Smooth sailing? User perspectives on marine recreation around the Isle of Arran

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UNIVERSITY of STIRLING

September 2023

MSc Environmental Management (Conservation)

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Abstract

The study of recreational activity in coastal and marine social-ecological systems (SESs) is sparse compared to terrestrial sites. This study examines the nature and distribution of marine-based recreation around the Isle of Arran, Scotland, aiming to provide a baseline assessment of user preferences and perspectives on current and future activity. A survey of 110 users, and interviews with ten stakeholders involved in facilitating recreational activities provided in-depth insight into relationships with other users, the environment, and governance systems within Arran's marine SES. Through a mixed-method approach, involving statistical and thematic analysis, use trends were quantified while retaining the nuances of stakeholder perceptions. Results highlighted that the most popular primary activities were swimming (37.3%, n=41) and paddle sports (32.7%, n=36). Highest cumulative use levels occurred in Whiting Bay, Lamlash and Brodick on Arran's east coast. Participants anticipated growth in marine recreation and valued wildlife abundance, environmental quality, and community among marine users. Concerns and emerging conflicts related to motorised watercraft, education, safety, crowding around popular entry points, and lack of local inclusion in the largely top-down management of Arran's marine environment. Findings demonstrate the utility of a SES approach in understanding participant behaviours, perspectives, and conflicts as embedded in the ecological, social, and governance systems within which they operate, offering grounding upon which future research, management, and decision-making can take place.

1. Introduction & Background

Coastal marine areas benefit a wide range of stakeholders, including fisheries, aquaculture, energy, tourism, and recreational users through ecosystem services such as food provision, hydrological system regulation, biodiversity, and cultural and spiritual value (Jobstvogt et al, 2014; Mace et al, 2012). A social-ecological systems (SES) framework approaches marine areas as multi-dimensional resources, within which varying habitats, users, and modes of governance interplay (Ostrom, 2009; Refulio-Coronado et al, 2021). Ostrom (2009) argued that understanding these variables and how they impact users' ability to self-organise around resource management can aid in assessing the sustainability outcomes of resource use. The SES framework has been applied to coastal and marine resources at multiple scales to explore relationships between actors, governance systems, wildlife, and the environment, with the aim of informing management and future use (e.g., Outeiro et al, 2018; Wahyudin et al, 2018; Defeo et al, 2021). However, few studies focus on the perspective of specific user groups, such as those participating in recreation or leisure, and the relationships that exist within the group as well as with the wider SES (Refulio-Coronado et al, 2021). Furthermore, research on marine recreation within the fields of tourism studies and natural resource management is sparse compared to similar studies of terrestrial areas (Pickering et al, 2018).

This study aims to understand recreational use levels, types, and distribution in the sea around the Isle of Arran, in the Firth of Clyde in southwest Scotland, along with stakeholder views regarding current and future recreational activity. Through a mixed-method analysis of both qualitative and quantitative data, this study offers an in-depth understanding of recreational user preferences, relationships, behavioural norms, and interactions with and within governance systems (Stosch et al, 2022). A SES framework was used to facilitate a holistic, system-wide approach to understanding how recreational activity is embedded within Arran's coastal waters as a resource system, providing a case study applicable to similar contexts in Scotland and beyond (Ostrom, 2009). Insight into emerging conflicts, cooperation and community, and perspectives on future use and management offers a grounding upon which policy decisions, local organisation, and further study can take place (Smith, 2018; Schéré et al, 2021).

a. Understanding marine social-ecological systems

Ostrom (2009) rejects the oversimplification of open access and shared resource systems, advocating for a multi-level SES framework to capture the complexity of actors and relationships within a given area. Through this approach, the sustainability of resource units, users, and governance mechanisms can be understood systematically and compared across multiple contexts (Ostrom, 2009; Refulio-Coronado et al, 2021). Marine and coastal SESs are among the most used and populated areas globally, with increasing urbanisation, tourism, industrial development, and the climate crisis causing new interactions and heightened use conflicts (Defeo et al, 2021). In a literature review of coastal SESs, Refulio-Coronado et al (2021) note a growing focus on their social and ecological vulnerability, resilience, governance, and capacity to adapt to change. Defeo et al (2021) argue that sandy beach SESs in particular face mounting pressure to serve the needs of multiple user groups while adapting to associated resource depletion, pollution, and lifestyle demands. Even in Marine Protected Areas (MPAs), designed to limit human activities to varying extents, trade-offs between extractive and non-extractive uses can create new conflicts, such as disruption to animal behaviour or challenges to local livelihoods which previously relied on resource extraction (Zupan et al, 2018; Inman et al, 2016). For example, Vergara Peña (2020) found that bottlenose dolphins in Cardigan Bay, Wales, were displaced by highspeed watercraft in popular tourist areas, but were attracted to fishing boats outside the Special Area of Conservation designated for their protection. Research on SESs must therefore

consider the intricacies of conflict, spatial dynamics of use, ecological implications, and user behaviour (Refulio-Coronado et al, 2021; Wahyudin et al, 2019).

Marine Spatial Planning (MSP), which maps the spatial dynamics of uses and impacts, offers a tool for informing approaches to conflict resolution, access, environmental protection, and governance in marine SESs (Smith, 2018; Noble et al, 2019). Smith (2018) contends that disagreements over the management of coastal marine areas arise from a lack of public involvement in MSP. He therefore argues that local engagement and research on the social, political, and ecological context of a marine environment should occur before planning is undertaken, rather than during or afterwards, and without pre-formulated policy or management ideas. He describes gaining this initial understanding as 'step zero' of MSP, which is a central aim of this study (Smith, 2018).

In Scotland, marine management and policymaking are often top-down processes with little public input, and many coastal communities have become sceptical of government consultation processes (Smith, 2018; Schéré et al, 2021). Conversely, a bottom-up approach refers to planning and management led by communities and local stakeholders, who are granted autonomy over decision-making, and avenues for shaping policy at higher governance levels (Smith, 2018). On the Isle of Arran, the successful community-led campaign for the establishment of the Lamlash Bay No-Take Zone (NTZ) and South Arran MPA reinforced high levels of environmental awareness, involvement in, and support for marine protections amongst the island's residents (Howarth-Forster, 2020). Resource systems may also be co-managed, with varying levels of state intervention (Schéré et al, 2021). However, in assessing the governance MPAs in the Irish Sea, Schéré et al (2021) found that an absence of meaningful communication between community stakeholders and government institutions responsible for MPA management resulted in dissatisfaction with the equitability of co-management partnerships. While community-led and bottom-up approaches do not guarantee success in terms of environmental protection and conflict remediation, and rely on the time, commitment, and leadership of local actors, they are built upon stakeholder integration into management which often facilitates a more inclusive approach than top-down management (Ostrom, 2009; Smith, 2021).

b. Approaching the study of user perspectives within complex social-ecological systems

Bottom-up approaches to policy designation can reduce conflict and polarisation between stakeholder groups, aiding the formulation of shared management goals (Ranger et al, 2016). Conflict risk increases where multiple user groups with competing objectives operate in proximity (Cusack et al, 2021). For example, fisheries may seek maximum sustainable yields, conservationist groups stricter environmental protections, and leisure users greater freedom to access scenic areas (Ranger et al, 2016; Schéré et al, 2021). Ostrom (2009) proposed ten variables which influence the sustainability of SES management: the resource system's 1) size, 2) productivity, and 3) predictability; 4) the mobility of resource units, 5) user numbers, 6) leadership, 7) social capital and behavioural norms, 8) knowledge about the system, 9) its importance to users, and 10) local autonomy in decision-making. In brief, she argued that high use levels and greater variation in user perspectives and behaviours can complicate and inhibit successful self-governance of the shared resource (Ostrom, 2009).

Innovative research methods, including participatory MSP, can aid in understanding conflicts and reaching equitable compromises between stakeholders with competing ideologies (Ranger et al, 2016). Noble et al (2019) used a mixed-method approach, involving interviews and participatory mapping, to explore social resilience in MPAs by analysing relationships between ecotourism

providers, water sport users, recreational fishers, and commercial fishers, finding that stakeholder disagreements were more likely in ecologically rich areas. Moreover, a study of catchment area uses across Scotland revealed that participatory mapping of aquatic environments, alongside qualitative stakeholder surveys and interviews, can help identify not only conflicts but shared views (Stosch et al, 2022). Ranger et al (2016) found that a multi-criteria approach, combined with Community Voice Method (CVM) (involving producing a film from participants' interview videos), facilitated non-confrontational deliberation in decision-making and helped participants understand the views of their peers. Using mixed methods for studying user-group preferences and spatial dynamics balances the simplification of quantitative data with the subjectivity of qualitative responses, while accounting for the multitude of stakeholders and objectives within SESs (Ostrom, 2009; Murray, 2016).

c. Managing marine recreation in Scotland: benefits, impacts, and interactions

Globally there has been relatively little research into the nature, scale, and distribution of recreational activities in marine areas compared to terrestrial sites (Pickering et al, 2018; Jobstvogt et al, 2014). For example, only three of 758 abstracts (0.004%) presented in the first seven conferences held on *The Monitoring and Management of Visitors in Recreation and Protected Areas* related to the marine environment (Pickering et al, 2018:10). Many studies of recreational activity maintain an economic approach, often analysing users' Willingness to Pay (WTP) in contexts of trade-offs between biodiversity protection, use impact, and infrastructure development (e.g., Paltriguera et al, 2018; Outeiro et al, 2018; Jobstvogt et al, 2014). Since the COVID-19 pandemic, outdoor recreation has increased in Scotland and elsewhere, linked to growing appreciation for local 'green' and 'blue' spaces for their physical and mental health benefits (Pröbstl-Haider et al, 2023; Marine Scotland, 2022). It is therefore especially important to understand how recreational users benefit from the marine environment, to maintain and improve access and environmental quality (Lloret et al, 2021).

Marine recreation supports local livelihoods in Scotland directly, through employment in the sector, and indirectly, through visitor spending on accommodation and in other local businesses (Marine Scotland, 2020). In 2015, the industry was found to contribute ~£3.7bn annually to Scotland's economy, with popular activities including coastal walking, wildlife watching, sailing, kayaking, and angling (Marine Scotland, 2016). Insights from tourism studies and recreation ecology have explored the impact of increased visitation on the environment, which includes erosion, pollution and wildlife disturbance, and the tensions that arise in tourist hotspots due to crowding or anti-social behaviour (e.g., Miller et al, 2016; Pickering et al, 2018). Inman et al (2016) highlight the benefits of voluntary codes of conduct for marine wildlife watching in Scotland, which tend to face less criticism than statutory regulations, and are widely used. Visitor management developments such as parking, toilet facilities and booking systems can aid in organising tourism and reducing widespread impacts, although resulting infrastructure can interfere with features that recreational users value such as tranquillity, wildlife conservation, or freedom of access (Pröbstl-Haider et al, 2023; Pickering et al, 2018). A significant challenge of increased outdoor recreation is balancing growing use and economic benefits with the protection of biodiversity and ecosystems (Pröbstl-Haider et al, 2023; Zupan et al, 2018; Miller et al, 2016). However, the impacts of recreation are not inherently negative, as is often assumed, and Miller et al (2016) argue that a focus on interactions rather than impacts can uncover avenues for understanding how recreation can benefit both users and the environment.

d. Research aims

There has been little documentation of recreational activities in the Isle of Arran's coastal waters (Howarth-Forster, 2020). Using Arran as a case study, this research aims to 1) provide a baseline assessment of the nature, scale, and distribution of marine recreation around the island; 2) investigate relationships and conflicts between users; and 3) understand how users value and

operate within the resource system through multi-level relationships with its i) community, ii) governance, iii) ecology, and iv) infrastructure. Through analysis of stakeholder perspectives on current and future recreation in Arran's marine environment, this research demonstrates the utility of a SES approach in understanding how user behaviours, perspectives, and conflicts are entangled with the complex systems within which they are embedded (Ostrom, 2009; Smith, 2018).

2. Methodology

a. The case study: Arran's coastal waters

The Isle of Arran has a population of around 4500 (Fig.1, NACPP, 2017). It is known for its food and drink, wildlife watching, and outdoor recreation, and is often dubbed 'Scotland in Miniature' due to its varied highland and lowland geology (Arran Geopark, 2017; VisitArran, 2023). In 2017, The Firth of Clyde employed 7200 people and contributed £136 million Gross Value Added (GVA) through marine tourism (Marine Scotland, 2020). Several local businesses offer marine recreational activities, including sea kayaking, sailing, and SCUBA diving (VisitArran, 2023b). The island is therefore of considerable interest as a destination for marine recreation. Furthermore, islands provide a useful scale for studying SESs as their physical boundedness defines a distinct unit for analysing spatial and social relations (Wahyudin et al, 2018; Smith, 2017).

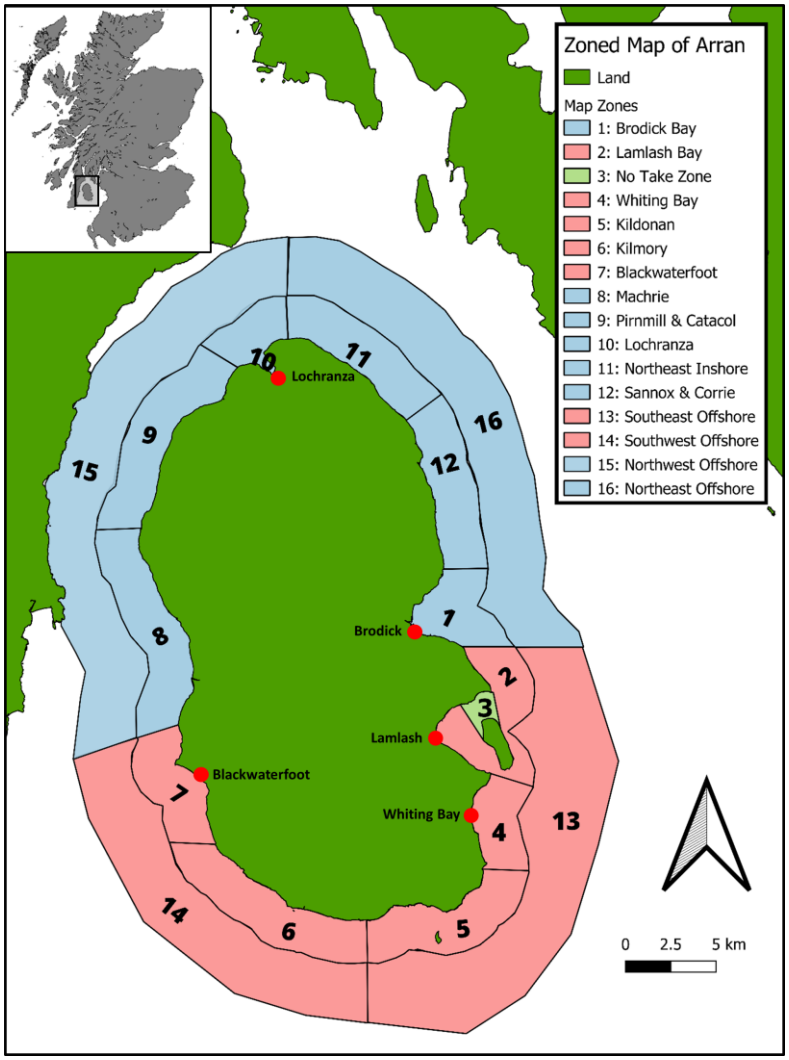

Figure 1. Zoned map of Arran used in both survey and interviews. The South Arran MPA is shown in **pink**, and the Lamlash Bay No Take Zone in **green** (Area 3).

In 2008, Scotland's first NTZ, an area of 2.67km^2, was established in Lamlash Bay after the Community of Arran Seabed Trust (COAST) led a community campaign to protect the area from ecologically damaging commercial dredging and bottom-trawling (Jones, 2018). Following extended local efforts, combined with government ambitions to increase the UK's Marine Protected Area (MPA) network, the 280km^2 South Arran MPA was designated in 2014 and enforced in 2016 (Stewart et al, 2020). Following the lifting of the three-mile inshore limit on trawling in 1984, the Firth of Clyde's finfish stocks have largely collapsed. However,

ongoing research is documenting the recovery of biodiversity in Arran's NTZ and MPA (Stewart et al, 2020; Jones, 2018). Low levels of commercial fishing continue around Arran, as well as open-cage salmon aquaculture in Lamlash Bay (Jones, 2018). Other water users include Caledonian Maritime Assets Limited (CMAL) who operate the ferry service, the Royal Navy, and individual and commercial recreational users (Stewart et al, 2020).

Map zones for data collection were created based on logical geographical boundaries between villages and bays and follow MPA boundaries where appropriate. Arran's coastal waters are defined at a 3.5-mile radius around the island, approximately matching the furthest offshore extent of the South Arran MPA, highlighted in pink (Fig.1; COAST, 2023b). Inshore zones extend to 1.5 miles offshore. To understand use levels, types, spatial distribution, and stakeholder opinions regarding recreational use of Arran's marine environment, a mixture of quantitative and qualitative data was collected, followed by statistical and thematic analyses (Noble et al, 2019; Stosch et al, 2022).

b. Data Collection

i. Survey of recreational users

In June 2023, an online survey with 50 questions on user identity, use types, areas used, and opinions on current and future marine recreation around Arran was disseminated through social media, local shops, news outlets, and word-of-mouth (Appendix.1; Fig.2). This variety of recruitment methods ensured that those without social media were included (Voyer et al, 2015). The survey contained multiple choice, Likert scale, and open-ended questions so that quantitative data was complemented by qualitative answers, reducing the likelihood of forming misguided conclusions (Aranda and Vezzoni, 2021). Likert scale questions included an 'I Don't Know' option to capture uncertainty beyond a 'Neutral' choice (Ryan, 2005). The map above (Fig.1) was included for participants to identify primary and secondary areas used for their first and second most frequent activities, influenced by the benefits of Participatory Geographical Information Science (PGIS) and Digital Participatory Mapping (DPM) for integrating individual and community perspectives into spatial planning (Aranda and Vezzoni, 2021; Reitz, 2021).

ii. Interviews with organisation and business stakeholders

Ten in-person interviews were conducted with stakeholders representing businesses and organisations involved in outdoor recreation on Arran. Interviewees were recruited as personal contacts of the researcher, who resides on Arran, and through participant recommendations. Interviews were recorded, lasting between 35 and 50 minutes, and semi-structured and conversation-like, allowing in-depth enquiry into topics raised by interviewees (Jennings, 2005). Participants were asked about their organisation's activities, relationships with other water users, and their views on the management of Arran's marine environment (Appendix.2). Conducting one-on-one interviews provided a confidential environment for interviewees to freely discuss their interactions with other users in Arran's small community (Stosch et al, 2022).

Figure 1 was used as a visual tool to elicit detailed explanations of spatial use. Participants were asked to point to or mark areas they use or avoid and explain why (Aranda and Vezzoni, 2021). This aimed to enhance quantitative understanding spatial use distribution, while prompting qualitative insights regarding relationships with other users, the environment, and governance systems (ibid; Stosch et al, 2022). Combining surveys and interviews is a well-established methodology for assessing user preferences in studies of outdoor recreation and tourism meaning that results can be evaluated against a wide pool of research (e.g., Pickering et al, 2018; Wahyudin et al, 2018; Lucrezi et al, 2018). Incorporating a social scientific approach into spatial and environmental sciences advances detailed understandings of relationships and conflicts (Moon et al, 2019).

c. Data Analysis

i. Analysis of quantitative data

Of 113 responses received, three were excluded from quantitative analysis as they did not indicate participation in marine recreation around Arran. However, all long-form answers were included in thematic analysis. Statistical analysis was performed using R (version 4.3.1). Chi-squared tests were used to examine relationships between categorical variables of age, gender, village of residence, areas used, preferred activities, frequency of use in the summer bathing water season (1st June – 15th September (SEPA, 2023)), seasonality of use, purpose of use, and group sizes (Zupan et al, 2018).

Spatial analysis was conducted using QGIS (version 3.28). Polygons were used for the collection and analysis of spatial data, to depict overall areas within which mobile activities take place (Aranda & Vezzoni, 2021). Visual analyses of area preferences were conducted. Cumulative use analysis was conducted through the incorporation of group size and use frequency data, which were given numeric values 1-4 and 1-6 respectively, multiplied to account for cumulative use, and then scaled from 0-1 (Zupan et al, 2018).

ii. Thematic analysis

Interview recordings were transcribed manually, and each participant numbered and anonymised. Thematic analysis followed Braun and Clarke's (2023) framework: codes and sub-codes were found and grouped under overarching themes, with an adaptive, flexible approach to thematic categorisation taken. Transcripts were analysed several times, until an authentic summary of participants' views was reached (Braun and Clarke, 2023; Jennings, 2005). The same process was applied to open-ended survey answers. A grounded theory approach was used, whereby themes were created as they arose, rather than being pre-determined. This was important for reducing bias, given the researcher's personal knowledge of participants and the study area (Jennings, 2005).

Thematic analyses are inherently intuitive and creative. While a reflexive, self-critical, and informed approach to analysis was maintained, it is unlikely that any two researchers would produce identical thematic categorisations (Braun and Clarke, 2023). The thematic analysis aimed to extract objective information on area use, and subjective values, perspectives, and relationships within the wider SES (Ryan, 2005; Braun and Clarke, 2023). The methodological approach outlined provided a well-rounded understanding of recreational use and its embeddedness within an assemblage of inter-related social and ecological actors and contexts (Stosch et al, 2021). By focussing on interactions and relationships between users and with the marine resource, a holistic understanding of the system

was achieved, in line with Ostrom's (2009) argument against the oversimplification of SESs for research purposes (Ostrom, 2009).

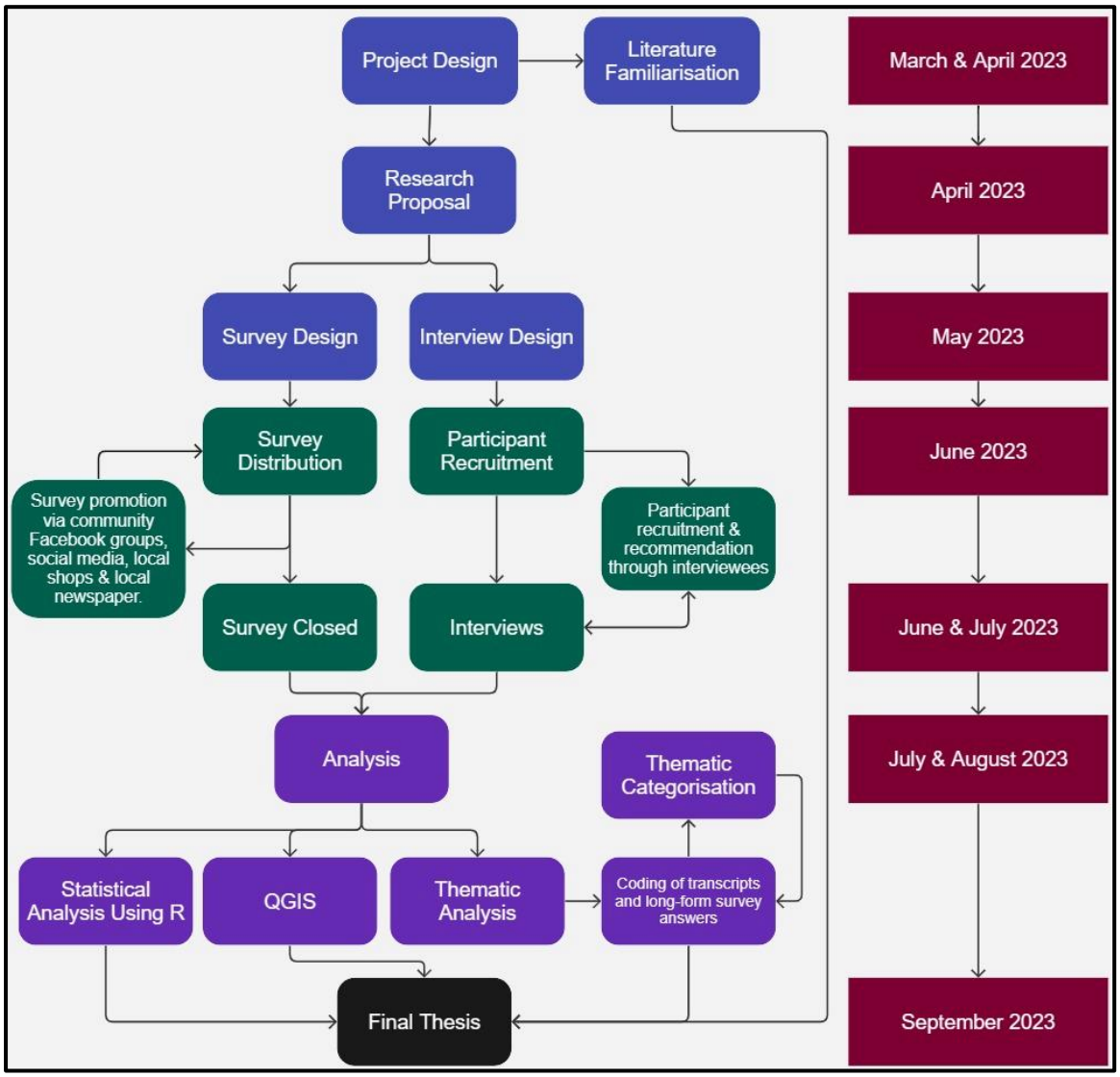

Figure 2. **Diagram of research process.**

3. Results

a. The survey population

Respondents were mostly middle-aged or older, with 25.5% (n=28) aged 55-64, 19.1% (n=21) aged 45-54, and 19.1% (n=21) aged over 65. Women respondents (n=70, 63.6%) nearly doubled the number of men (n=40, 36.4%). 13 respondents completed the survey on behalf of an organisation or business involved in marine recreation around Arran.

81 (71.7%) survey respondents were from Arran, 11 (9.7%) lived on Arran part-time or seasonally, 11 (9.7%) visit Arran less than twice per year, and 10 (8.8%) visit Arran 1-2 times per year or less. Of those that visit, 15 visit regularly through the year while 8 visit mostly in summer.

45 (39.8%) respondents were employed full-time, 30 (26.5%) were retired, 15 (13.3%) were self-employed and 12 (10.6%) were employed part-time.

b. Types, levels, and distribution of recreational activities

i. Overview

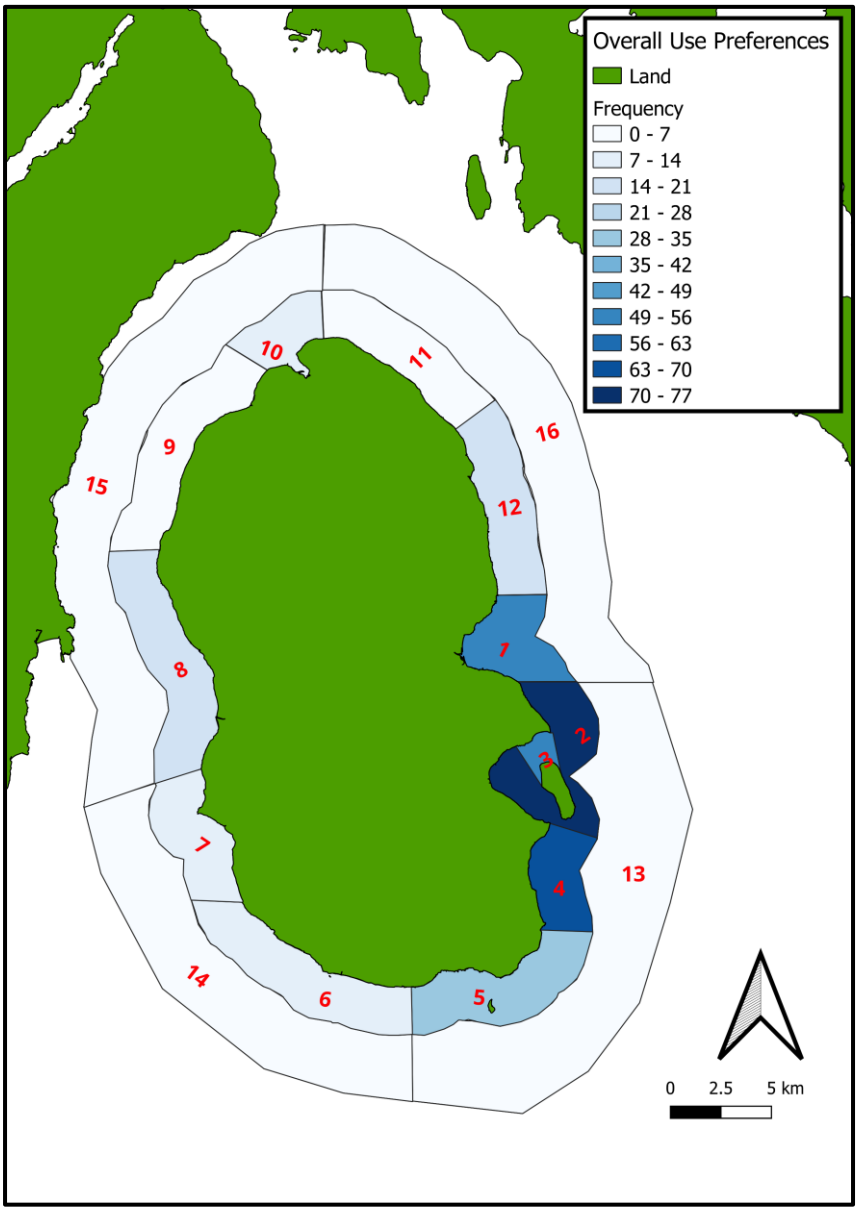

Figure 3. **Overall area preferences**. This map shows the sum of respondents' primary and secondary area use preferences for both primary and secondary activities.

When the primary and secondary areas used for participants' first and second most frequent activities were combined, the most popular areas were Lamlash Bay (area 2, n=77), Whiting Bay (area 4, n=68), Brodick (area 1, n=56), and the NTZ (area 3, n=54) (Fig.3). Many respondents were from or primarily visit Whiting Bay (n=28, 25.4%), Lamlash (n=25, 22.7%) and Brodick (n=17, 15.4%), Arran's most populated villages (NACPP, 2017). Respondents' secondary activities were strongly associated with their village (chi-squared test, χ_2=371.4, p<0.001), while their primary activities were not.

Regarding primary activities, 41 (37.3%) respondents chose swimming, 24 (21.8%) selected 'Kayaking or Canoeing', and 12 (10.9%) chose Stand-Up Paddleboarding (SUP) (Fig.4). For secondary activities, snorkelling (n=15, 13.6%) replaced SUP (n=11, 11%) as the third most popular activity (Fig.5). No associations were found between activity type and areas used. 42 respondents (38.2%) participate 2 to 5 times per month in their primary activity, followed by 21 respondents (19.1%) who participate most days. 35 respondents have been participating in their primary activity for 3 to 5 years, in line with impressions of uptake during the COVID-19 pandemic, mentioned by six interviewees. 71 respondents (64.5%) listed 'Leisure or relaxation' as one of their primary purposes for participating in their primary activity, followed by 'Mental or emotional well-being' (n=41, 37.3%), 'Exercise' (n=34, 30.1%), and 'Wildlife watching' (n=25, 22.7%).

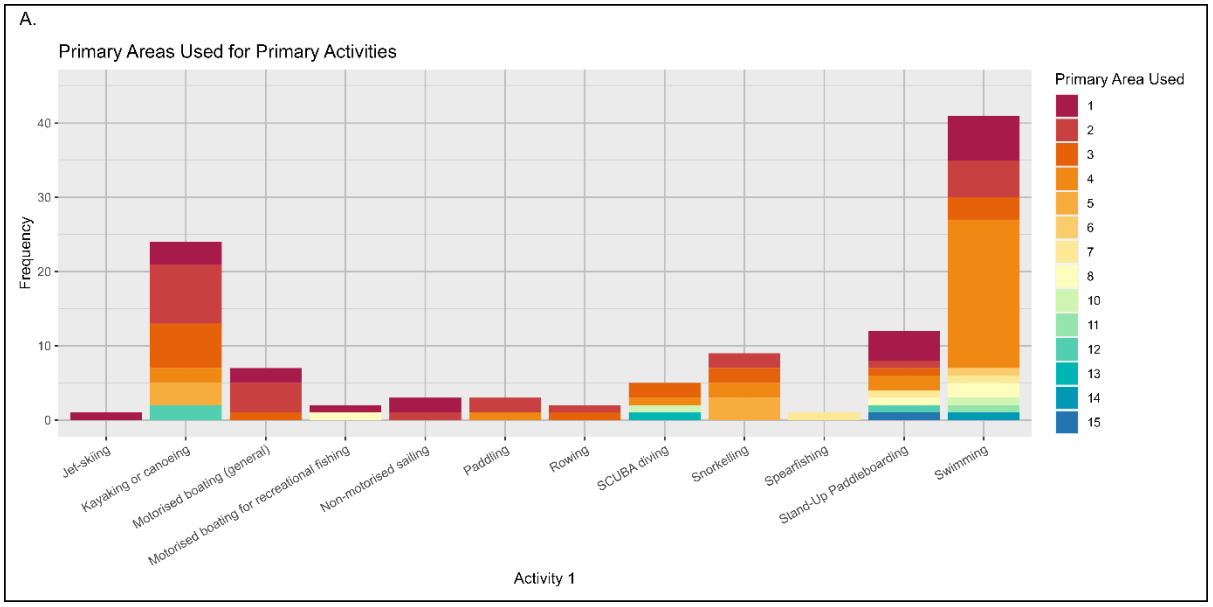

***Figure 4*. Respondents' primary activities** and the area they use most for these.

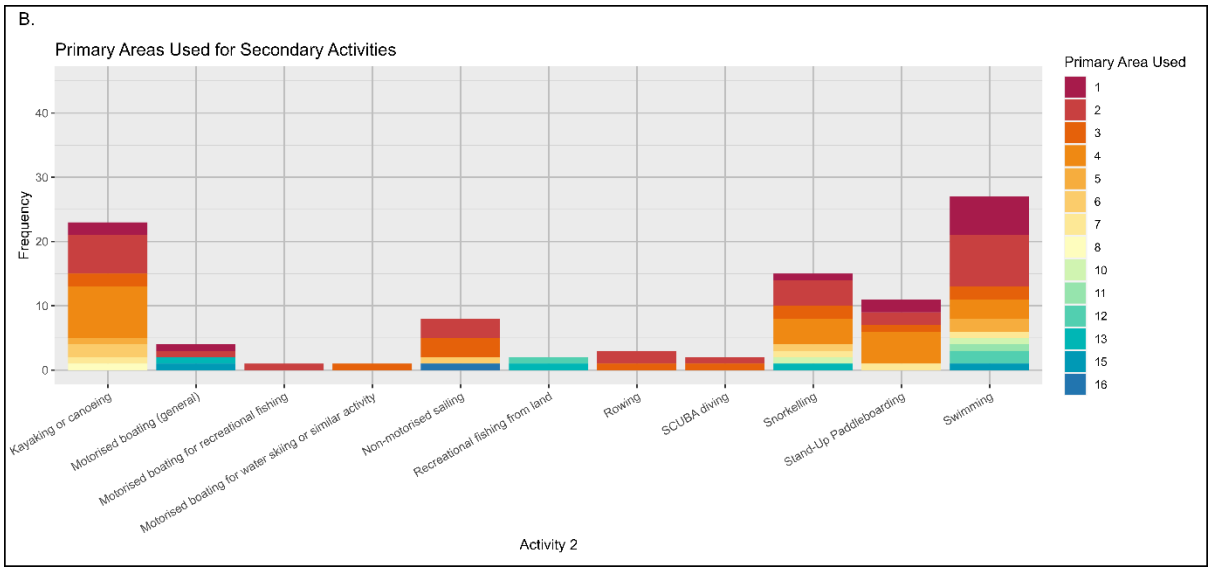

***Figure 5*. Respondents' secondary activities** and the area they use most for these.

ii. Group size and use frequency

There was significant association between group size and primary area used for respondents' primary activities (chi-squared test, χ_2=60.7, p=0.015), suggesting that larger groups tend to use area 4 (Whiting Bay). 10 (9.1%) respondents use Whiting Bay in groups of 6 to 10, while 3 (2.7%) use it in groups of 11+. 20 respondents who listed swimming as their primary activity used Whiting Bay most frequently, often in larger groups. However, no associations were found between group size and activity type. Group size was also associated with use frequency for respondents' primary activities (chi-squared test, χ_2=43.6, p<0.001). Those participating in groups of over 6 more were more likely to use the water most days, while groups of 2 to 5 and individuals were more inclined to participate 2

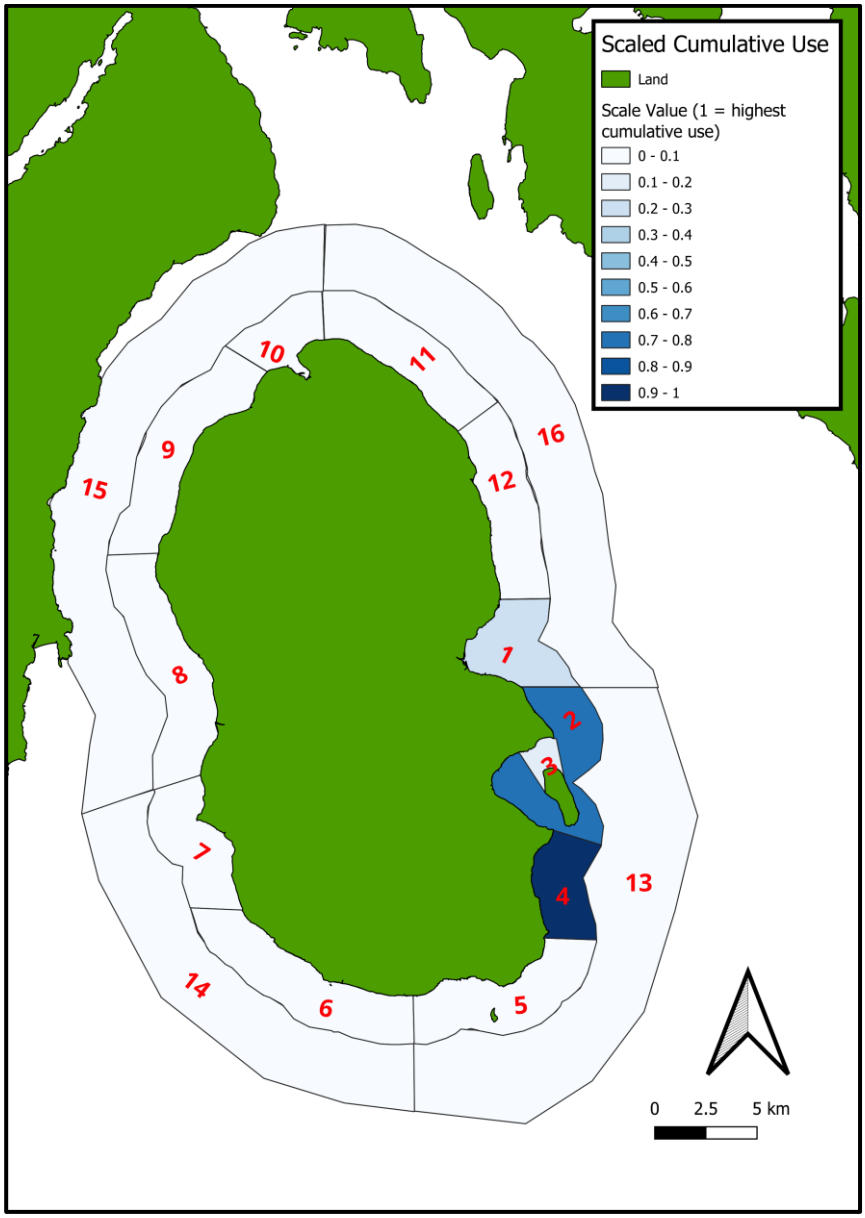

Figure 6. Scaled cumulative use. This map combines group sizes with frequency of use for the participants' primary areas and primary activities. Group sizes and frequency of use data were given numeric values 1-4 and 1-6 (respectively) based on their values, multiplied to account for cumulative use, then scaled from 0-1.

to 5 times per month. Figure 6 illustrates this cumulative use, showing that while more respondents prefer Lamlash Bay overall (Fig.3), Whiting Bay has higher cumulative use levels for respondents' primary activities (Fig.6).

iii. Seasonal Use

Significant associations existed between seasonality and primary area used, for both primary (chi-squared test, χ_2=132.2, p<0.01) and secondary (chi-squared test, χ_2=167.9, p<0.001) activities. Use is less seasonal for primary activities, with 36 (32.7%) respondents participating year-round, and 33 (30%) in all seasons apart from winter, primarily using areas 4 (n=28, 25.4%), 2 (n=24, 21.8%), and 3 (n=16, 14.5%). However, for participants' secondary activities, the largest proportion of respondents participate only in summer (n=39, 35.5%). Seasonality also strongly correlates with use frequency in the summer season (1st June – 15th September) for respondents' primary activities (chi-squared test, χ_2=75.5, p<0.001), with those participating in their primary activity year-round more likely to participate most days (n=16, 14.5%) or 11-20 times per month (n=10, 9.1%) in the summer season.

iv. Use by organisations

Organisations are significantly more likely than individuals to enter the water in groups of 6 to 10 (chi-squared test, χ_2=9.35, p=0.025), and tend to engage more frequently in their secondary activities (chi-squared test, χ_2=19.0, p<0.01). A significantly higher proportion of organisations than individuals use the NTZ (area 3) for their secondary activity (4 of 13 organisations (30.8%), versus 10 of 97

individuals (10.3%)) (chi-squared test, χ_2=24.4, p=0.03). Moreover, use purposes significantly differed between organisations and individuals (chi-squared test, χ_2=52.6, p=0.01), with 30.8% (n=4) of organisations stating their sole primary purpose was 'Education', versus only one individual user (0.9%). The benefits of the NTZ for education were mentioned by interview participant 4, who said that "*everything that we do is linked to education, and the No Take Zone facilitates that beautifully*".

c. Perspectives on use, interactions, and governance

Theme	**Codes**
Locations used	Brodick Corriegills Lamlash Kildonan Blackwaterfoot Machrie Sannox Pirnmill Whiting Bay Arran as a destination
Access	Access for young people Disabled access Good access/facilities Infrastructure needs/lack of access Responsible use Island access: limits the ferry places on tourism
Economy / Economics	Recreation as alternative blue economy to fisheries Local economy The market & operating costs Staff & local employment
Use-levels & demand	Seasonality The users Change over time Responsible use Current low/non-damaging levels
Safety	Safety concerns Positive experiences of safety Lifeboat callouts Improving safety Legislation/rules/regulations
Reasons for participating	Perspective Education/learning Relaxation Wildlife Fun Unspoilt nature Citizen science Socialising Health Variety Particular sports offering unique experiences
Conduct and behaviour around wildlife	Nesting birds Seals Codes of conduct
Recreational users	Inter-organisational support Sharing staff/resources Organisation/Community/Cooperation Jet-skis
Non-recreational users	Public/land-based users Fish farms Caledonian MacBrayne/CMAL The fishing sector (mobile & non-mobile)
Arran's marine environment	Overfishing The wider (eco)system Good condition Ecosystem recovery

	Pollution Sea temperature rise Sea conditions and weather
Management and governance	COAST as an avenue for involvement in marine management Marine protections Top-down & bottom-up governance Lack of government support & investment Ideological/political disagreements

Table 1. Themes and codes resulting from thematic analysis of interview data. While complex and overlapping, themes are analysed and organised along with open-ended and Likert scale survey questions under overarching topics of 1) use, access, and infrastructure, 2) interactions and conflicts, and 3) governance, community, and cooperation.

i. Use, access, and infrastructure

Table 1 summarises the themes and codes which arose during thematic analysis. Most interviewees expressed that use levels remain low, with room for growth. Similarly, survey respondents did not perceive crowding (Fig.7). 73.5% disagreed with the statement '*I am concerned about current levels of recreational activities in the sea around Arran*' (Strongly Disagree=22, Disagree=61), despite many noting recent increases in activity and in organisations offering recreational excursions. Some interviewees reported increased use levels since the COVID-19 pandemic, including Participant 9 who said, *"if there's been any benefit of COVID, it's been that it gave people the opportunity to get outside more*". Others mentioned that increased availability of once specialist equipment, such as wetsuits, makes participation more accessible. While most participants were not concerned about current levels of activity, this was often contingent on ideas about responsible use.

15 survey respondents (13.3%) mentioned the need to balance future increased activity with environmental protection and education on responsible use. Many viewed marine recreation as an opportunity to foster environmental awareness and conservation. Participant 1 stated they are "*very keen to discuss with clients the issues that face the coast, such as overfishing, litter from fishing boats, and of course fish farms, which are a big problem,*" and Participant 3 thought "*a lot of water based providers are very good at stating the importance of the environment. A lot of sports can't happen if the environment isn't healthy".* Eight interviewees (80%) raised the idea that marine recreation and/or Arran as a destination attracts individuals who are environmentally conscious and know how to use the water safely and responsibly.

Responses to the statement 'I feel I can access the water when and where I desire' were overwhelmingly positive (Agree=49, Strongly Agree=55; Fig.7). Nonetheless, many suggested improvements to access, including the need for changing rooms, showers, a small marina facility, and a pontoon in Lamlash Bay to facilitate wheelchair access onto boats. Four interviewees (40%) and eight survey respondents mentioned this need for a pontoon in Lamlash. They believed this would also facilitate sea access at all tidal states, increase footfall for local businesses, and reduce crowding pressure at Lamlash pier which Participant 4 said is "*like a zoo*" in summer, sometimes slowing the RNLI lifeboat when launching. Participant 10 said that "*what we don't want, I think, is too much happening in one area*", and Participant 8 also highlighted risk of conflict caused by lack of facilities: "*I think the more recreation you have in such a small facility, then you get angst, where people think they have priority*".

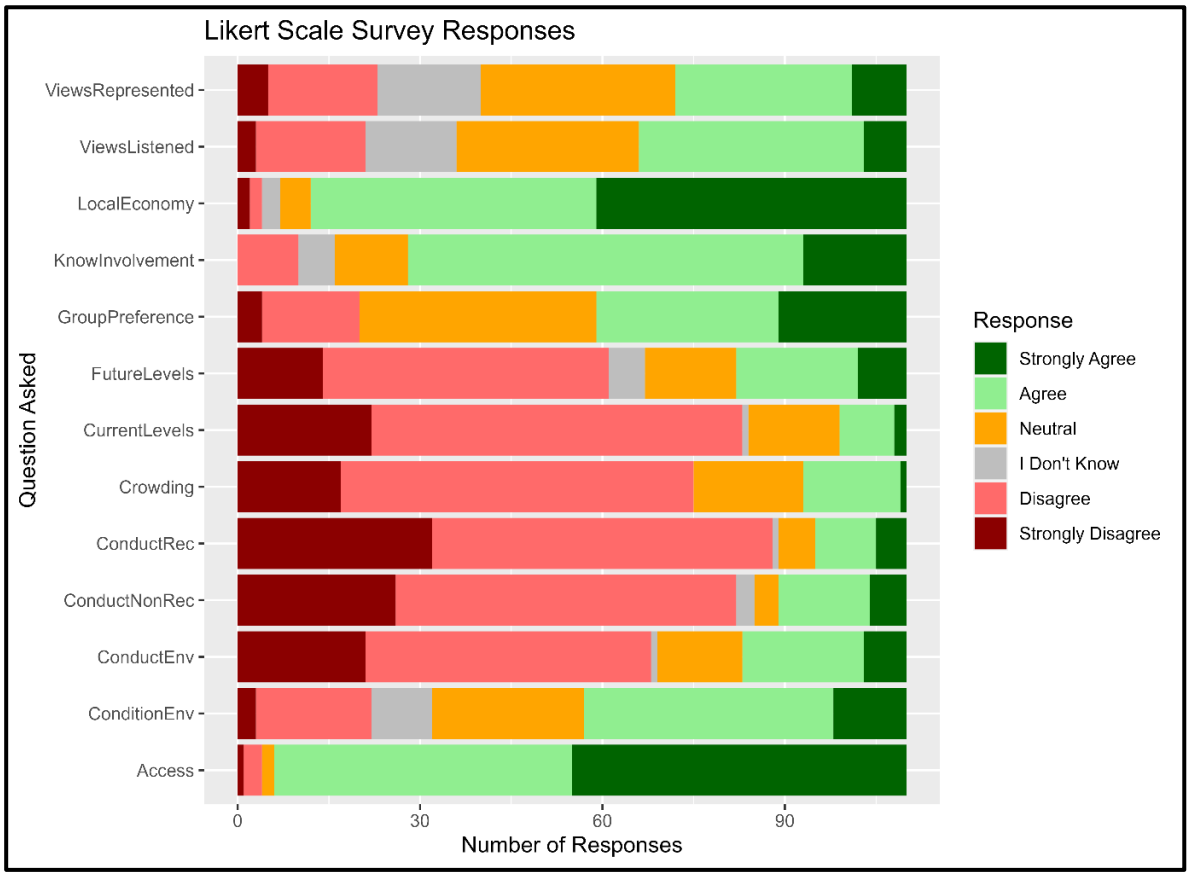

Figure 7. Likert scale responses. *In the order above, questions asked were:*
ViewsRepresented: *'My views are well-represented in the management and/or protection of Arran's coastal waters.'*
ViewsListened*: I feel that I will be listened to if I express my views regarding the management of Arran's coastal waters.'*
LocalEconomy*: 'Marine recreation is important to Arran's local economy.'*
KnowInvolvement*: 'I know ways in which I can be involved in the management and/or protection of Arran's coastal waters.'*
GroupPreference*: 'I prefer to enter the water as part of a group.'*
FutureLevels*: 'I am concerned about future levels of recreational activities in the sea around Arran.'*
CurrentLevels*: 'I am concerned about current levels of recreational activities in the sea around Arran.'*
Crowding*: 'The areas I use can be crowded with other recreational users.'*
ConductRec*: 'I have had issues with the conduct of other recreational users towards myself or others in the last year.'*
ConductNonRec*: 'I have had issues with the conduct of non-recreational marine users towards myself or others in the last year.'*
ConductEnv*: 'I have had issues with the conduct of other recreational users towards the environment in the last year.'*
ConditionEnv*: 'Arran's marine environment is in good condition.'*
Access*: 'I feel I can access the water when and where I desire.'*

ii. Interactions and conflicts

Respondents were mostly positive about interactions with other recreational and non-recreational users, and the environment (Fig.7). However, concerns about jet-skis were raised frequently among survey respondents (n=35, 31.0%) and interviewees (n=8, 80%) relating to noise pollution, safety (e.g., high speeds, and distance from the shore and other users), and wildlife disturbance. Some reported direct conflict, including Participant 5 who had "*a couple of run-ins with jet-skis and fast boats*", although they were also adamant that most motor craft users are considerate towards other users. Additional safety concerns included yachters and power craft users not following International Rules for Preventing Collisions at Sea (IRPCS) and other maritime signals, or not having the skills to operate safely. Interviewees reported good relationships with other activity providers, including sharing of resources and staff.

Positive relationships with non-recreational users were described, including with CMAL, local creel fishers, and commercial divers. Arran's small community facilitated cooperation with the ferry service, for example: *"We know the captain. We know the crew. So, you know, just in terms of sending messages and whatever to each other. It's easily done*." (Participant 9). Some negative sentiments toward CMAL related to operational issues affecting ferry predictability and number of tourist clients. Concerns about pollution related to litter and plastic, sewage discharge, agricultural run-off, and open-cage salmon farming, despite reports of good relationships with local fish farm staff. Six survey respondents proposed the implementation of regular water quality testing, especially in Lamlash. Participants also mentioned the mobile fishing sector regarding overfishing and destructive fishing methods, including recent dredging which had taken place near Lochranza. Participant 8 emphasised that damage to wildlife spectacles, which they would usually show their clients, can cause direct conflict with recreation and tourism-based businesses. Participant 3 also suggested that recreational users may avoid certain areas as a result of ecological damage from the mobile fishing sector.

Activity providers interviewed valued giving groups a chance to observe seals and other wildlife, but were aware of their behaviour, including keeping a distance, or adhering to codes of conduct for wildlife watching. Concerns were raised about users disturbing seals and nesting seabirds by getting too close, along with some suggestions that seals and cetaceans may be "*enjoying the interaction*" (Participant 5). Some noted that recreational experiences are contingent on abundant opportunities for wildlife encounters, and that these are made more likely through biodiversity protection. Two interviewees raised worries about recent marine heatwaves.

When asked what could resolve negative interactions, survey respondents proposed improved infrastructure, *"such as pontoons, launching sites, changing facilities and parking*", and education, including on responsible use, maritime law, wildlife interactions, and safety. Signage on the ferry, island-wide rangers, and organisations such as COAST, were suggested avenues for further educational outreach. Some proposed stricter legislation on speed limits, or mandatory training for large motor vessel users. Others advocated for forms of zoning, including "*restriction of access to the shore in key bird breeding areas during the breeding season*", and limiting areas open to high speed activities. Participant 3 suggested that if the community *"identified that zoning was needed, I think that would be great. But coming from a top down … I don't think that would work".* Similarly, other interviewees noted the balance between improving legislation and preserving recreational users' enjoyment and freedom.

iii. Governance, community, and cooperation

Interviewees valued existing inter-organisational support, including local partnerships, resource sharing, and feelings of community. Participant 8 said that "*everybody is winning at the moment, because we all have the same community ethos*". Some interviewees were satisfied with existing "*tacit agreements*" (Participant 5), mutual respect, and informal cooperation. Others felt that some formal organisation would be useful to stakeholders, including Participant 8 who said "*none of us are actually brought together to try and work on … How do we market? How do we increase? How do we go after better facilities?".* Several users commented on the success of the MPA and NTZ in improving biodiversity, and Participant 10 thought that "*people are quite vigilant in reporting if they do see … a fishing boat coming in".*

Most users knew how they could be involved in the wider management of Arran's coastal waters (Agree=65, Strongly Agree=17). 22 (19.5%) survey respondents were currently or previously involved with COAST, and a further 15 (13.3%) expressed their support for the organisation. Interviewees noted that COAST provided a useful avenue for information on and involvement in marine management, like Participant 5 who felt "*COAST gives us an outlet to… a way of knowing how you can challenge things and change things"*. However, there was no clear consensus regarding whether respondents felt their 'views are well-represented in the management and/or protection of Arran's coastal waters', with 29.1% (n=32) feeling Neutral, and 15.5% (n=17) stating 'I Don't Know'. Many were concerned about top-down governance, and ingenuine efforts by regional and national government to consider local viewpoints. For example, Participant 3 suggested that *"community engagement will always be an add-on for them* [The UK and Scottish Governments]*, … which is a pity because that's the only way that governance within communities is going to work*". One participant noted local conflict between fishers and conservationists due to anger over Scottish Government proposals for Highly Protected Marine Areas (HPMAs). While participants appear to be satisfied with local organisational norms, involvement in wider governance spheres is causing some frustration.

4. Discussion

Analysis revealed swimming and paddle sports as popular activities, with highest use levels in the larger villages of Arran's east coast (NACPP, 2017). Participants anticipated growth in marine recreation, were not concerned about current and future use levels, and valued community and support between commercial providers, individual recreational users, and non-recreational stakeholders. Concerns were raised regarding motorised watercraft, crowding around popular entry points, and top-down governance. Findings underscore the multifaceted nature of recreational use and user interrelationships with other stakeholders, the environment, and governance. This makes an SES framework, which encapsulates the complex nature of resource systems, especially useful for understanding marine recreation around Arran (Ostrom, 2009; Refulio-Coronado et al, 2021).

a. Arran's marine social-ecological system

Many respondents emphasised issues caused by motorised watercraft, especially jet-skis, which, despite their low numbers, were viewed as having disproportional impact on other users through noise, speed, and lack of safety awareness (Refulio-Coronado et al, 2021). In March 2023, the UK Government enacted legislation bringing personal watercraft under International Regulations for Preventing Collisions at Sea (1972), aiming to improve safety, potentially reducing tension between jet-skiers and other users (*The Merchant Shipping (Watercraft) Order 2023*). Research in Cardigan Bay, Wales, by Vergara Peña (2020) found that only motorised watercraft caused bottlenose dolphins to directly alter their behaviour, moving away from protected areas with higher recreational use levels. Therefore, mobile species such as seabirds and marine mammals around Arran may avoid

sites with increased use of motorised watercraft, and further research should monitor this (Inman et al, 2016; Miller et al, 2022).

Protected areas such as Arran's NTZ and MPA increase biodiversity and ecosystem resilience to local and global human impacts (Notley et al, 2019; Jones, 2018). However, cumulative disturbance could reduce the predictability of wildlife encounters which respondents valued, reducing species abundance in waters shared with recreational users and causing discontent among users who find motorised watercraft disruptive to conservation objectives (Zupan et al, 2018; Noble et al, 2019). Interactions between mobile users and species complicates the concept of MSP which seeks to neatly map distinct use areas and resource distribution, as neither wildlife nor recreational users are constrained to particular spaces (Smith, 2018; McKinley et al, 2019). However, by integrating a SES approach, this study captures both spatial use patterns and interactions between users and the environment (Sijtsma et al, 2019).

While many users raised ideas about pro-environmental behaviour, there was demand for further education and outreach regarding responsible conduct at sea. Inman et al (2016) and Vergara Peña (2020) have demonstrated the effectiveness of voluntary codes of conduct in mediating interactions between wildlife and increasingly large volumes of recreational users and vessels, in both Scotland and Wales. Statutory and non-statutory regulations can aid in altering behaviour and encouraging responsible use of the marine environment, emphasised through participants' advocacy for regulatory tools such as speed limits, zoning, codes of conduct, economic incentives (e.g., reduced insurance costs following watercraft training), and education (Inman et al, 2016; Refulio-Coronado et al, 2021). Through analysis of attitudes and behaviour following encounters with humpback whales, Clark et al (2019) additionally show that marine recreation, and specifically wildlife encounters, can instil pro-environmental qualities in users, highlighting educational and sociocultural benefits. Many respondents stated the importance of education through marine recreation, suggesting that the act of entering the water for leisure purposes additionally increases users' knowledge and appreciation for marine environments.

Respondents also specified mental or emotional well-being improvements from participating in marine recreation. The concept of cultural ecosystem services (CES) encapsulates the intangible mental, emotional, social, or spiritual benefits obtained from the environment (Jobstvogt et al, 2014). CES within marine environments, including intimate environmental knowledge and mental well-being benefits expressed by participants, have not been widely explored under Ostrom's SES framework (for examples, see Jobstvogt et al, 2014; Lloret et al, 2021; Sijtsma et al, 2019). Her variable, 'importance to resource users', encapsulates the value users attach to a resource, but has been mainly explored regarding the economic value of extractive uses such as aquaculture (Ostrom, 2009:421; Outeiro et al, 2018). The multiplicity of tangible and intangible benefits gained from marine environments, and suggestions by participants on interventions for improving recreational experiences for both users and wildlife reinforces the utility of combining educational, statutory, and voluntary tools for shaping interactions and mediating conflicts (Baynham-Herd et al, 2021).

According to users, marine recreation brings substantial economic benefits to Arran (Marine Scotland, 2020; Refulio-Coronado et al, 2021). Although year-round use is significant among individual users surveyed, marine recreation in Scotland is highly seasonal (Marine Scotland, 2020). Several respondents reported reduced reliability of tourist numbers caused by technical issues with the island's ferry service, resulting in decreased income predictability (McIvor, 2021). Additionally, if facilities and infrastructure are not able to cater for high use in the tourist season, businesses' ability to take advantage of seasonal tourism is diminished (Mandić et al, 2018; Wahyudin et al, 2018). While the economic benefits of recreation are widely cited (e.g., Marine Scotland, 2015; Pickering et

al, 2018; Paltriguera et al, 2018), there is relatively little attention paid to its seasonality in colder climates, and how this influences local economies (Marine Scotland, 2020). Some coastal areas have implemented seasonal management plans to account for use fluctuations, such as Kingmere Marine Conservation Zone in England (Ranger et al, 2016). Arran's economic dependence on the marine environment for recreational tourism is interlinked with dependencies on transport, biodiversity, weather, and facilities (Mandić et al, 2018; Noble et al, 2019).

b. Conceptualising resource system sustainability: Ostrom's framework

In her 2009 framework, Ostrom identifies ten variables which influence users' ability to self-organise around resource management (Ostrom, 2009, see 1.b). 'Number of users' is particularly relevant to this study, with highest use levels in Lamlash, Whiting Bay and Brodick, and Whiting Bay receiving the highest cumulative use. While survey respondents were not concerned about crowding, interviewees detailed tensions caused by crowding at specific multi-use access points, particularly Lamlash and Brodick slipways, where multiple users including divers, yachters, kayakers, rowers, the lifeboat, and swimmers access the water and use facilities. Gonson et al's (2018) study of marine recreation in New Caledonia highlights that conflicts arise when crowded destinations reach 'social carrying capacity' (SCC), influenced by user perceptions of crowding, spatial availability, and user density. At SCC, users may move elsewhere, and there is heightened risk of adverse environmental impacts. Whereas the sea offers plenty of space, entry points may have a bottleneck effect on users, or attract crowding at shoreside locations with good access (Marine Scotland, 2015; Gonson et al, 2018). Ostrom's variables for analysing resource use sustainability aid in pinpointing how negative interactions may emerge between users (Ostrom, 2009; Voyer et al, 2015).

Pröbstl-Haider et al's (2023) literature review of outdoor recreation following the COVID-19 pandemic suggests that many studies focus on terrestrial sites and areas already known to be crowded. However, interviewees highlighted that despite low overall use, specific situations at entry points can increase the likelihood of conflict arising, namely due to lack of infrastructure to accommodate for multiple use types simultaneously. The 'size of the resource system' is a relevant variable here, particularly at the scale of individual slipways, as well as 'mobility', with users' ability to move elsewhere limited by lack of facilities at alternative entry points (Ostrom, 2009:420). Increased facilities and infrastructure were desired by many survey respondents, and Scotland's 2015 *National Marine Plan* stipulated that this will require strategic collaboration by terrestrial and marine planning systems to balance infrastructural development with maintaining landscapes of aesthetic and ecological value (Marine Scotland, 2015; Lloret et al, 2021; Pröbstl-Haider et al, 2023).

c. Governance and community in Marine Spatial Planning

Numerous case studies demonstrate that stakeholder involvement in MSP and conservation can aid conflict resolution and increase local environmental stewardship (e.g., Voyer et al, 2015; Stosch et al, 2022; Ranger et al, 2016). Howarth-Forster (2020) found that Arran locals had high levels of environmental awareness and support for existing marine protections compared to Scotland's general population. This study revealed that many respondents support or are involved with COAST, an organisation which aims to "*protect and restore sea life and sustainable livelihoods around Arran and the Clyde*", and that they provide an avenue for involvement in marine management and conservation (COAST, 2023a). However, respondents were uncertain about how to take their views to higher levels of government, with many concerned that public policy consultations by Scottish and UK Governments are ingenuine in purporting community engagement.

Lack of involvement of coastal communities in MSP is a common frustration around Scotland (Smith, 2018). While Arran may benefit from the leadership of organisations such as COAST, local autonomy

is limited as ultimately marine management decisions are made at the national level (Ostrom, 2009; Schéré et al, 2021). This demonstrates the need for ongoing community participation across governance spheres and stakeholder groups, rather than as a one-off exercise, to facilitate open conversation around issues and conflicts as they arise (Ranger et al, 2016). Additionally, in analysing the social acceptability of MPAs, Voyer et al (2015) argue that the idea of the community, as a homogenous entity, should be dismantled to account for the variety of perspectives and values within communities.

Ostrom (2009) highlights the influence of shared informal governance norms on the sustainability of SES management by resource users. She argues that when resource users believe they share moral and ethical standards, community cohesion, trust, and therefore system sustainability is enhanced, and likelihood of conflict escalation is reduced (Ranger et al, 2016; Ostrom, 2009). This challenges Hardin's commonly accepted 'Tragedy of the Commons' (Hardin, 1968), which proposes that open-access resource systems inevitably collapse due to the selfish pursuit of users' own interests (Ostrom, 2009). Around Arran, recreational users frequently share resources, equipment, staff, use areas, and clientele, and tend to cooperate in popular areas by waiting or making space, for example for the ferry or lifeboat. Smith (2018) highlights that where pathways for local participation in management and policymaking are limited, informal organisation of marine activities amongst communities can replace formal governance. Such use arrangements function without the need for formal management measures and are based on social capital gained from positive relations with one another and the environment (Ostrom, 2009; Refulio-Coronado et al, 2021).

In Arran's coastal waters, positive stakeholder relations benefited from informal cooperation, shared environmental attitudes, and a sense of community, whereas examples of conflict included feelings that one sector or industry was interfering with another, such as through the damage of resources (e.g., marine biodiversity) valued by recreational users (Cusack et al, 2021). Redpath et al (2013) argue that conservation conflicts arise when there are two or more parties acting with competing interests in a resource system. On Arran, disagreements between recreational users and other sectors, namely aquaculture and mobile fishing, were mainly latent or expressed disagreements, which Cusack et al (2021) would quantify as low intensity when applying theory from armed conflicts to conservation conflicts.

However, one respondent was subject to verbal aggression over the proposed implementation of HPMAs. They were seen to be pro-conservation, while others involved were angered at the possibility of further restrictions on fishing activity (Marine Scotland, 2022; Brooks, 2023). This suggests polarisation between stakeholder groups and that national-level MSP and policy can cause complex conflicts at a local level (Ranger et al, 2016; Sijtsma et al, 2019; Voyer et al, 2015). Conflicts between recreational users, fisheries and aquaculture in the Firth of Clyde would benefit from further research to effectively include stakeholder perspectives in MSP (Smith, 2018). Schéré et al (2021) demonstrate the utility of the International Institute for Environment and Development's Site-level Assessment for Governance and Equity (SAGE) tool for gaining a comprehensive view of management equity in MPAs. In addition, participatory mapping combined with qualitative methods, such as interviews, can effectively incorporate community voices into MSP, capturing the nuances of use, shared values, and conflicts (Stosch et al, 2022; Smith 2018; Sijtsma et al, 2019).

d. A note on methodology, limitations & avenues for future research

Arran presents a useful case study on community cooperation amongst recreational stakeholders around a shared resource (Paltriguera et al, 2018). Several emerging issues stand out, including concerns about facilities, conflicts at access points, wildlife interactions, and inclusion in top-down

decision-making. By researching user preferences without pre-existing policy goals, this study unearths an accurate representation of the current state of the sector (Smith, 2018). A mixed-method approach to studying aquatic SESs has been advocated for by Stosch et al (2021), Noble et al (2019) and Murray et al (2016), who found that it eased some tensions between the understanding of quantitative use distribution while retaining the nuances of stakeholder perceptions. The categorisation of qualitative data is never neat, which limits the detail this research can provide (Braun and Clarke, 2023). However, by complementing interviews with quantitative data, a broad, representative view was obtained (Murray et al, 2016).

The researcher is an Arran resident which aided the establishment of trusting relationships with interviewees, reducing insider-outsider suspicions often associated with small communities and extractive research processes, and enabling a deeper exploration of research questions (Jennings, 2005; Ranger et al, 2016). Despite participant confidentiality there is also chance that participants would reshape their explanations because of personal connections to the researcher (Braun and Clarke, 2023). Several interviewees and survey respondents commented on the thought-provoking nature of the research, highlighting the production of knowledge as a co-creative process between researcher and participants (Reitz, 2021; Moon et al, 2019).

Fully quantifying use levels would require observational data collection across the study site, which is a potential avenue for future research, although respondents suggested use levels are low relative to other popular tourist sites around the UK (Gonson et al, 2018; Naylor et al, 2019). Further research could experiment with methods such as focus groups, workshops, and Community Voice Method (CVM), demonstrated by Ranger et al (2016) to aid in moving beyond polarised debate towards facilitating ongoing stakeholder collaboration in policymaking. Moreover, understanding the views of non-recreational users, such as fishing, transport, and land-based stakeholders, regarding marine recreation would contribute to a broader assessment of Arran's coastal SES (McNeill et al, 2018; Noble et al, 2019).

5. Conclusion

Through the study of marine recreation in Arran's coastal waters, this research has demonstrated the utility of an SES framework for providing insight into the complex relationships and interactions which arise between users and the environment through marine-based recreation. A mixed-method approach contextualised quantitative information on the nature, scale, and distribution of such use with qualitative user perspectives. It was found that recreational use was concentrated amongst Arran's most populated villages, and that swimming and paddle sports were most popular. Contention around motorised watercraft, top-down governance, and the fishing and aquaculture sectors highlight avenues for further study. Despite this, relationships between users from different stakeholder groups, and with the environment, were generally viewed positively, showcasing Arran as a case study for community cooperation around marine recreation. According to respondents, use levels remain low, but predictions of growth in the sector deem it essential that ongoing conversations around recreation and marine management are maintained. Through a mixed-method examination of local perspectives in relation to spatial distribution, and current and future use patterns, weaknesses and strengths in the sector have been assessed and can be applied within policy and management contexts.

6. Acknowledgements

This project was made possible by the invaluable guidance of my supervisor, Professor Nils Bunnefeld, and the input of the Community of Arran Seabed Trust into initial study design. I am additionally grateful for the enthusiasm and commitment of participants, who contributed detailed insights into marine recreation around Arran. Finally, thank you to my friends, family, and flatmates for their unconditional support.

7. Appendices

Appendix 1: Survey Questions

Section:	Questions asked:
1. About you	1. Are you a resident on, or visitor to Arran? a. My main residence is on Arran b. I live on Arran part-time or seasonally c. I visit Arran more than twice per year d. I visit Arran 1-2 times per year, or less 2. If you are a visitor, what time of year do you visit Arran most? If you live on Arran, please skip this question. a. Spring (March – May) b. Summer (June – August) c. Autumn (September – November) d. Winter (December – February) e. I visit regularly throughout the year 3. If you are a visitor, how many times per year do you usually visit Arran? If you are a part-time or full-time resident on Arran, please skip this question. 4. What is your age? a. 18-24 b. 25-34 c. 35-44 d. 45-54 e. 55-64 f. 65+ g. Prefer not to say 5. What is your gender? a. Woman b. Man c. Non-binary d. Prefer not to say e. Other() 6. What is your sexual orientation? a. Heterosexual (straight) b. Bisexual c. Lesbian woman d. Gay man e. Prefer not to say

	f. Other() 7. What is your ethnic background? a. White b. Mixed/multiple ethnic backgrounds c. Asian/Asian British d. Black/African/Caribbean/Black British e. Arab f. Prefer not to say g. Other() 8. Do you consider yourself to have a disability? a. Yes b. No c. Prefer not to say 9. Do you have any children? a. Yes b. No c. Prefer not to say 10. What is your primary occupation? a. Unemployed b. Student c. Seasonal staff (resident) d. Self-employed or freelance without employees e. Self-employed with employees f. Employed (full-time) g. Employed (part-time) h. Retired i. Prefer not to say j. Other() 11. If you live on Arran, where do you live? (Select closest village). a. Whiting Bay b. Lamlash c. Brodick d. Corrie e. Sannox f. Lochranza g. Pirnmill h. Machrie i. Blackwaterfoot j. Shiskine k. Kilmory l. Kildonan m. I do not live on Arran n. Prefer not to say 12. Do you represent an organisation or business which provides, facilitates, or is otherwise involved in marine-based recreational activities or excursions for the public in the sea around Arran? a. Yes b. No 12A. If you answered yes to the question above, please provide the name of your organisation or business, and continue to fill out the survey on behalf of your organisation with regard to the activities you

	offer. Please ensure that this survey is completed just once per organisation.
2. Areas Used	1. What is your most frequent recreational activity in the sea around Arran? a. Kayaking or canoeing b. Rowing c. Stand-Up Paddleboarding (SUP) d. Windsurfing or kitesurfing e. SCUBA diving f. Snorkelling g. Swimming h. Non-motorised sailing i. Jet-skiing j. Motorised boating (general) k. Motorised boating for water skiing or similar activity l. Motorised boating for recreational fishing m. Recreational fishing from land n. Other() 2. On average, how many times per month do you participate in this activity on Arran during the summer season (1st June – 15th September)? a. Less than once per month b. Once per month c. 2-5 times per month d. 6-10 times per month e. 11-20 times per month f. Most days 3. Please tick the seasons during which you participate in this activity on Arran. a. Spring (March – May) b. Summer (June – August) c. Autumn (September – November) d. Winter (December – February) 4. What is the group size with whom you usually enter the water? a. 1 b. 2-5 c. 6-10 d. 11+ 5. How long have you been participating in this activity on Arran? a. Less than a year b. 1-2 years c. 3-5 years d. 6-9 years e. 10+ years 6. With reference to the map below, use the drop down menu to select the number of the area you use most frequently for this activity. a. [drop down menu of numbers 1-16] 7. Is there a second area that you also use frequently for this activity? If so, please refer again to the map above and use the drop-down

	menu to select the number of the second area you use frequently. If you tend to only use one area, you may skip this question. a. [drop down menu of numbers 1-16] 8. What is your main purpose for participating in this activity? If you are representing an organisation or business, please select the main focuses of your business marketing. a. Wildlife watching b. Leisure or relaxation c. Mental or emotional well-being d. Exercise e. Adventure f. Education g. Sports training h. Scenery i. Other()
2B. Areas Used for Second Most Frequent Recreational Activity	[Repeat of questions above for the activity which respondents participate in second most frequently.]
3. Preferences, Access, Interactions, and Participation	Likert scale questions: [Scale is as follows, unless otherwise specified: Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree, I Don't Know.] 1. I prefer to enter the water as part of a group. 2. I feel I can access the water when and where I desire. 3. Do you encounter other users outside your group when you are in the sea? [Likert scale: Never, Rarely, Sometimes, Often, Always] 4. The areas I use can be crowded with other recreational users. 5. I have had issues with the conduct of other recreational users towards the marine **environment** in the last year. 6. I have had issues with the conduct of other **recreational marine users** towards myself or others in the last year. 7. I have had issues with the conduct of **non-recreational marine users** towards myself, others, or the environment in the last year. 8. I am concerned about **current** levels of recreational activities in the sea around Arran. 9. I am concerned about **future** levels of recreational activities in the sea around Arran. 10. Marine recreation is important to Arran's local economy. 11. Arran's marine environment is in good condition. Open-ended questions: 1. Do you anticipate your use of the marine environment changing in the future? If relevant, please describe. 2. What, if anything, would help you gain further benefit from the marine environment around Arran? 3. If you have had any, please expand on the issues you have encountered with other marine users, activities, or wildlife. a. If you have encountered any issues, what do you think could, could have, or did help resolve these?

3B. Participation and Management	Likert scale questions: 1. I know ways in which I can be involved in the management and/or protection of Arran's coastal waters. 2. I feel that I will be listened to if I express my views regarding the management of Arran's coastal waters. 3. My views are well-represented in the management and/or protection of Arran's coastal waters. Open-ended questions: 1. How does Arran benefit from marine-based recreation? 2. Please describe any ways you are currently, or have been, involved in the protection, management, or governance of Arran's marine environment. 3. What do you think the future of marine recreational activity around Arran looks like? 4. If you would like to, please share any further comments regarding marine recreation around Arran, or your experience completing this survey.

Appendix 2: Interview Guide

Topic:	**Examples of questions asked:**
1. Setting the scene / introduction	• Which business or organisation do you represent? • What types of experiences or services do you offer? • How long have you been operating for? • How often do you take people out? How many people? • What times of year do you operate?

2. Assessing distribution, nature, and scale of use (using map as a visual aid)	• Can you provide more detail about the areas you use the most and what draws you to them?
	  ○ What is the access like there?
	  ○ For rental businesses: which areas are used by your customers?
	• Are there any areas you avoid? Why?
	• Are there any areas you would like to make more use of but don't feel you can? What would help with this?
	• How has your choice of which areas to use changed over time?
	• What kind of experiences do you market to your clients/customers?
	• How do your clients/customers benefit from marine recreation?
	• Do you ever have any concerns regarding the safety of recreational users?
	  ○ How has this changed over time?

	○ Are there specific areas where safety issues are more common? • What are your thoughts on the impacts of recreational activities on marine life? • Do you think there is a difference in access or quality of recreational opportunities within versus outside the MPA or NTZ areas?
3. The broader impacts of marine recreation on Arran	• What are your views on the impacts of recreational activities on Arran's marine environment, both positive and negative? • Have you ever experienced negative interactions with other users (recreational, non-recreational, or wildlife)? • How do recreational organisations and businesses tend to cooperate with each other? • What are your views on how recreational users should conduct themselves in relation to each other and the environment? • What are your views on the current level of marine recreational use around Arran? • What do you think the ideal and maximum capacity of recreational users would look like? • How does Arran's local economy benefit from marine recreation? • Why do you think people are drawn to Arran? (How) has this changed over time?
4. Participation and Governance	• What are your views on the current state of recreational activities in Arran's coastal waters? • How well do you feel that your views are represented in marine management and protection around Arran? • Are you part of any organisations involved in marine management? What is your experience of this? • Do you feel that you will be listened to if you express your views on the management of Arran's marine environment? • What are some of the ways you think public and stakeholder participation in marine governance around Arran could be improved or made easier? • What would help you benefit more from the marine environment around Arran?
5. Round-off	• Is there anything you feel we have not covered that you would like to bring up? • Is there anyone else on the island who you think I should talk to?

	• Do you have any feedback on the survey and interview process?

9. References

Aranda, N.R. and Vezzoni, R. (2021) Technology as a Tool for Environmental Engagement: The Case of Digital Participatory Mapping (DPM). In: A. Franklin, ed. Switzerland: Springer International Publishing AG, pp. 418-450.

Arran Geopark (2017) *Arran Rocks!* Available: https://www.arran-geopark.org.uk/arran-rocks/ [Accessed: 12th August 2023].

Baynham-Herd, Z., Redpath, S., Bunnefeld, N., Molony, T. and Keane, A. (2018) Conservation conflicts: Behavioural threats, frames, and intervention recommendations. *Biological Conservation,* 222 (2018), pp. 180-188.

Braun, V. and Clarke, V. (2023) Toward good practice in thematic analysis: Avoiding common problems and be(com)ing a knowing researcher. *International Journal of Transgender Health,* 24 (1), pp. 1-6.

Brooks, L. (2023) Scottish government ditches controversial marine protection plan. *The Guardian*. Available: https://www.theguardian.com/uk-news/2023/jun/29/scottish-government-ditches-controversial-marine-protection-plan [Accessed: 23rd August 2023].

Clark, E., Mulgrew, K., Kannis-Dymand, L., Schaffer, V. and Hoberg, R. (2019) Theory of planned behaviour: predicting tourists' pro-environmental intentions after a humpback whale encounter. *Journal of Sustainable Tourism,* 27 (5), pp. 649-667.

Community of Arran Seabed Trust [COAST] (2023a) *Our Mission.* Available: https://www.arrancoast.com/mission/ [Accessed: 24th August 2023].

Community of Arran Seabed Trust [COAST] (2023b) *South Arran MPA.* Available: https://www.arrancoast.com/south-arran-mpa/ [Accessed: 12th August 2023].

Cusack, J.J., Bradfer-Lawrence, T., Baynham-Herd, Z., Castelló y Tickell, S., Duporge, I., Hegre, H., Moreno Zárate, L., Naude, V., Nijhawan, S., Wilson, J., Zambrano Cortes, D.G. and Bunnefeld, N. (2021) Measuring the intensity of conflicts in conservation. *Conservation Letters,* 14 (3).

Defeo, O., McLachlan, A., Armitage, D., Elliott, M. and Pittman, J. (2021) Sandy beach social–ecological systems at risk: regime shifts, collapses, and governance challenges. *Frontiers in Ecology and the Environment,* 19 (10), pp. 564-573.

Gonson, C., Pelletier, D. and Alban, F. (2018) Social carrying capacity assessment from questionnaire and counts survey: Insights for recreational settings management in coastal areas. *Marine Policy,* 98 (2018), pp. 146-157.

Howarth-Forster, L. (2020) *Marine Social Attitudes on Arran.* MSc Marine Environmental Management, University of York.

Inman, A., Broker, E., Dolman, S., McCann, R. and Wilson, A.M.W. (2016) The use of marine wildlife-watching codes and their role in managing activities within marine protected areas in Scotland. *Ocean & Coastal Management,* 132 (2016), pp. 132-142.

Jennings, G.R. (2005) Interviewing: a focus on qualitative techniques. In: G.R. Jennings et al., ed. *Tourism Research Methods: Integrating Theory with Practice.* Wallingford, UK: CABI Publishing, pp. 99-117.

Jobstvogt, N., Watson, V. and Kenter, J.O. (2014) Looking below the surface: The cultural ecosystem service values of UK marine protected areas (MPAs). *Ecosystem Services,* 10, pp. 97-110.

Jones, I. (2018) *Investigating spatial trends in biodiversity around the South Arran Marine Protected Area.* Master of Science, University of York.

Lloret, J., Gómez, S., Rocher, M., Carreño, A., San, J. and Inglés, E. (2021) The potential benefits of water sports for health and well-being in marine protected areas: a case study in the Mediterranean. *Annals of Leisure Research* (ahead of print).

Lucrezi, S., Ferretti, E., Milanese, M., Sarà, A. and Palma, M. (2021) Securing sustainable tourism in marine protected areas: lessons from an assessment of scuba divers' underwater behaviour in non-tropical environments. *Journal of Ecotourism,* 20 (2), pp. 165-188.

Mace, G.M., Norris, K. and Fitter, A.H. (2012) Biodiversity and ecosystem services: a multilayered relationship. *Trends in Ecology & Evolution,* 27 (1), pp. 19-26.

Mandić, A., Mrnjavac, Ž and Kordić, L. (2018) Tourism Infrastructure, Recreational Facilities and Tourism Development. *Tourism and Hospitality Management,* 24 (1), pp. 41-62.

Marine Scotland (2015) *Scotland's National Marine Plan: A Single Framework for Managing Our Seas.* Edinburgh: The Scottish Government.
Available: https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2015/03/scotlands-national-marine-plan/documents/00475466-pdf/00475466-pdf/govscot%3Adocument/00475466.pdf [Accessed: 24th January 2023].

Marine Scotland (2016) *Scottish Marine Recreation & Tourism Survey 2015.* The Scottish Government.
Available: https://webarchive.nrscotland.gov.uk/20180108184212/www.gov.scot/Topics/marine/seamanagement/national/RecandTourism [Accessed: 15th August 2023].

Marine Scotland (2020) *Marine tourism.* Available: https://marine.gov.scot/sma/assessment/marine-tourism [Accessed: 15th August 2023].

Marine Scotland (2022) *Highly Protected Marine Areas: policy framework.* Scottish Government.
Available: https://www.gov.scot/publications/highly-protected-marine-areas-policy-framework/pages/7/ [Accessed: 21st June 2023].

McIvor, J. (2021) Arran ferry woes costs island businesses thousands. *BBC.*
Available: https://www.bbc.co.uk/news/uk-scotland-glasgow-west-56979420 [Accessed: 23rd August 2023].

McKinley, E., Acott, T. and Stojanovic, T. (2019) Socio-cultural Dimensions of Marine Spatial Planning. In: J. Zaucha and K. Gee, eds. *Maritime Spatial Planning.* Switzerland: Springer International Publishing AG, pp. 151-174.

McNeill, A., Clifton, J. and Harvey, E.S. (2018) Attitudes to a marine protected area are associated with perceived social impacts. *Marine Policy,* 94 (2018), pp. 106-118.

The Merchant Shipping (Watercraft) Order 2023 2023, c. 35.
Available: https://www.legislation.gov.uk/uksi/2023/35/made. [Accessed: 23rd August 2023].

Miller, A.B., Blahna, D.J., Morse, W.C., Leung, Y. and Rowland, M.M. (2022) From recreation ecology to a recreation ecosystem: A framework accounting for social-ecological systems. *Journal of Outdoor Recreation and Tourism,* 38 (2022), pp. 100455.

Moon, K., Blackman, D.A., Adams, V.M., Colvin, R.M., Davila, F., Evans, M.C., Januchowski-Hartley, S.R., Bennett, N.J., Dickinson, H., Sandbrook, C., Sherren, K., St. John, F.A.V., Kerkhoff, L., Wyborn, C. and Ellison, A. (2019) Expanding the role of social science in conservation through an engagement with philosophy, methodology, and methods. *Methods in Ecology and Evolution,* 10 (3), pp. 294-302.

Murray, G., D'Anna, L. and MacDonald, P. (2016) Measuring what we value: The utility of mixed methods approaches for incorporating values into marine social-ecological system management. *Marine Policy,* 73 (2016), pp. 61-68.

Naylor, L.A., Brady, U., Quinn, T., Brown, K. and Anderies, J.M. (2019) A multiscale analysis of social-ecological system robustness and vulnerability in Cornwall, UK. *Regional Environmental Change,* 19 (7), pp. 1835-1848.

Noble, M.M., Harasti, D., Pittock, J. and Doran, B. (2019) Understanding the spatial diversity of social uses, dynamics, and conflicts in marine spatial planning. *Journal of Environmental Management,* 246 (2019), pp. 929-940.

North Ayrshire Community Planning Partnership [NACPP] (2017) *Locality Profile: Arran.* Available: http://northayrshire.community/wp-content/uploads/2018/02/Locality-Profile_Arran_Final_Version_Sept2017.pdf [Accessed: 13th April 2023].

Notley, W. (2019) *An investigation into the recovery of Lamlash MPA No Take Zone and South Arran MPA: Has protection led to improved biodiversity and habitats?* Master of Science, University of York.

Ostrom, E. (2009) General Framework for Analyzing Sustainability of Social-Ecological Systems. *Science,* 325 (5939), pp. 419-422.

Outeiro, L., Villasante, S. and Oyarzo, H. (2018) The interplay between fish farming and nature based recreation-tourism in Southern Chile: A perception approach. *Ecosystem Services,* 32 (A), pp. 90-100.

Paltriguera, L., Ferrini, S., Luisetti, T. and Turner, R.K. (2018) An analysis and valuation of post-designation management aimed at maximising recreational benefits in coastal Marine Protected Areas. *Ecological Economics,* 148, pp. 121-130.

Pickering, C., Rossi, S.D., Hernando, A. and Barros, A. (2018) Current knowledge and future research directions for the monitoring and management of visitors in recreational and protected areas. *Journal of Outdoor Recreation and Tourism,* 21, pp. 10-18.

Pickering, C., Rossi, S.D., Hernando, A. and Barros, A. (2018) Current knowledge and future research directions for the monitoring and management of visitors in recreational and protected areas. *Journal of Outdoor Recreation and Tourism,* 21, pp. 10-18.

Pröbstl-Haider, U., Gugerell, K. and Maruthaveeran, S. (2023) Covid-19 and outdoor recreation – Lessons learned? Introduction to the special issue on "Outdoor recreation and Covid-19: Its effects on people, parks and landscapes". *Journal of Outdoor Recreation and Tourism,* 41, pp. 100583.

Quilliam, R.S., Taylor, J. and Oliver, D.M. (2019) The disparity between regulatory measurements of E. coli in public bathing waters and the public expectation of bathing water quality. *Journal of Environmental Management,* 232 (2019), pp. 868-874.

Rakotonarivo, S.O., Bell, A.R., Abernethy, K., Minderman, J., Duthie, A.B., Redpath, S., Keane, A., Travers, H., Bourgeois, S., Moukagni, L., Cusack, J.J., Jones, I.L., Pozo, R.A. and Bunnefeld, N. (2021) The role of incentive-based instruments and social equity in conservation conflict interventions.

Ranger, S., Kenter, J.O., Bryce, R., Cumming, G., Dapling, T., Lawes, E. and Richardson, P.B. (2016) Forming shared values in conservation management: An interpretive-deliberative-democratic approach to including community voices. *Ecosystem Services,* 21, pp. 344-357.

Refulio-Coronado, S., Lacasse, K., Dalton, T., Humphries, A., Basu, S., Uchida, H. and Uchida, E. (2021) Coastal and Marine Socio-Ecological Systems: A Systematic Review of the Literature. *Frontiers in Marine Science,* 8.

Reitz, T. (2021) Back to the Drawing Board: Creative Mapping Methods for Inclusion and Connection. In: A. Franklin, ed. *Co-Creativity and Engaged Scholarship: Transformative Methods in Social Sustainability Research.* Switzerland: Springer International Publishing AG, pp. 323-337.

Ryan, C. (2005) Ethics in tourism research: objectivities and personal perspectives. In: P.M. Burns et al., ed. *Tourism Research Methods: Integrating theory with practice.* Wallingford, UK: CABI Publishing, pp. 9-19.

Schéré, C.M., Schreckenberg, K., Dawson, T.P. and Jones, N. (2021) It's Just Conservation: To What Extent Are Marine Protected Areas in the Irish Sea Equitably Governed and Managed? *Frontiers in Marine Science,* 8 (2021).

Scottish Environment Protection Agency [SEPA] (2023) *Bathing Waters.* Available: https://www2.sepa.org.uk/bathingwaters/ [Accessed: 14th August 2023].

Sijtsma, F., Mehnen, N., Angelstam, P. and Muños-Rojas, J. (2019) Multi-scale mapping of cultural ecosystem services in a socio-ecological landscape: A case study of the international Wadden Sea Region. *Landscape Ecology,* 34 (7), pp. 1751-1768.

Smith, G. (2018) Good governance and the role of the public in Scotland's marine spatial planning system. *Marine Policy,* 94 (2018), pp. 1-9.

Stewart, B.D., Howarth, L.M., Wood, H., Whiteside, K., Carney, W., Crimmins, É, O'Leary, B.C., Hawkins, J.P. and Roberts, C.M. (2020) Marine Conservation Begins at Home: How a Local Community and Protection of a Small Bay Sent Waves of Change Around the UK and Beyond. *Frontiers in Marine Science,* 7 (2020).

Stosch, K.C., Quilliam, R.S., Bunnefeld, N. and Oliver, D.M. (2022) Catchment-Scale Participatory Mapping Identifies Stakeholder Perceptions of Land and Water Management Conflicts. *Land,* 11 (2), pp. 300.

Vergara Peña, A. (2020) *Effects of marine recreation on bottlenose dolphins in Cardigan Bay.* Doctor of Philosophy, Bangor University.

VisitArran (2023) *Arran: The Island.* Available: https://www.visitarran.com/ [Accessed: 13th April 2023].

VisitArran (2023b) *Sailing & Watersports.* Available: https://www.visitarran.com/see-do/activities/sailing-watersports [Accessed: 13th April 2023].

Voyer, M., Gollan, N., Barclay, K. and Gladstone, W. (2015) 'It's part of me'; understanding the values, images and principles of coastal users and their influence on the social acceptability of MPAs. *Marine Policy,* 52 (2015), pp. 93-102.

Wahyudin, Y., Kusumastanto, T., Adrianto, L. and Wardiatno, Y. (2018) A Social Ecological System of Recreational Fishing in the Seagrass Meadow Conservation Area on the East Coast of Bintan Island, Indonesia. *Ecological Economics,* 148(2018), pp. 22-35.

Zupan, M., Bulleri, F., Evans, J., Fraschetti, S., Guidetti, P., Garcia-Rubies, A., Sostres, M., Asnaghi, V., Caro, A., Deudero, S., Goñi, R., Guarnieri, G., Guilhaumon, F., Kersting, D., Kokkali, A., Kruschel, C., Macic, V., Mangialajo, L., Mallol, S., Macpherson, E., Panucci, A., Radolovic, M., Ramdani, M., Schembri, P.J., Terlizzi, A., Villa, E. and Claudet, J. (2018) How good is your marine protected area at curbing threats? *Biological Conservation,* 221 (2018), pp. 237-245.