercise and viewing the coast, particularly for older individuals. Whilst this section of coast will remain static and defended long-term (HTL for all three epochs), many coastal areas in the UK (including in the NW, see Figure 2.2) are transitioning to non-defence SMP options in epoch two in 2025 (Hardiman, 2015; Brown *et al.,* 2023). Such options are consistent with a national FCERM Strategy that emphasises resilience and adaptation over physical defence (EA, 2020). Yet, this transformational shift in management approach is clearly incongruous with existing public expectations for physical defences, and with people's place-based values and emotional connections to defended coastlines.

Consequently, if communities are to have a greater involvement in adapting to and planning for climate change impacts in their local coastal spaces, there is an increasing need for people to recognise the coast not as static and fixed, but as 'fluid' (Bell *et al.,* 2015). Overcoming ingrained and emotionally connected place-based mindsets demands a new engagement approach. As Brown *et al.* (2023, p.14) argue, 'herein lies the implied paradigm shift: to engage we rely on past feelings about the coast, but simultaneously we need to shift our perspectives to an adaptive future'. Shifting perspectives towards adaptation is achievable, as demonstrated by the COVID-19 pandemic, when people adapted their behaviours and routines – something which led to people reframing their place-based values and connections (Section 4.4.3). As McKinley *et al.* (2021) suggest, the pandemic showed that societies and individuals can adapt quickly when faced with visible threats.

The visibility of the pandemic was perhaps an important factor in stimulating adaptation. Both COVID-19 and climate change are invisible threats, yet the pandemic became a tangible and visible threat due to its characterisation as a global phenomenon that impacted people's physical health on local scales (Ruiu *et al.,* 2020). In contrast, climate change is often portrayed as a distant issue that only affects vulnerable nations, making it difficult for Western societies to recognise it as an immediate threat that deserves immediate intervention (Ruiu *et al.,* 2020). Drawing parallels with this work, the collaborative process for developing the Coast Watchers citizen science project highlighted beach litter - not climate change - as a key concern for local people (Chapter 5). This is perhaps a result of climate change being immeasurable to people, distant and invisible based on personal experience alone (Weber, 2010) – key factors in producing apathetic perceptions towards it (Section 7.3.2.3). Comparatively, litter is a tangible and visible concern for beach users that is encountered daily (Sections 4.4.2.2 and 5.3), has a meaningful and immediate impact on people's place-experiences, and can be mitigated (e.g. beach cleaning).

Lessons from the pandemic and the Coast Watchers project suggest that engaging communities with tangible issues, such as marine litter, can serve as a gateway to broader conversations about coastal change. Notably, through the experiential learning afforded by citizen science engagement with marine litter, participants developed a heightened awareness of the coastal environment (Section 6.3.2.3) and showed interest in monitoring other coastal changes (Section 6.3.2.6). Whilst marine litter may seem disconnected from climate change, engagement with a visible phenomenon like marine litter could present a useful platform, or 'hook', for further conversations and engagement with other aspects of coastal change (which could include climate change). This could be particularly relevant for coastal locations where there are few visible implications or threats from climate change (e.g. no direct erosion risk). Although this citizen science approach may be slow and reach a limited audience, engagement could offer a long-term, actions-based learning process that gradually builds community resilience to long-term coastal change.

By engaging communities with tangible, visible issues such as marine litter, collaborative citizen science projects can not only address immediate and locally relevant environmental concerns but also lay the foundations for building coastal communities' understanding of, and potentially resilience to, less visible challenges posed by climate change.

8.4. Advancing Coast Watchers

The typical science-focused, top-down and contributory nature of citizen science was highlighted as a critique of the research field (Section 2.3.7). In response, this thesis proposed a revised typology that shifted the definition of citizen science towards more participatory forms (e.g. collaborative, co-created and extreme; Section 2.3.9). As a collaborative citizen science project, Coast Watchers was designed to sit on this revised typology, as the project sought participation from various stakeholders to balance researcher and participant inputs (Figure 8.1). Therefore, stakeholders and participants were offered multiple roles in the project, including in the design (Chapter 5), data collection, dissemination, and evaluation. Emphasis was also placed on the project being participant-focussed, whereby the project was grounded in place (Chapter 4) and participant's experiences during, and outcomes from, the project were explored alongside scientific findings (Chapter 6). Ultimately, through this collaborative process, Coast Watchers aimed to build people's understanding of coastal change and ability to participate in a resilience-based coastal management.

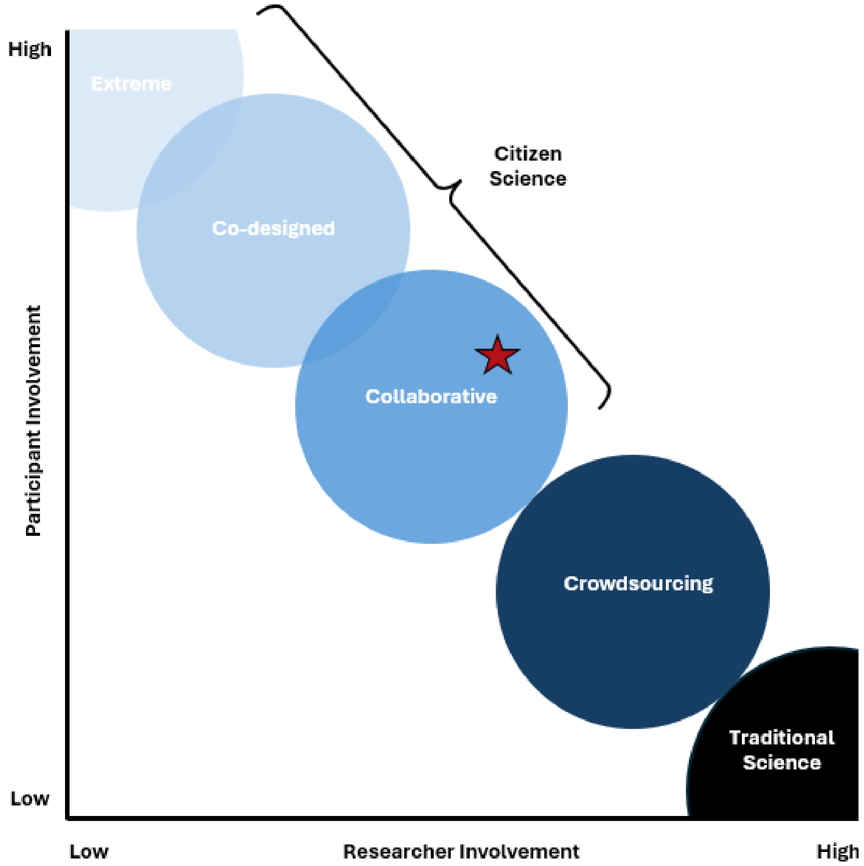

Figure 8.1. *Situating Coast Watchers on the revised citizen science typology (red star).*

Reflecting on the collaborative process, Coast Watchers built participant's understanding of coastal change to a large extent (Chapter 6). Notably, exploring the issue of marine litter through citizen science fostered learning about the types, amounts and patterns of litter on the beach. Involvement also helped to change perceptions of litter sources and connect participants to the wider impacts of litter on the coastal environment. A key factor for achieving the learning outcomes may include the experiential learning opportunity afforded by 'doing' citizen science in the coastal environment - including surveying, observing and discussing findings with peers and the researcher. Such actions allowed participants to form their own conclusions, connect to the coastal environment and notice changes, a 'learning by doing' experience (Reese, 2011) that even empowered some participants to disseminate findings within their social circles.

Several practical factors may also have supported the realisation of these learning outcomes. Notably, working with a pre-existing beach cleaning group (RBRCG) and local coastal stakeholder ensured the project was successfully organised, effectively promoted, conducted in a practical location, able to connect participants to a wider social network, and answer local questions and hypotheses. Moreover, the time invested by the local stakeholder in helping to organise the project allowed the researcher to focus on citizen science delivery, engaging with participants and sharing data. It is recommended that future citizen science researchers collaborate with similar community groups to effectively organise projects and reach targeted audiences– whilst such effort could also foster long-term positive relationships between science and society.

However, synthesising across the final chapters, a crucial finding is that whilst citizen science can engage participants, increase awareness, and enhance understanding of local coastal changes, it does not offer participants a direct route into formal coastal management decision-making. Perhaps the key reason for this, irrespective of the participants motivations to be involved, is that the opportunities for people to fully engage in coastal management decisions appear limited (Chapter 7). For Coast Watchers, perhaps one way this could have been overcome would have been through participatory workshops at the end of the project. Workshops could have brought together participants and local stakeholders to discuss key findings, identify actionable outcomes for coastal management, and agree next steps to lobby for local change. Such workshops may have also helped to elevate Coast Watchers to the status of 'co-design' in the citizen science typology, emulating the workshops undertaken by Robinson *et al.* (2024) to plan and co-design actions informed by citizen science data.

Coast Watchers, and other citizen science projects, could also increase their participatory nature by reaching and including more diverse audiences and voices. For example, rather than just advertising for participants, which may attract those who are *already* motivated to engage or have the time (Section 6.3.2), projects could actively seek participants of contrasting socio-economic backgrounds, identities, values and lived experiences (Cooper *et al.*, 2021). Such effort could lead to 'new edges of scientific discovery and actionable science' (Cooper *et al.*, 2021, p.1388) and improve discussions and decisions about environmental challenges (Kimura & Kinchy, 2019). However, it is acknowledged that positive outcomes from participatory workshops and diverse participation are only possible if empowered citizen scientists can be actively accounted for within decision-making processes.

8.5. A New Participatory Decision-making Model for FCERM

This thesis highlights the ongoing shift in FCERM towards a more participatory, resilience-based approach (Section 2.4). However, the extent to which a more participatory approach is realised in practice is limited. This is largely because, despite over two decades of effort to 'normalise' public participation in decision-making processes (Kelly & Kelly, 2019), ‘consultation’ remains the dominant paradigm for ‘involving’ people in coastal management (Section 7.3.2.1; Famuditi *et al.,* 2018; Bradshaw *et al.,* 2021; Bradshaw, 2022). Consultation processes provide the public with time-restricted windows for one-way feedback, ‘invited’ engagement spaces (Yuille, 2023) that offer little meaningful impact on decisions (IAP2, 2018). As a result, the public remains in the tokenistic, lower rungs of Arnstein’s (1969) ladder, undermining true participatory engagement.

To address this, the participatory ‘EDD’ model (Section 2.4.4), compared to the traditional ‘DAD’ model (Section 2.4.2), was introduced as the EA’s preferred method for collaborative decision-making. Whilst the ‘EDD’ model encourages public involvement, its three stages appear geared towards supporting single, one-off decisions rather than fostering long-term, sustained participation. For instance, once the ‘decision’ is made, the engagement process may end, along with any relationships built during that time. Consequently, despite good intentions to support public participation, the model may serve to reinforce the short-term and episodic consultation-based approach. In which case, the model may be incompatible with the need to foster long-term community resilience to climate change.

A more effective alternative may involve shifting away from decision-centric models towards a process-based model that emphasises sustained, long-term engagement. Such a model could focus on building relationships and visibility between authorities and communities at the local scale. Drawing on the methodology of this thesis, a new model could be proposed based on three key phases: Acquainting, Collaborating, and Empowering (ACE; Table 8.1). Crucially, the term ‘Empowering’ is not bound by a fixed endpoint and is suggestive of a long-term process that promotes ongoing ‘action-based’ engagement to help foster agency (Section 7.3.4.2; De Meyer *et al.,* 2020). Critically, this model shifts the focus away from treating the public as passive ‘audiences’ in need of ‘expert’ guidance, instead facilitating the long-term participation of local experts in decision-making processes over time (Cone *et al.,* 2013). If LAs lack the capacity, skills or sufficient public relationships to deliver this participation (Section 7.3.2.3), there are opportunities for other engagement-focussed organisations, charities or trusts to facilitate and deliver place-based public participation. Participation could include delivering collaborative or co-designed citizen science projects, or engaging communities in developing adaptation pathways using an 'ACE' model.

Table 8.1. *Characteristics of the proposed 'ACE' model.*

Model Stage	Description
1. Acquaint	- A process of understanding the community and their concerns. - Involves a place-based approach to situate the engagement within the local context. - Aims to build relationships, visibility and trust between authorities and the community.
2. Collaborate	- Work with the community to deliver practical actions, strategies and decisions. - A two-way process of learning and knowledge sharing. - Communities are given responsibility.
3. Empower	- Communities gain agency, power and decision-making capacity. - Longer-term, communities have the skills, knowledge and power to participate and share their voices in sustained coastal management efforts.

However, it is recognised that irrespective of the model employed, efforts are unlikely to be successful unless they are supported by sufficient participation infrastructure on national scales. Infrastructure includes necessary funding, resources, training, appropriate governance structures, and the transfer of responsibility and power to the public. This is particularly important given that LAs, who currently are responsible for public participation in coastal management, lack sufficient time, resources, and training to do so effectively (Section 7.3.2.3). Without such support, there is a risk that the disconnect between strategic engagement goals and on-the-ground practices will persist, as indicated by participants' perceptions of the 2020 FCERM Strategy's engagement ambition (Chapter 7). A similar challenge was faced in forming collaborative catchment groups in the UK, as Watson (2015) noted: 'Government ministers and policymakers were keen to emphasise the potential benefits of forming collaborative catchment groups, but were remarkably silent regarding the means by which the benefits of such groups could be realised… collaborative catchment groups were not officially recognised or given any kind of legal status' (p.21).

Similarly, without clear Government support, legal frameworks and resource, the engagement rhetoric in the FCERM Strategy could fall short of its ambitions. In which case, suspicion, mistrust and conflict may prevail, leaving communities feeling ignored or sidelined from key decisions that directly impact their coastal livelihoods.

8.6. Citizen Science as a Mode of Public Participation in Coastal Management

This thesis set out to understand how communities could have more meaningful and active roles within coastal management processes, focussing specifically on engagement through citizen science. The work aimed to engage people in a participant-focussed citizen science project that builds people's understanding and ability to participate in a resilience-based coastal management in North West England. Whilst the thesis has evidenced broader institutional and systemic challenges that restrict public participation in coastal management decision making, questions remain regarding the specific value, importance, and role of citizen science as a tool for public engagement in coastal management processes.

Synthesising findings across this thesis, citizen science demonstrates clear benefits for facilitating public participation in some aspects of coastal management. These include its capacity to collect otherwise-difficult-to-collect data that carries impact, motivate citizens to monitor and address coastal challenges that they are concerned about in a place they are attached to, deliver environmental benefits, foster learning and, in some cases, empower people to get their voices heard. However, citizen science is certainly not a panacea for public participation in coastal management. This section reflects on the value of citizen science for coastal management with respect to some of the key elements explored in this research: place attachments, development and implementation of citizen science, and the politics associated with coastal management and decision making.

A key role of citizen science in coastal management is its ability to mobilise citizens to address coastal challenges and issues in places which they are emotionally attached to. In this research, significant time was spent grounding Coast Watchers in place, including an exploration of people's values, experiences in and attachments to coastal spaces within the research case study area of the Fylde Coast (Chapter 4). Findings highlight the coast's value for promoting emotional attachments including nostalgic and subliminal experiences, hedonic mental health benefits and physical health outcomes, particularly for older people. Supported by the collaborative design process in Chapter 5, the work helped to identify challenges in the coastal environment that can undermine such place attachments, including marine litter.

Such place-based citizen science projects can then carry significant benefits for coastal management and decision-making. Projects can collect data to better understand, evidence and manage locally relevant and meaningful challenges in the coastal environment. This includes collecting data on challenges which may otherwise be data deficient due to funding, resources or practicalities, such as marine litter. Consequently, such citizen science projects carry value for management beyond academic data collection exercises.

For the public, grounding citizen science projects in people's emotional place-attachments can then inspire action because people are motivated to protect and improve places that are meaningful to them (Manzo & Perkins, 2006). Participation in such projects can further deepen place attachments (Haywood *et al.*, 2020), offer enhanced learning possibilities (Haywood *et al.*, 2024), and increase the tangibility and hyper-localness of global anthropogenic challenges. In this case, Coast Watchers stimulated experiential learning about marine litter that changed participants' preconceptions and allowed them to disseminate knowledge within their social circles. Participation in marine litter citizen science projects can also be a stepping stone for further engagement with other coastal challenges, something that could ensure project's carry legacy beyond their conclusion. For coastal practitioners, such projects offer clear social benefits by creating a network of informed, motivated and place-connected citizens who can be meaningfully engaged in future decisions that impact them and the environment they seek to protect.

However, it is recognised that such an outcome from citizen science projects may not necessarily be appropriate for all participants. Some participants may only want to be involved to the extent that they collect data, engage with likeminded people and benefit from volunteering in a 'healthy blue space', with little or no inclination to participate in decision making. Furthermore, it can be difficult for citizen science projects to appeal to or reach wide, diverse audience. For instance, Coast Watchers lacked inclusivity, as it was largely limited to a specific sample of participants with sufficient motivation and time. This is particularly important within a resilience-based coastal management, where a *nation of people*, not just empowered individuals, are being called upon to share their voices in resilience building activities.

Yet, as Chapter 7 highlighted, the current decision-making context is not necessarily conducive to meaningful public participation. Significant high-level change is needed to governance structures and balances of power to better account for people in decision-making processes and to accommodate the participatory rhetoric claimed in in the national FCERM strategy (EA, 2020). Consequently, whilst findings from this case study suggest that citizen science can carry clear benefits for social learning, the environment and data collection to address coastal challenges, it is not a pre-cursor or panacea for widespread public participation in coastal management decision-making at present.

8.7. Recommendations for Future Work

To build upon the work undertaken in this thesis, several opportunities for future research are suggested.

Legacies of the COVID-19 Pandemic for Coastal Communities

- Chapter 4 captured the immediate impact of the COVID-19 pandemic and resulting lockdowns on people's place connections, values and experiences. Future research could consider the implications on people's resilience or ability to adapt to flooding and erosion threats. For example, given the pandemic demonstrated quick adaptation to a threat (McKinley *et al.,* 2021), it is pertinent to understand the extent to which this adaptation experience has influenced people's capacity for, or acceptance of, transformational adaptation in coastal areas (e.g. MR)?
- There are also important questions regarding the pandemic's impact on social dynamics within coastal communities, and the implications these may have for people's readiness or capacity for climate adaptation. Chapter 4 suggested that people's sense of place along the coast shifted during the pandemic, but to what extent has this left lasting legacies? For instance, has the pandemic influenced people's long-term engagement with the coastal environment and did the

increased willingness to protect the coast during the pandemic translate into long-term, positive local action? Furthermore, coastal resort towns like Blackpool and Cleveleys were suggested to be more vulnerable to the economic implications of the pandemic (Warren *et al.,* 2020), therefore to what extent were the economies of coastal communities disproportionately impacted compared with inland localities? Similarly, given the underlying poor health outcomes faced by coastal communities (Whitty, 2021), to what extent did the pandemic exacerbate health and socio-economic inequalities? What implications could any resulting socio-economic challenges have for climate adaptation, for instance on people's level of climate concern compared with other day-to-day concerns, or even on the availability of FCERM funding? Investigating these questions on a place-based scale could demonstrate the socio-economic legacies of the pandemic on coastal communities and highlight any resulting opportunities and challenges that effect the readiness or capacity of coastal communities to adapt.

Using Citizen Science to Understand CSO Implications for Beach-user Health

- Of all the litter types recorded on Rossall Beach (Section 6.3.1.1), sanitary waste triggered the greatest anger and disgust during and after survey events. Whilst no positive correlation was observed between voluntarily reported CSO occurrences and sanitary items surveyed on the beach, it was acknowledged that this might be due to missing data (e.g. unreported CSO discharges; Section 6.3.1.3). If a reliable dataset of CSO discharges could be acquired, a national-scale study comparing CSO discharges with the quantity and distribution of sanitary waste on beaches would be valuable. Such a study could explore the degree of correlation between CSO events and the presence of sanitary waste, the processes driving the onshore transport and deposition of this waste, and the environmental and health implications of CSO discharges on UK beaches. Understanding the impacts of sanitary waste on water quality and the health of beach users is particularly important, especially since wet wipes deposited on beaches can harbour harmful bacteria (Metcalf *et al.,* 2022). Citizen science initiatives could play a pivotal role in this study, for instance through the annual GBBC, which could provide a geographically representative comparison of sanitary waste, CSO discharge events, and water quality across the UK. Such a study would empower citizen scientists to collect new and crucial knowledge on the effects of CSOs on the coastal environment, whilst supporting ongoing efforts to regulate and manage CSOs.

Understanding the Participant-focussed Outcomes from Marine Litter Citizen Science Projects

- Whilst the science-focussed outcomes of citizen science are well documented, more work is needed to assess participant-focussed outcomes. In this thesis, Chapter 6 offered a novel insight into both science- and participant- focussed outcomes from a marine litter citizen science project, laying a foundation for further comparative research. Future work could assess whether the findings from this case study hold true across other place-based citizen science projects, or across larger or more diverse citizen science audiences.
- It would also be interesting to explore the extent to which engagement with marine litter, as a visible and tangible concern for the community in this work, provides a platform for engagement with other coastal phenomena or climate change discussions in other locations. Such work could inform future engagement strategies.

Future Directions for Public Participation in Coastal Management

- Critically, irrespective of strategic intentions (e.g. EA, 2020), a more participatory coastal management is unlikely to materialise without Government-level support (Section 8.5). Future research could aim to quantify the benefits of public engagement and participation in coastal management processes. Such work could help to substantiate the economic value of engagement processes and ensure that future FCERM funding provides dedicated engagement resource.
- Future work could also review participatory approaches in other research fields and disciplines (e.g. planning; Yuille, 2023) to identify lessons (e.g. innovative engagement techniques) and best practice (e.g. to overcome the barriers to participation; Section 7.3.2.3) that could be applied in a coastal setting.
- The SMP was introduced as a textbook ‘DAD’ approach to decision-making, whereby the SMP policy has been predetermined without extensive public

participation. However, currently, perceived public awareness of the SMP is seemingly low. To increase awareness, the EA (2024b) launched the 'SMP Explorer'. There are research opportunities here. Given the 'DAD' approach, to what extent can people contribute to decision-making when the SMP policy has already been set? In which case, could an increased SMP awareness also increase the public perception of 'fait accompli' decision-making – in which case, to what extent will the SMP become an additional blocker to participation?

- Finally, there are valuable research opportunities in applying a place- and process-based engagement model (e.g. 'ACE'; Section 8.5) to better understand, collaborate with and empower coastal communities to share their voices in coastal management. For example, the 'ACE' model could be used to collaboratively develop an adaptation pathway on a place-based, SMP policy unit scale. Adaptation pathways are largely untested in practice (Werners *et al.,* 2021) but could offer an actions-based opportunity for the community and practitioners to collaboratively design pre-agreed and a no-regret strategies to respond to evolving environmental, economic or social opportunities and challenges. Such work could help to realise a resilient and participatory coastal management moving forwards, and crucially develop a standardised and nationally supported framework for delivering widespread public participation in coastal management processes.

8.8. Conclusion

The thesis embarked on a journey to develop and engage people in Coast Watchers, a case study citizen science project in NW England. To ground Coast Watchers in place, the thesis highlighted people's place-based attachments to and values in coastal space, and captured people's experiences and place-disruptions during the COVID-19 pandemic. There are several implications from the work for research and coastal management policy and practice. The work highlighted how the COVID-19 pandemic shifted people's experiences and value of coastal blue space. These findings imply that place-disruptions can impact the mental and physical health value attributed to blue spaces. It highlights the need for further research on the effect of coastal climate challenges on place-disruptions, and their resulting implications on community resilience. For coastal management policy, these findings carry implications for a how people's sense of place, values and emotions are acknowledged, accounted for and mitigated within coastal management decisions.

This is particularly important within the context of climate change at the coast, where adaptive management decisions may have transformational effects on coastal spaces and the communities who reside within them.

The work applied a collaborative citizen science model, which gave people roles in designing, conducting and evaluating the project. The design process highlighted marine litter as a key local concern. A year of marine litter surveying on Rossall Beach revealed plastic as the dominant material type, with most litter seemingly derived from offshore sources and little evidence for significant input from direct littering. For participants, involvement in Coast Watchers afforded an experiential learning opportunity and helped to change preconceptions of the main litter sources. The work demonstrated a novel investigation of both science and participant-focussed outcomes from a marine litter citizen science project, contributing to a paradigm shift beyond a science-centric understanding of citizen science and providing a comparison for future work.

This work carries implications for citizen science researchers and practitioners. The thesis demonstrates that by developing a citizen science project that is grounded in place and collaborates with participants in the project's design, data collection, dissemination, and evaluation, citizen science can achieve both science-, and crucially, participant-focussed benefits. This finding has important implications for the design of future citizen science projects, as citizen science that is, by definition, participatory and place-based may carry greater potential for improved social outcomes for participants than from traditional contributory or crowdsourced projects.

Importantly, a crucial finding is that whilst citizen science can engage participants, increase awareness, and enhance understanding of local coastal changes, it does not necessarily offer participants the opportunity to elevate their engagement into formal coastal management decision-making. This is because, at this present time, there are few opportunities for communities to have a sustained and collaborative role in coastal management processes beyond consultation, with a lack of LA resource and perceived low readiness for engagement contributing factors. However, under an emerging resilience-based FCERM, which shows clear intent for public participation, there may be opportunities for authorities to collaborate with coastal communities. There are implications here for future policy. The work suggests that dedicated resources for public engagement, and restructured governance and power dynamics that grant communities a statutory voice in decision-making, could better actualise such intent for public participation and involve communities in adapting to current and future coastal challenges.

Overall, this thesis contributes to the growing need to engage coastal communities in understanding, monitoring and managing environmental challenges. Further work and research to understand how community-level decision making could be clearly accounted for in governance structures is integral to achieving a coastal future that is equitable, participatory and resilient.

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Appendix

Appendix A: Chapter 4 Survey & Interview Materials

Figure A.1*. Chapter 4 online survey participant recruitment adverts.*

Coastal Space & COVID-19

Start of Block: Introduction

Introduction

Thank you for taking the time to fill in the following survey.
I am a PhD Geography student at Lancaster University, undertaking a project called Coast Watchers.

This survey is trying to understand how the coast is important for people's lives, health and wellbeing, with a focus on the impact that COVID-19 has had upon this. I have approached you because, as a resident in the Wyre or Fylde region (or perhaps further afield), your insight is highly valuable and will help to shape my research. Hopefully, the topic area is also of interest to you.

The survey, which should only take between 10 – 15 minutes of your time, consists of three sections. The first section asks a little bit about you, the second section considers your general use of the coast and its value to you, before the third section asks you to reflect on the impact that COVID-19 has had upon this.

Your participation in the study is greatly appreciated. I have set a deadline of Friday 26th June for completion of the survey should you wish to participate. Please also feel free to share and forward the email and the attached survey link to friends and family.

By filling in this survey, you are giving consent for your data to be used. Data that you share with me will be confidential, and only stored for the duration of the analysis. You may also withdraw your response from the study by contacting me using the details below, but this must be no later than four weeks after the survey deadline. Should you have any further questions or queries, please feel free to contact me using the details below.

Yours Sincerely,

Joseph Earl

Lancaster Environment Centre, Lancaster University, LA1 4YQ
Email: j.earl@lancaster.ac.uk

1. I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

◯ Yes (1)

---

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason. If I withdraw within four of commencement of the study my data will be removed.

◯ Yes (1)

---

3. I understand that any information given by me may be used in future reports, academic articles, publications or presentations by the researcher/s, but my personal information will not be included and I will not be identifiable.

◯ Yes (1)

---

4. I understand that data will be kept according to University guidelines for a minimum of 10 years after the end of the study.

◯ Yes (1)

---

5. I agree to take part in the above study.

◯ Yes (1)

End of Block: Introduction

Start of Block: About You

Appendix A

About You

Please answer these questions, so that I know a little bit more about you.

Q1 What is your gender?

- ◯ Male (1)
- ◯ Female (2)
- ◯ Other (3)
- ◯ Prefer not to say (4)

Q2 How old are you?

- ◯ 0 - 20 (1)
- ◯ 21 - 40 (2)
- ◯ 41 - 60 (3)
- ◯ 61 - 80 (4)
- ◯ 81+ (5)
- ◯ Prefer not to say (9)

Q3 What is your employment status?

- ○ Employed full time (1)
- ○ Employed part time (2)
- ○ Unemployed (3)
- ○ Retired (4)
- ○ Student (5)
- ○ Other (6)
- ○ Prefer not to say (7)

---

*

Q4 Please can you provide your postcode

____

Q5 How long have you been a resident at your current address?

- ○ Under 1 year (1)
- ○ 1 - 5 years (2)
- ○ 6 - 10 years (3)
- ○ Over 10 years (4)
- ○ Prefer not to say (5)

Q6 Can you see the beach, sea or seafront promenade from your residence?

- ○ Yes (1)
- ○ No (2)

End of Block: About You

Start of Block: Use of Coastal Space

Use of Coastal Space

For this next section, please think back to day to day life before the outbreak of COVID-19 and the resulting lock down.

The questions will consider your use of the coast. Here, the coast includes the beach, sea and the sea front promenade.

Q7 How often do you visit the coast? (pre-lockdown)

- ○ Every day (1)
- ○ 4-6 times a week (2)
- ○ 2-3 times a week (3)
- ○ Once a week (4)
- ○ Monthly (5)
- ○ Yearly (8)
- ○ Never (6)

Q8 For what purpose(s) do you visit the coast?

Please tick all that apply.

- ☐ Work (1)
- ☐ Recreation & Leisure (2)
- ☐ Volunteering (3)
- ☐ Other (4) ____
- ☐ I don't visit the coast (5)

Q9 How do you feel when you are at the coast?

Please answer these statements according to your level of agreement.

	Strongly disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
The coast is important for my ***mental health*** (3)	○	○	○	○	○
The coast is important for my ***physical health*** (4)	○	○	○	○	○
I feel relaxed when I am at the coast (1)	○	○	○	○	○
The coast brings back positive memories (5)	○	○	○	○	○
I feel like I belong at the coast (7)	○	○	○	○	○
I miss the coast when I am not spending time there (8)	○	○	○	○	○

Q10 What words would you use to describe how you feel at the coast and what the coast means to you?

____

Q11 Excluding time and weather, are there any factors that limit or restrict your use of the coast?
Please tick all that apply.

- ▢ Poor accessibility to the coast (Including personal transport, public transport, roads, paths etc.) (1)
- ▢ Distance I live from the coast (2)
- ▢ Dangers in the natural environment (Including loose & uneven beach sediment, currents, waves, tides, etc.) (3)
- ▢ Dangers in the built environment (Including uneven surfaces, large drops between the sea wall & beach, exposed coastal defences etc.) (4)
- ▢ Dangers in society (Including anti-social behaviour, overcrowding, pollution etc.) (5)
- ▢ Safety (Including lack of access to emergency services, poor mobile phone signal, lack of access to amenities etc.) (6)
- ▢ Other (7) ____

Q12 Do you volunteer or work in the protection of the coastal environment, either on your own or in a group?
Please tick all that apply.

- ☐ I volunteer at monthly beach clean events (1)
- ☐ I pick litter on my own (2)
- ☐ I report species that I find on the beach (3)
- ☐ I work in the protection of the coastal environment (4)
- ☐ Other (5) ____

End of Block: Use of Coastal Space

Start of Block: Lockdown

COVID-19 & the Coast

This next section will now consider the impact of COVID-19 and the resulting lockdown, both on your health and your use of the coast.

It will encourage you to reflect on your experience during the lockdown. The coast includes the beach, sea and the sea front promenade.

Q13 Compared with normal, non-lockdown conditions, how has COVID-19 impacted your health?

Please respond to each of the following statements.

	Strongly Disagree (19)	Disagree (20)	Neither Agree nor Disagree (21)	Agree (22)	Strongly Agree (23)
My **Mental Health** is worse than in normal, non-lockdown conditions (1)	○	○	○	○	○
My **Physical Health** is worse than in normal, non-lockdown conditions (2)	○	○	○	○	○

Q14 Are you able to leave your residence at all during lockdown?

○ Yes (1)

○ No (2)

Skip To: Q20 If Q14 = No

Q15 In general, do you take advantage of your exercise opportunity outside of your residence?

Here, exercise involves all forms of activity outside of your residence, including walking, running, cycling, exercising of dogs etc.

○ Yes (1)

○ No (2)

Q16 In a typical week during lockdown, how often do you visit the coast for your exercise or leisure?

- Daily (1)
- 4-6 times a week (2)
- 2-3 times a week (3)
- Once a week (4)
- Less than once a week (5)
- Monthly (8)
- I haven't visited the coast (6)

Q17 Which locations do you visit the most for exercise during the lockdown?

Definition of 'Green Space': parks, sports fields, woods and natural meadows

	I don't visit (4)	I rarely visit (1)	I sometimes visit (2)	I visit the most (3)
Coast (1)	○	○	○	○
Green Space (See Definition above) (3)	○	○	○	○
Rivers, Lakes, Canals & Reservoirs (5)	○	○	○	○
Urban Housing Estates (6)	○	○	○	○
Urban Parks (7)	○	○	○	○
Other Space (8)	○	○	○	○

Q18 Compared with pre-lockdown conditions, how many people are doing the following activities at the coast during the lockdown?

	Fewer People (1)	No Change (2)	More People (3)	Unsure (4)
Exercising of Dogs (1)	○	○	○	○
Walking (Including the use of mobility scooters & wheelchairs) (2)	○	○	○	○
Running (3)	○	○	○	○
Cycling (4)	○	○	○	○
Visiting in cars (7)	○	○	○	○
Fishing (10)	○	○	○	○

Q19 Have these changes in busyness and number of people influenced when and how you use the coast?

Please provide a brief explanation.

____

Q20 Specifically during the lockdown period, how do you feel when you are at the coast?

Please answer these statements according to your level of agreement.

	Strongly Disagree (17)	Disagree (16)	Neither Agree nor Disagree (15)	Agree (14)	Strongly Agree (13)
The coast is important for my ***mental health*** during the lockdown (1)	○	○	○	○	○
The coast is important for my ***physical health*** during the lockdown (2)	○	○	○	○	○
I feel relaxed when I am at the coast during the lockdown (3)	○	○	○	○	○

Q21 What words would you use to describe why the coast has become more or less important during the lockdown compared to pre-lockdown, normal conditions?

____

Q22 Has the lockdown changed how you experience the coastal environment?

○ I feel more **connected** to the coastal environment (1)

○ I feel more **disconnected** to the coastal environment (2)

○ It has not changed how I experience the coastal environment (3)

Q23 Has the lockdown influenced the extent to which you want to protect the coastal environment for the future?

- ◯ It has made me want to protect the coastal environment more (1)
- ◯ It has not changed how much I want to protect the coastal environment (3)
- ◯ I'm not sure (2)

Display This Question:

If Q23 = It has made me want to protect the coastal environment more

Or Q23 = I'm not sure

Q24 In what ways do you want to protect the coastal environment more?

Please tick all that apply

- ▢ I want to learn more about wildlife at the coast (1)
- ▢ I want to learn more about how the waves, tides and beach work (2)
- ▢ I want to attend monthly beach clean events (3)
- ▢ Other (4) ____

Q25 Do you have any other comments regarding how the lockdown has impacted yourself, or your use of the coast?

____

End of Block: Lockdown

Start of Block: Comments

Q26 If you have any other comments that you wish to make, please write them below.

____

Q27 If you like be involved in further research, either in a focus group or interview, then please leave your contact details (name, telephone or email) below. Thank you.

____

End of Block: Comments

Figure A.2. *Chapter 4 online survey questions and integrated consent form.*

Dear sir/madam,

I hope this email finds you well. Just to introduce myself, I am a PhD student at Lancaster University. My research concerns Coast Watchers, a public engagement project at Cleveleys on the Fylde Coast. I am currently looking at the impact COVID-19 has had on the coast.

I know it may seem like a while ago, but I'd like to thank you for taking the time for fill in my survey about Coastal Space & COVID-19.

You may or not recall, but you left your email address at the end of the survey to say that you were happy to be contacted for follow up research.

I am contacting you to ask if you are willing to participate in an online interview? This will involve a discussion with myself in which you will have the opportunity to share your thoughts and opinions to a set of questions. The interview will last between 45 - 60 minutes and can be done from the comfort of your own home on your computer, laptop, iPad, tablet computer or smart phone.

The interview will be carried out using Microsoft Teams, which is a really simple to use software. Don't worry if you have never used it before, I will send through a set of clear instructions prior to the interview to help you get set up. For more information about my research and what the focus groups will involve, please click on the attached information form.

If you are no longer interested, that is absolutely fine, please just ignore this email. However, if you do wish to take part (which I hope you do!), then please reply to this email stating your availability.

Once I have sufficient responses for a particular date and time, I will get in touch with more information.

I look forward to hearing back from you!

Thank you and best wishes,

Joseph

For more information about the Coast Watchers project, please visit:
https://www.visitfyldecoast.info/environment/coast-watchers/what-is-coast-watchers/

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PhD Geography Student

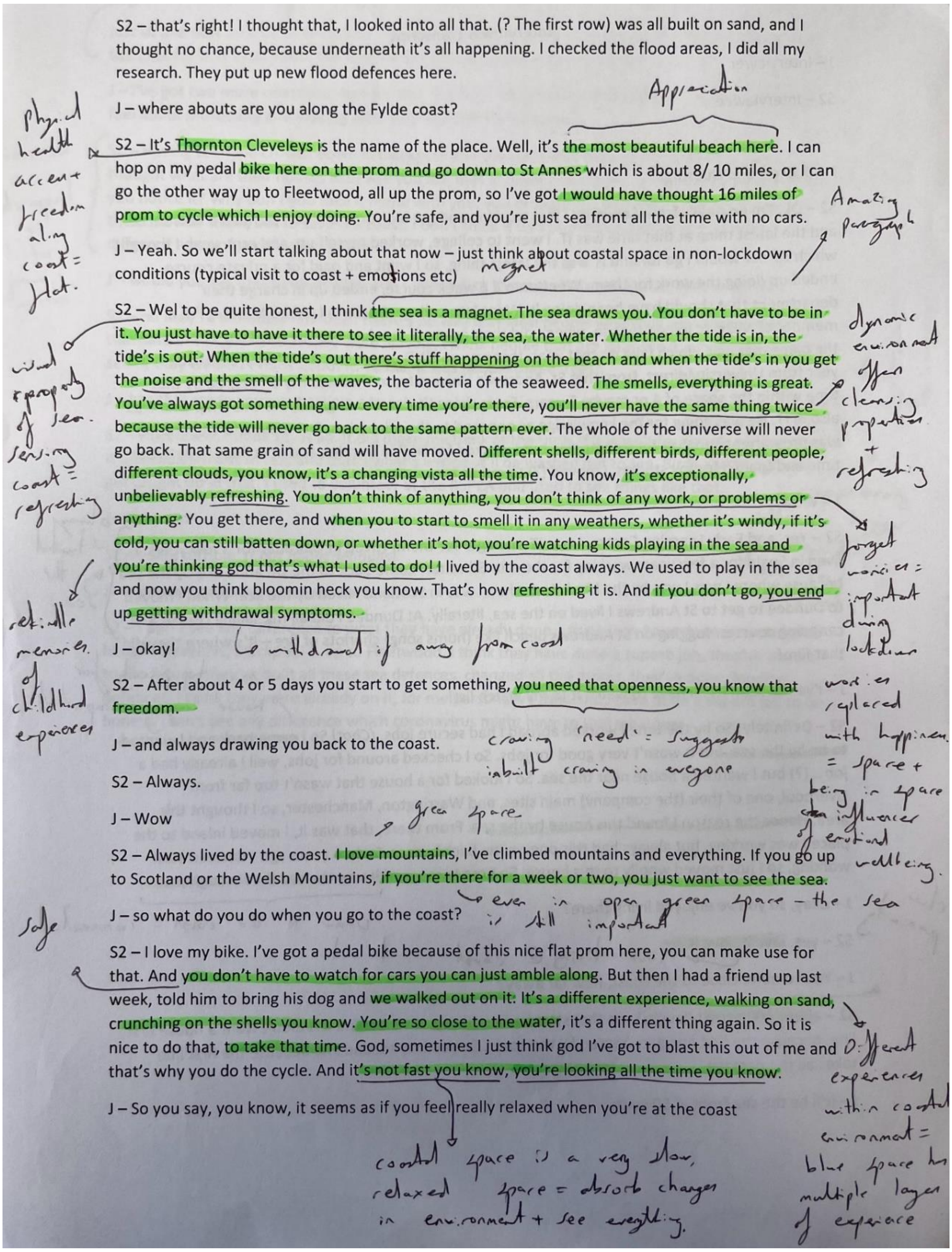
Figure A.3. *Chapter 4 interview recruitment email.*

Table A.1. *Chapter 4 interview guide for participants who live in the Fylde coastal region.*

Theme	Question No.	Question
Introduction	1	*Where do you live?*
	2	*Can you tell me a little about why you chose to move to/live at the coast?*
	3	*If you lived inland previously, what were the reasons you moved to the coast?*
Place Routine	4	*Could you explain why you visit the coast, what you do there, and what a typical visit to the coast looks like?*
Place Experience	5	*How do you feel when you are at the coast when you are there? Does that feeling change throughout different parts of the coast?*
	6	*Compared to how you feel in other spaces (e.g. woodland, urban space etc.)... what is it specifically about the coast that makes you feel this way?*
	7	*What single thing do you cherish most when you visit the Fylde coast? What makes the coast special for you?*
	8	*What do you dislike most about the coast? And why?*
	9	*Does being at the coast brings back positive or negative memories for you? If so, what?*
	10	*What is the value of the Fylde Coast to you?*
Lockdown Wellbeing	11	*How have you have you been feeling during this lockdown period?*
Lockdown Coastal Experience	12	*Have you been to the coast during lockdown? If yes, continue. If no, see below.*
	13	*No – why not? In what ways have you stayed connected to the coast/outdoor space?*
	14	*Can you explain to me if visiting the coast has been valuable to you during lockdown, either physically or emotionally?*
	15	*Do you think your feelings would have been different if you lived elsewhere and didn't have access to the coast?*
	16	*What, if any, health benefits have you noticed from visiting the coast during lockdown?*
Pandemic Reflection	17	*Is there anything you feel that you take for granted about living near to the coast that was taken away during lockdown?*
	18	*Is there anything new or surprising or different that you have noticed about being at the coast during lockdown?*
Business & Routine	19	*Have you noticed any differences in the number of people visiting the coast?*
	20	*If busier, why do you think the coast has been busier during the lockdown? Who do you think has been using it more?*
	21	*Has this changing busyness impacted your routine, or the way you have used the coast?*
Place Protection	22	*Do you think people should have been able to visit the coast during lockdown?*
	23	*How have people reacted here in the Fylde to the changing numbers of people visiting the coast?*
	24	*Has the lockdown changed how you feel about protecting and looking after the coastal environment now? Why is that?*
Conclusion	25	*Any other comments?*

Table A.2. *Chapter 4 interview guide for participants who lived away from the Fylde coast.*

Theme	Question No.	Question
Introduction	1	*Where do you live?*
	2	*Have you previously lived near to the coast?*
Place Routine	3	*What coastal locations do you tend to visit?*
Place Experience	4	*How do you feel when you are at the coast when you are there? Does that feeling change throughout different parts of the coast?*
	5	*Compared to how you feel in other spaces (e.g. woodland, urban space etc.)... what is it specifically about the coast that makes you feel this way?*
	6	*What single thing do you cherish most when you visit the Fylde coast? What makes the coast special for you?*
	7	*What do you dislike most about the coast? And why?*
	8	*Does being at the coast brings back positive or negative memories for you? If so, what?*
	9	*What is the value of the Fylde Coast to you?*
Lockdown Wellbeing	10	*What has been your experience of the pandemic and lockdown?*
	11	*How have you have you been feeling during this lockdown period?*
Lockdown Experience	12	*Have you visited the coast during the lockdown, or post lockdown? Why did you choose to visit the*
	13	*If they have visited the coast, refer to above questions.*
	14	*Have you missed visiting the coast? Impact of this on your health?*
	15	*In light of the pictures of the busy beaches on the south coast during lockdown, how have these images made you feel?*
	16	*Do you think people should have been able to visit the coast during lockdown?*
	17	*Do you think you would have had a different lockdown experience if you could have visited the coast?*
	18	*If you could go to the coast today, how would that make you feel?*
	19	*In what ways, if any, have you stayed connected to the coast during the lockdown?*
Post Lockdown Plans	20	*As the lockdown is lifted over the coming weeks, which places do you want to visit?*
	21	*Do you have any plans to go to the coast?*
Place Protection	23	*Has the lockdown changed how you feel about protecting and looking after the coastal environment*
Conclusion	24	*Any other comments?*



S2 – that's right! I thought that, I looked into all that. (? The first row) was all built on sand, and I thought no chance, because underneath it's all happening. I checked the flood areas, I did all my research. They put up new flood defences here.

J – where abouts are you along the Fylde coast?

S2 – It's Thornton Cleveleys is the name of the place. Well, it's the most beautiful beach here. I can hop on my pedal bike here on the prom and go down to St Annes which is about 8/ 10 miles, or I can go the other way up to Fleetwood, all up the prom, so I've got I would have thought 16 miles of prom to cycle which I enjoy doing. You're safe, and you're just sea front all the time with no cars.

J – Yeah. So we'll start talking about that now – just think about coastal space in non-lockdown conditions (typical visit to coast + emotions etc)

S2 – Wel to be quite honest, I think the sea is a magnet. The sea draws you. You don't have to be in it. You just have to have it there to see it literally, the sea, the water. Whether the tide is in, the tide's is out. When the tide's out there's stuff happening on the beach and when the tide's in you get the noise and the smell of the waves, the bacteria of the seaweed. The smells, everything is great. You've always got something new every time you're there, you'll never have the same thing twice because the tide will never go back to the same pattern ever. The whole of the universe will never go back. That same grain of sand will have moved. Different shells, different birds, different people, different clouds, you know, it's a changing vista all the time. You know, it's exceptionally, unbelievably refreshing. You don't think of anything, you don't think of any work, or problems or anything. You get there, and when you to start to smell it in any weathers, whether it's windy, if it's cold, you can still batten down, or whether it's hot, you're watching kids playing in the sea and you're thinking god that's what I used to do! I lived by the coast always. We used to play in the sea and now you think bloomin heck you know. That's how refreshing it is. And if you don't go, you end up getting withdrawal symptoms.

J – okay!

S2 – After about 4 or 5 days you start to get something, you need that openness, you know that freedom.

J – and always drawing you back to the coast.

S2 – Always.

J – Wow

S2 – Always lived by the coast. I love mountains, I've climbed mountains and everything. If you go up to Scotland or the Welsh Mountains, if you're there for a week or two, you just want to see the sea.

J – so what do you do when you go to the coast?

S2 – I love my bike. I've got a pedal bike because of this nice flat prom here, you can make use for that. And you don't have to watch for cars you can just amble along. But then I had a friend up last week, told him to bring his dog and we walked out on it. It's a different experience, walking on sand, crunching on the shells you know. You're so close to the water, it's a different thing again. So it is nice to do that, to take that time. God, sometimes I just think god I've got to blast this out of me and that's why you do the cycle. And it's not fast you know, you're looking all the time you know.

J – So you say, you know, it seems as if you feel really relaxed when you're at the coast

Figure A.4. Example of preliminary coding by hand.

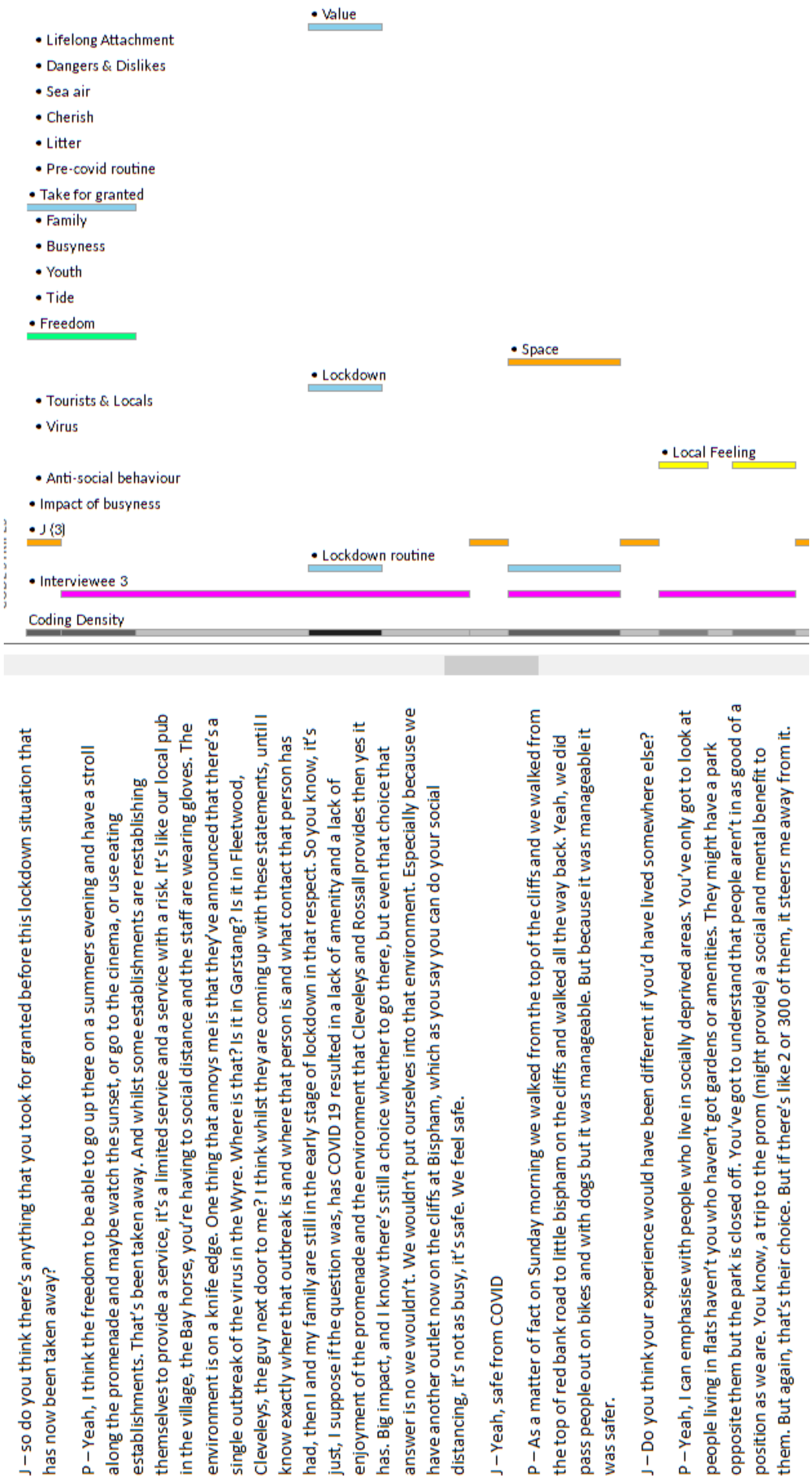


Figure A.5. *Example of secondary coding using NVivo to group and categorise codes and themes across the interviews.*

Table A.3. *Analysis of a sample of interview quotes from Chapter 4 for the codes 'Busyness' and 'Litter' within the 'Lockdown Experience' theme.*

Theme	Code	Interview Quotes	Analysis	Summary
Lockdown Experience	Busyness	*We've not wanted to go down there when there's a lot of people about. We've wanted to go [to the coast] in the evenings really when it's calming down. [P1]*	Changed routine as a result of busyness in coastal space. Evenings safer.	Link between number of people and sense of safety: changing routine or visiting specific locations can allow participant to continue accessing coastal space, but when it is much safer.
		As soon as the heat goes out of the sun, then people leave, they go, particularly children and groups, that then makes it safer because there's less people about. [P1]	Evenings safer, correlation between number of people and safety.	
		Since COVID yes, because I am shielding a vulnerable member in my house, so although I run and we both go out, we tend to go out very early morning. Whereas normally, I'd be on the coast midday, or anytime really. But that's the COVID, so if it wasn't COVID, I would be up there more I think. [P5]	Mornings perhaps present less busy times to visit the coast and are therefore safer for vulnerable people. Changed routine compared to non-pandemic.	
		But then it got silly here, people were crowded together as though it's all over and nobody's bothered and all that, so I've kept to my little coastline here. [P4]	Busyness as reckless - others do not share a lack of concern for pandemic , but sense of protection away from crowds. Safety in locations which are known and have sense of ownership over.	
		You can understand because you've got a better environment or a nicer environment that people in lesser environments would want to come into your environments. But you're not going to stop it, and I think the only way you're going to deal with it is for you to not go into that environment. [P3]	Busyness cannot be mitigated - aware that coast is attractive space - only solution to adapt and not visit that space.	Changed routine to avoid busy environments.
		I've certainly avoided certain areas. Purely on the grounds on it's a bit of a hassle to get through the crowds. [P8]	Busyness a factor in residents 'avoiding' certain areas.	Not necessarily fear of contagion which is the driver of a changed routine, sense of personal disruption more important.
	Litter	*A lot more litter left behind as well. I went down onto the prom, I think it was Monday last week, and honestly it was just disgusting. [P2]*	Increase in litter in coastal space during pandemic period.	Increase in litter during the pandemic period, particularly 'fresh' (directly litter items) including pandemic specific items.
		It's mostly these face masks that are showing up all over the bloody place. You always get the beer cans, but it's these face masks that are disgusting. [P9]	Increase in pandemic associated litter.	
		Over the years when we've been doing the litter picking it's mainly stuff that has been washed out of the sea. At the moment a lot of the litter that's on the beach has been freshly left there. Particularly drinks cans and bottles. [P1]	Increase in 'fresh' litter compared with 'normal' conditions.	
		Increased visitor numbers and people coming from other areas and bringing their rubbish with them and leaving it there and not taking it back. [P3]	Increased litter - perception that non-local beach users are responsible.	Increase in litter attributed to non-local beach users - 'othering' of the issue
		They're definitely not local. There's no way that local people who walk along there would do that kind of thing. The stuff they were leaving, I think people that are local see it, whereas they didn't see it, they wouldn't think about it. To me, it was people that come in. [P8]	Non-local beach users perceived to be responsible for litter increase, attributed to a lack of thought (or environmental awareness perhaps?)	

Appendix B: Chapter 6 Interview Materials

Lancaster University

Dear [Insert Name]

I hope you are well and enjoying your summer.

I am emailing you to ask if you would be interested in taking part in an online interview about your experiences participating in the Coast Watchers litter survey work?

The interview will take between 45 – 60 minutes of your time and will ask you questions about your involvement and experiences in the project, any learning that you have taken away, and your perspectives on the future direction of Coast Watchers.

I would really appreciate your involvement in an interview, as it will be beneficial for my PhD and will hopefully be an enjoyable conversation for you.

By taking part in an interview, you are giving consent for your data to be used. Data that you share with me will be anonymous, and only stored for the duration of the analysis. You may also withdraw your response from the study, but this must be within four weeks of taking part in the interview.

Please get in touch if you have any questions

All the best,

Joseph Earl

Lancaster Environment Centre
Lancaster University
LA1 4YQ
PhD Geography Student

Figure B.1. *Chapter 6 participant recruitment email.*

Table B.1. *Chapter 6 interview guide.*

Theme	Question No.	Question
Introduction	1	*Where do you live & how often do you visit the coast?*
	2	*What is your association with beach cleaning?*
Involvement & Experiences in Coast Watchers	3	*How did you find out about the Coast Watchers project and what motivated you to join the project?*
	4	*How many Coast Watchers beach cleaning sessions have you attended?*
	5	*Can you summarise your experiences on the day at the sessions?*
Outcomes	6	*What are your overall take-away's from the litter surveying?*
	7	*What would you say is the most important take away for you?*
	8	*What, if anything, do you think the process of recording beach litter, compared to just collecting it, has had on you?*
	9	*What brought you back to the project month after month?*
	10	*Other that what we have discussed, were there any other outcomes that you have taken away from your involvement?*
	11	*Was there anything that you did not enjoy, or perhaps would change about your involvement?*
Concerns	12	*What were your thoughts about marine litter before being involved in the project? Have those thoughts changed after being involved?*
Place Interactions	13	*In what ways, if any, do you think your involvement has shaped the way you think about or interact with the coastal environment?*
Pro-environmental Behaviours	14	*Has the project affected your practices regarding waste management or litter? / given you any ideas for how you might change your everyday practices?*
Dissemination	15	*What are your thoughts on the way the results were presented? Did that match your style of learning?*
	16	*Have you talked about the project with anyone else?*
Longevity of Coast Watchers	17	*Would you like to continue surveying litter on the beach?*
	18	*Do you want more ownership of that?*
	19	*Thinking longer term, do you want to be more involved with Coast Watchers?*
	20	*What does greater involvement look like?*
	21	*Where do you see the project going or progressing?*
	22	*Is there anything else that you would like to learn about or perhaps monitor in the beach or coastal*
	23	*Why do you think that is important?*
	24	*Would you be interested in volunteering on a different day of the week on a monthly basis to monitor*
	25	*What impact would you like the Coast Watchers project to have? Is there anything you think that we could do as a group to get our voice heard/make decisions?*
Identification	26	*Lastly, to what extent do you identify as citizen scientist, or a Coast Watcher?*
Conclusion	27	*Any other comments?*

Table B.2. *Analysis of a sample of interview quotes from Chapter 6 for the codes 'Contradicting Perspectives' and 'Waste Management Practices' within themes of 'Outcomes' and 'Pro-environmental Behaviours' respectively.*

Theme	Code	Interview Quotes	Analysis	Summary
Outcomes	Contradicting Perspectives	*I'm pretty surprised that not a lot of it was fresh, if I'm honest with you. [P3]*	Surprise at the lack of evidence for direct littering, contrary to expectations.	Participants expected to see more directly dropped litter than were surveyed. Participants better understand the source and stores of litter, highlighting an increased awareness as the sea is an important source of litter, not just from beach users. Consequently, the process of citizen science surveying provides an opportunity for experiential learning which can directly contradict people's initial expectations.
		I was quite surprised that there's less litter dropped than the amount of litter that comes in on the tide. [P7]		
		People leaving their litter - which largely doesn't seem to be the case, does it? You know, we don't seem to be getting as much as you would expect with people. [P9]	Expectation for more directly litter items, particularly from holiday makers or tourists (direct link to perceptions during pandemic), but citizen science surveying has provided evidence to change mindsets.	
		I thought there would probably be more fast food packaging, a lot more discarded debris should I say. [P2]		
		It was just the anticipation of it - you think 'ohh yeah, holidaymakers here again and we're going to get loads more litter'. And actually, you don't, you know you get some more, but you don't get the vast amounts that you expect to find. [P7]		
		I obviously used to go on day trips whatever you know, go to the beach and I used to see the rubbish and think, ohh you know there must have been a lot of people here the other day and they've left all this rubbish knocking about. And know I know that it's not all that you know. [P1]	Direct learning opportunity from citizen science surveying: 'now I know'	
Pro-environmental Behaviours	Waste Management Practices	*The other thing I was really surprised and made me think about is packaging and especially food packaging that I personally consume, or is out there. It's not good. And now that you've seen the aftermath of where it ends up like first hand, it really makes you stop and think, OK do I actually need this? Let's try and replace some plastic, which I've tried to do anyway from like refill bottles and stuff, but it's kicked me to do it a lot more... probably from the first session, certainly by the second session that confirmed it - I was like, yeah, I want to take the environmental welfare a lot more seriously. So what can I do to kind of combat what I'm seeing right now on the beach cleans. [P3]*	The experiential learning opportunity afforded by citizen science (i.e. appreciation of the impact of waste plastics on the marine environment) has motivated pro-environmental behaviour.	Citizen science beach litter surveying can be a stimulus for changed, or enhanced waste management practices. However, it is impossible to determine if their behaviours changed because of their involvement in Coast Watchers, or if those changes would have occurred regardless (Wyles & Ghilardi-Lopes, 2023).
		It has made an impression when I go shopping, looking for stuff that's packaged differently, that's not full of plastic. [P7]	Increased willingness to undertake pro-environmental behaviour.	
		We've always recycled as best we've can, but I'm even more vigilant now I would say... I've become much more vigilant with things like that since I started the beach clean, definitely. [P8]		
		I'm not sure because I've I think I've always been quite conscientious of my waste. [P11]	Beach surveying did not have an impact on waste management practices for some participants.	Pro-environmental behaviour outcomes not apparent for all participants - perhaps because it attracts a specific environmentally conscious audience.
		No it hasn't, because I've always been quite conscious of it. [P1]		

Appendix C: Chapter 7 Interview Materials

Lancaster University

Dear [Insert Name]

I hope you are well and enjoying your summer.

I am a PhD student at Lancaster University exploring the role of citizen science within coastal management and decision making.

As a practitioner who operates on local/national (delete as appropriate) scale coastal management, I am emailing ask if you would be interested in taking part in an interview about this research topic.

The interview will take between 45 – 60 minutes of your time and will ask you questions about your role in coastal management, trends towards a collaborative coastal management, and your perspectives on whether citizen science has a role to play within that. The interview can be online or in-person, depending on convenience and practicalities of travelling to your location.

I would really appreciate your involvement in an interview, as it will be beneficial for my PhD and will hopefully be an enjoyable conversation for you.

By taking part in an interview, you are giving consent for your data to be used. Data that you share with me will be anonymous, and only stored for the duration of the analysis. You may also withdraw your response from the study, but this must be within four weeks of taking part in the interview.

Please get in touch if you have any questions.

All the best,

Joseph Earl

Lancaster Environment Centre
Lancaster University
LA1 4YQ
PhD Geography Student

Figure C.1. *Chapter 7 participant recruitment email.*

***Table C.1**. Chapter 7 interview guide for coastal practitioners.*

Theme	Question No.	Question
Introduction	1	*Please can you briefly explain what your role is within your organisation?*
	2	*How would you define or describe coastal management?*
	3	*What does your role in coastal management look like?*
Role of communities in decision making	4	*To what extent are communities currently involved or have a role in coastal management operations or decision making locally?*
	5	*Can communities or citizens take coastal management decisions into their own hands?*
	6	*Are there any informal ways communities or citizens are involved in coastal management?*
Engagement practices	7	*Can you tell me about your experiences engaging communities in coastal management?*
	8	*What does engaging communities in coastal management look like in practice? Do you have any examples or experiences? At what stage of the decision-making process can people contribute? When does this occur? What has been the outcome?*
	9	*What aspects of coastal management have people contributed to in these instances? To what extent have these contributions met your expectations? What would make it more valuable?*
	10	*Have you experienced any challenges engaging with communities? Do you have the time or resources available to support you?*
	11	*Do you think it is important to engage with coastal communities in coastal management on local scales?*
National strategy	12	*The national FCERM strategy states 'People want to have a voice in shaping how resilience to flooding and coastal change is achieved in the places in which they live and work.' What are your thoughts on this national strategy and what does it mean for you and your local communities in practice?*
	13	*Are you aware of this strategy? Do you think communities are? Who do you think is driving this and why?*
	14	*What do you think having a voice means? How do you think this will work in practice? In what ways could people's voices contribute more?*
	15	*Compared with existing community involvement in coastal management, to what extent do you feel this strategy signals an increasing focus on working and collaborating with the public?*
	16	*To what extent does this drive translate to a local level? Does the strategy influence your day-to-day coastal management activities?*
	17	*Do you think communities want to be more involved in making coastal management decisions or shaping their coastal resilience?*
	18	*Do you see space for further engagement? What would greater involvement look like – when and where in the decision-making process can people contribute more?*
	19	*Do you think a collaborative coastal management is currently achievable or feasible, for example, are existing funding, tools or mechanisms able to fully support you and communities in making coastal management decisions on national or local scales? What would have to change to make it happen?*
Readiness	20	*How would you describe your personal and local community's (NW) level of readiness for a collaborative coastal management?*
	21	*To what extent do you think communities are aware of: SMP policies and what they mean? The implications of climate change at the coast?*
	22	*How ready or prepared do you think you are (as a coastal manager/practitioner) for involving and collaborating with communities to build coastal resilience? Are communities ready or prepared?*
	23	*Do you envisage any problems or challenges arising for you or the community from further collaboration? Any benefits?*
Power in decision making	24	*Are there boundaries (e.g. spatial or temporal) regarding the extent to which citizens can contribute to decisions, and if so, who sets these?*
	25	*If communities have a greater voice in coastal management and decision making, do you envisage any shifts in where the power is held? Do you think this will have any impact on your day-to-day activities?*
Conclusion	26	*Any other comments?*

Table C.2. *Chapter 7 interview guide for coastal community actors.*

Theme	Question No.	Question
Introduction	1	*Please can you briefly describe your background, your community and role within it (if you have one)?*
	2	*How would you define or describe coastal management?*
	3	*Are your community currently experiencing any coastal flood or erosion issues? Any perceived risks/future concerns?*
	4	*Do you know what the process for making coastal management decisions looks like? Do you know who is responsible for*
Role of communities in decision making	5	*To what extent do you feel that your community are currently involved or engaged in coastal management operations or decision*
	6	*Can communities take coastal management decisions into their own hands?*
	7	*Are there any informal ways in which your community are involved in coastal management?*
	8	*Do you have any examples for how your local community are managing or preparing for coastal change?*
Engagement practices	9	Can you tell me about your experiences engaging, or being engaged by practitioners, in coastal management?
	10	*What does 'being engaged' look like in practice? At what stage of the decision-making process have you been able to contribute? Do you have any examples where you have/have not been involved? What has been the outcome?*
	11	*If no engagement has taken place, why?*
	12	*What contribution have you been able to make, if any? Do you think your contributions were valued? What would make them*
	13	*If no contribution was made, what contribution could the community make?*
	14	*Have you experienced any challenges in the engagement process? Do you feel time and resources have been invested into engaging you, or helping you to be engaged?*
	15	*Do you think it is important for coastal communities to be engaged in coastal management on local scales?*
National strategy	16	*The national FCERM strategy states 'People want to have a voice in shaping how resilience to flooding and coastal change is achieved in the places in which they live and work.' What are your thoughts on this national strategy?*
	17	*Are you or the community aware of this strategy? Is it something you have felt on the ground? Who do you think is driving this and why?*
	18	*What do you think having a voice means? How do you think this will work in practice? Do you currently feel that you have a voice?*
	19	*Do you think communities want to be more involved in making coastal management decisions or shaping their coastal resilience?*
	20	*Do you think coastal managers or authorities want communities to be more involved in coastal management?*
	21	*What would greater involvement look like to you – when and where in the decision-making process can people contribute more?*
	22	*Do you think a collaborative coastal management is currently achievable or feasible? What would have to change to make it happen?*
Readiness	23	*How would you describe your personal and local community's (NW) level of readiness for this style of collaborative coastal management?*
	24	*To what extent are you, or your community, aware of: SMP policies and what they mean? The implications of climate change at the coast?*
	25	*How ready or prepared do you think you are as a community to build coastal resilience? Are coastal managers ready or*
Power in decision making	26	*Do you envisage any problems or challenges arising for the community or coastal managers from further collaboration? Any benefits?*
	27	*Do you think your community currently has any power within the coastal decision-making process?*
	28	*Are there boundaries (e.g. spatial or temporal) regarding the extent to which you feel the community can contribute to decisions, and if so, who sets these?*
	29	*To what extent do you think is there willingness to distribute power to the communities?*
Conclusion	30	*Any other comments?*

Table C.3. *Analysis of a sample of interview quotes from Chapter 7 for the codes 'Financial Resources' and 'Relationship Between Coastal Management Authorities and Communities' within themes of 'Systematic Challenges' and 'Readiness' respectively.*

Theme	Code	Interview Quotes	Analysis	Summary
Systemic Challenges	Financial Resources	*I've not come across any funding pots that [reward engagement]. [P6]*	No existing funding pots which specifically fund, or reward community engagement in coastal management activities.	Non-availability of financial resource to undertake further engagement. Engagement possibly not valued by funders, meaning it is likely to get sidelined by competing priorities. Who will fund further engagement, is it reliant on the 'good will' of practitioners?
		If we got the salt marsh funding that's hopefully coming round next year, we might do it again, but there's no funding for community engagement in that. [P4]		
		There's no extra money for engagement. I'm trying to think on the funding side, whether there is any? It will ask what engagement and consultation you've done, but you don't get any plus points if they're on board or not. You know, the way it is at the moment is all about what are you protecting, what's the cost benefit? [P6]		
		It was always very, very difficult to fund the getting people to work together element because it was so intangible. People didn't see the benefits of just getting people on speaking terms. [P2]	Funding engagement difficult in the past - contributed towards a changed role for coastal partnerships. Value of engagement not quantifiable in economic terms.	
		Brutally it comes down to the finance, the funding. If it's direct funding given to do it, fine, if it's built into the process as part of your larger scheme. But there's got to be the resource to do it, you know. And do it properly, you know, we can tick our box by posting an online consultation. [P6]	Financial resource the key restrictor of the engagement extent for a scheme.	The extent to which the community can be involved is a factor of the available finance, or funding restrictions associated with policy implementation in practice.
		I'm just weary of the funding of what we do. Because everything unfortunately comes down to funding, and whilst the community might have more of an influence on what we what desire to do, the cost will drive it. I mean even a lot of the stuff in the SMP depends on funding. The simple way to say is the community might have more influence on policy, ultimately they won't have more influence on how it's implemented simply because there's funding restrictions. [P1]	Funding restrictions a significant blocker to the extent to which the community can be involved. Difficult to overcome.	
Readiness	Relationship Between Coastal Management Authorities and Communities	*You do hear gripes of people saying 'oh the Council never tell us anything', you know, and this that and the other don't represent us… this is not just in our subject area. Who their councillors are, who to go to and making the whole process more transparent not just for flood risk, but for everything. Yeah, I mean, I think that's it, really. As I've said before, it is in essence a culture, a political culture. [CA1]*	Lack of transparency and visibility of processes and accountability within local authorities - a common issue. Problem bigger than for FCERM.	
		I would have said it was, it was just dealt with by somebody almost sort of like faceless, you know, somebody that I don't know, that it involves large diggers and plenty of people moving sand and stones about. [CA3]	Lack of visibility of coastal management actors and processes - 'Faceless'	Lack of visibility of coastal management processes within local authorities. Learning important to overcome these issues, but dependant on personal journey, stimulated either by 1:1 conversation with engineer or experience during a flood event. Needs to be much more widespread to communities at risk.
		I would never have credited that everything is so carefully monitored and measured and watched and checked, because there's no evidence of that to the average Joe public. [CA5]		
		I only know how coastal management works because I've been involved with [coastal engineer] and he's explained it to me on a one to one basis. And when he did explain how everything works and it's planned over a 100-year span, I got the shock of my life to be honest, because I'd got no idea that all that work went into the back of what we physically see as local residents and users. Up to that point, I would have just said that they winged it and did things as they needed to. [CA5]	Only through personal learning journeys have perspectives shifted - sense of surprise at what coastal management involves, and who is involved,	
		I had my eyes opened a little bit because during Storm Desmond I was very involved with the local radio station at that time and the people that came to the door to tell us what was actually happening came from all over the place, all sorts of different agencies. [CA3]		
		A lot of our stuff is so complex. Trying to get it out an accessible message, it's pretty difficult and you know historically we get in the local press and there'd be free papers going to every property and you can just get articles in that. And that's all gone, so you're relying on Facebook, web pages, WhatsApp, all that stuff. It's like, well how effective it is, and all these wonderful stats 'we've had 20,000 hits' – does it mean anything? [P6]	Practitioner perspective - difficult to convey an accessible message due to the complexity of the practice. Contributes to a lack of visibility. Also uncertainty as to which audiences are being reached - what impact is current 'engagement' having?	Decreasing visibility of coastal management over time. Social media can reach large audience, but lacks targeted focus (e.g. thin engagement; Nabatchi & Leighninger, 2015)

Appendix D: Research Outputs

Journal Abstracts

Earl, J., Gormally-Sutton, A., Ilic, S. & James, M.R. (2022) 'Best day since the bad germs came': exploring changing experiences in and the value of coastal blue space during the COVID-19 pandemic, a Fylde Coast case study. *Coastal Studies & Society*, *1*(1), pp.97-119.

Blue spaces have long been associated with beneficially impacting human health and wellbeing. This article reflects upon the impact of the COVID-19 pandemic on people's experiences in coastal blue space and the health and wellbeing benefits derived from exposure to the space. Undertaken after the UK's first lockdown during summer 2020, the work employed a qualitative mixed methods approach through a survey and interviews to provide an in-depth case study of people's experiences in and value of coastal blue space before and during the pandemic on the Fylde Coast in Lancashire. Findings show that participants valued the physical and mental health benefits derived from routine visits to coastal space, stimulated by emotional connections, a sense of escape and sensorial immersion. However, a busier coast in the lockdown's aftermath provoked a changed experience in coastal space for many participants due to a detachment from coastal space and the provoking of negative emotional experiences driven by heightened fears, reduced safety and increased litter. Mitigatory responses, through a changed coastal routine, and reflective responses, through a changed value of the coast, were found, the latter due to an increased appreciation of the health benefits from coastal exposure for some participants. Importantly, the findings highlight the need for coastal management to account for these experiences in protecting the health value of coastal space.

Pollastri, S., **Earl, J.**, Edwards, L. & Ilic, S. (2024) Morecambe Bay Timescapes: Drawing Together Coastal Futures That Will, May, or Could. *TRACEY-Drawing and Visualisation Research*, *17*(1), pp.1-17.

This article considers the role of drawing and creative processes of visualizing possible coastal futures as a means for engaging young people in climate change research and coastal management processes. Whilst predictive models show the impact of climate change in coastal areas around the globe, what will happen to individual places will largely depend on local strategies and interventions. Yet, the complexity of these phenomena as well as the high level of specialisms involved often tends to leave local communities, and young people in particular, unable to participate decision-making processes which will determine the future of the places where they live. In the Morecambe Bay Timescapes project, three secondary schools and one college across Morecambe Bay were involved in a programme of activities which combined fieldwork, archival research, climate modelling, and art practice which led to the design of visions of hyperlocal coastal futures. These visions were used as part of an interactive exhibition that brought together young people and experts in conversations about possible futures. This article describes the role that drawing played in enabling such conversations, by providing a way for students to work through multiple layers of complexity and articulate their reflections.

Conference Presentations

- **Eurocoast Zoominar**, Online (2020). Presentation: '*Coast Watchers Through the Coronavirus Pandemic.'*
- **Lancaster Environment Centre Winter Conference**, online (2021). Video: *Coast Watchers: 'Exploring the Value of Coastal Space During the COVID-19 Pandemic.'*
- **Young Coastal Scientists & Engineering Conference [YCSEC]**, Online (2021). Presentation: '*Coronavirus & the Coast: Exploring Changing Values & Experiences of Coastal Space Along the Fylde, Lancashire.'*
- **CITiZAN Connecting Coastal Heritage, Communities & Climate Change Conference**, Liverpool (2022). Presentation on: '*Engaging Communities on Understanding Coastal Challenges*'
- **YCSEC**, Bournemouth (2022) Poster presentation (Figure D.1): *'Exploring the Distribution & Accumulation of Beach Litter Using Citizen Science'* [Awarded Best Poster]
- **Future Places: Reimagining Landscapes**, Lancaster (2022) Panel: *'Morecambe Bay Timescapes'*.
- **UK Coastal Research Conference**, Plymouth (2023). Presentation: *'Learning from Citizen Science to Support Coastal Management'* [Awarded Best Presentation].
- **European Geosciences Union [EGU]**, Vienna (2024). Poster (Figure D.2): *'Collaborative Citizen Science to Support Coastal Management'*.

Figure D.1. *Poster to YCSEC, 2022 [Awarded Best Poster Presentation].*

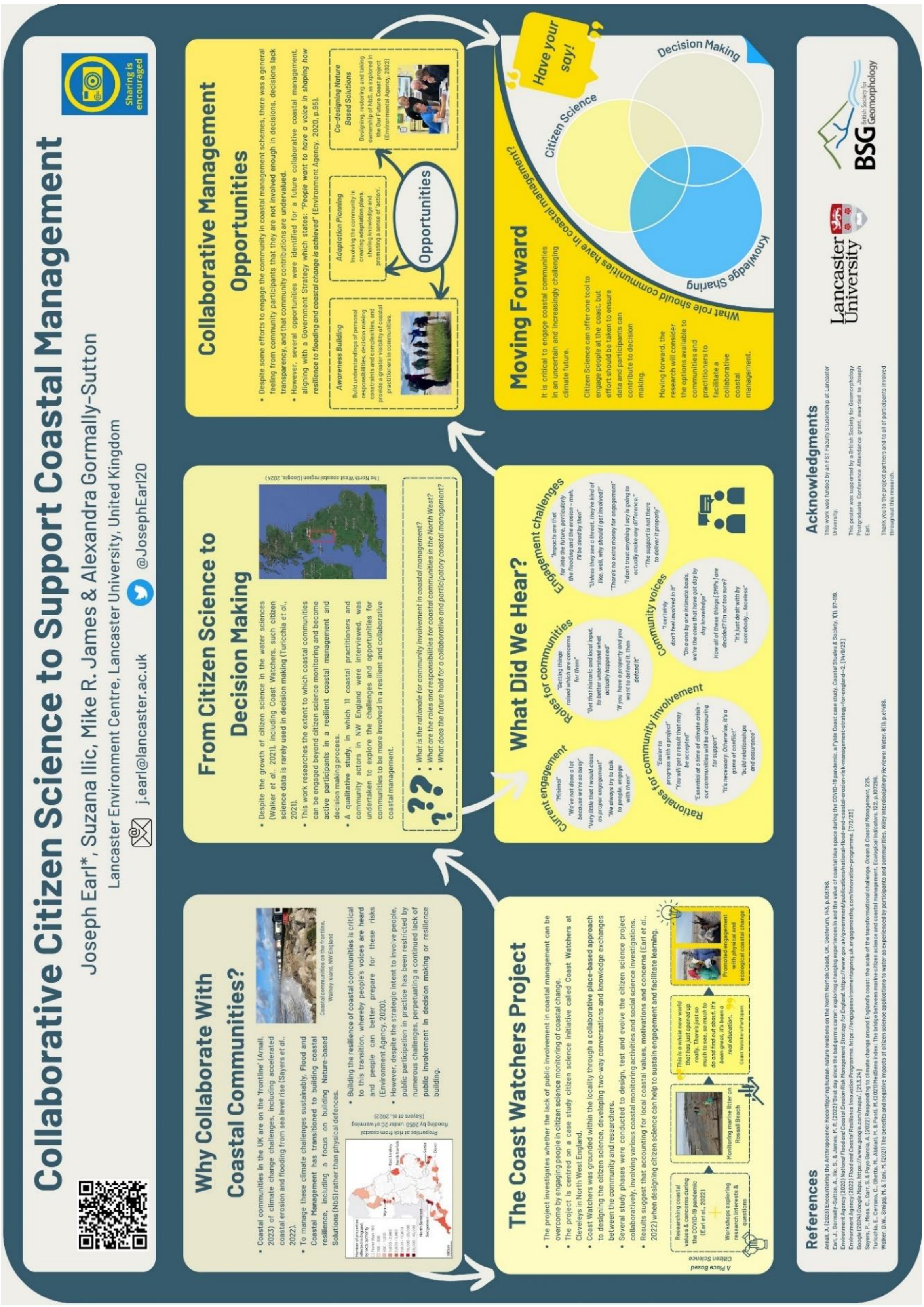


Figure D.2. *Poster to EGU, 2024.*

Engagement Activities

- **Tangled in Plastic** (2021): Engagement sessions with primary school students to learn about marine plastic as part of Lancaster University's 'Entangled Festival'.
- **Travelling in Climate Time** (2021): Public engagement workshop as part of the COP26 festival.
- **Morecambe Bay Timescapes** (2021-2022): ESRC funded project engaging students around Morecambe Bay to learn about and visualise coastal climate futures.
- **Coastal Live Lab** (2022): EPSRC IAA funded project to engage school students and a coastal community in exploring, noticing, and recording their coastal environment.
- Various talks & lectures to community groups.

Online Articles

Earl, J. (2020) *Understanding the Beach*. Available at: https://www.visitcleveleys.co.uk/environment/beach-care/understanding-the-beach/

Earl, J. (2023) *Measuring Marine Litter on Rossall Beach*. Available at: https://www.rossallbeach.org.uk/2023/10/08/measuring-marine-litter-on-rossall-beach/

Earl, J. & Ilic, S. (2024) *Why you shouldn't take pebbles from the beach – here's the science.* Available at: https://theconversation.com/why-you-shouldnt-take-pebbles-from-the-beach-heres-the-science-230560