CS-MACH1

D2.2 – Final assessment report on data sharing and management requirements of Marine Citizen Science Initiatives (MCSI) and communities

VLIZ

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Executive summary

This report assesses data management practices across European marine and coastal citizen science initiatives (MCSI), using a mixed-methods approach that combines a Europe-wide survey with qualitative interviews.

The findings highlight a rapidly growing and active ecosystem, with strong data collection capacity supported by digital tools such as mobile applications, GPS, sensors, and image-based reporting. Citizen science initiatives are increasingly contributing to biodiversity monitoring, pollution tracking, habitat assessment, and environmental observation across European marine regions.

At the same time, the results reveal a clear structural imbalance: while data collection is often well established, data stewardship remains comparatively underdeveloped. Many initiatives continue to face challenges related to:

- data management and storage
- data validation
- metadata standardisation
- long-term preservation
- structured data publication and interoperability

The study shows that the main gap is operational rather than conceptual. Awareness of the FAIR principles is relatively widespread across the community, but implementation remains uneven due to:

- limited financial and human resources
- lack of technical expertise
- insufficient long-term support structures
- difficulties translating FAIR principles into practical workflows

A critical bottleneck concerns data validation, which frequently depends on limited expert capacity, particularly within biodiversity-focused initiatives. This reduces scalability and can delay the usability and publication of citizen-generated data.

The results further demonstrate that inconsistencies in metadata, varying levels of standardisation, and fragmented storage and publication practices continue to limit interoperability with major European and international data infrastructures such as GBIF, EMODnet, OBIS, and the Digital Twin Ocean. Consequently, a significant share of citizen science data remains insufficiently findable, reusable, or integrated into wider European marine data ecosystems.

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The combined survey and interview approach proved particularly valuable in identifying not only broad trends across the MCSI landscape, but also the practical realities shaping data management decisions within projects. The findings show that many initiatives operate with limited capacity, relying heavily on volunteer engagement, temporary funding, and small teams to maintain increasingly complex data workflows.

Despite these challenges, the report highlights a strong willingness across the community to improve collaboration, interoperability, and knowledge exchange. Overall, the findings demonstrate that the primary challenge is not the generation of citizen science data itself, but the capacity required to manage, validate, standardise, and integrate these data sustainably into European marine data infrastructures.

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Main trends, strengths, and structural challenges in data management practices across European marine and coastal citizen science initiatives are highlighted in this fiche.

1

THE ECOSYSTEM IS MATURE IN DATA COLLECTION, BUT IMMATURE IN DATA STEWARDSHIP

Citizen science initiatives are effective at generating data, but face persistent challenges in managing, validating, and publishing it in a structured and sustainable way.

2

THE CORE GAP IS OPERATIONAL, NOT CONCEPTUAL

Most initiatives understand what should be done (e.g. FAIR), but lack the resources, expertise, and operational workflows required for implementation.

3

DATA VALIDATION IS THE PRIMARY SCALABILITY CONSTRAINT

Expert-dependent validation models limit scalability and delay data usability, particularly in biodiversity monitoring.

4

FAIR IMPLEMENTATION IS UNEVEN AND OFTEN IMPLICIT

Many projects apply elements of FAIR without formalising them, resulting in inconsistencies and limited interoperability across datasets.

5

FINDABILITY IS THE WEAKEST FAIR COMPONENT

Despite relatively high levels of data accessibility, a substantial proportion of datasets remain undiscoverable due to insufficient metadata, indexing, and integration into established data infrastructures.

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6

GAPS IN CITIZEN SCIENCE DATA INTEGRATION LIMIT IMPACT

Despite large volumes, citizen science data often lack standardized, seamless integration into research and policy infrastructures.

7

LIMITED COORDINATION CAPACITY CONSTRAINS DATA MANAGEMENT AND SCALABILITY

Citizen science projects often rely on limited or volunteer-supported coordination, leading to challenges in ensuring consistent data management, continuity, and scalability.

8

TRAINING DEMAND IS HIGH BUT MUST BE PRACTICAL TO BE EFFECTIVE

Nearly all initiatives express training needs, but emphasise hands-on, workflow-based learning rather than abstract or purely theoretical frameworks.

9

THERE IS STRONG READINESS FOR COLLABORATION AND NETWORKING

The high willingness to engage (≈90%+) indicates that coordination mechanisms can be effectively implemented if they provide clear and practical value.

10

THE MAIN RISK IS NOT LACK OF DATA, BUT UNDERUTILISATION OF EXISTING DATA

Without improvements in validation, standardisation, and interoperability, much citizen-generated data will remain underutilised and poorly integrated into scientific and policy frameworks.

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List of referenced acronyms

CMCC	Centro Euro-Mediterraneo sui Cambiamenti Climatici
CS	Citizen Science
CSIC	Consejo Superior de Investigaciones Científicas
CS-MACH1	MArine Citizen science data Horizon
DMP	Data Management Plan
DTO	Digital Twin Ocean
EC	European Commission
ECSA	European Citizen Science Association
EDITO	European Digital Twin Ocean
EurOBIS	European Ocean Biodiversity Information System
EMODnet	European Marine Observation and Data Network
ETT	ETT SPA
FAIR	Findable, Accessible, Interoperable and Re-usable
GBIF	Global Biodiversity Information Facility
Ifremer	French Institute for Ocean Science
MARIS	Marine Information Service, MARIS B.V
MCSI	Marine Citizen Science Initiatives
MCSDN	Marine Citizen Science Data Network
OutBe	OutBe S.R.L.
SMHI	Swedish and Meteorological Institute
SSBE	SeaScape Belgium
VLIZ	Flanders Marine Institute
WP	Work Package

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1. Introduction

1.1. Context of Work Package 2 within the CS-MACH1 project

The **CS-MACH1** project aims to strengthen the role of marine and coastal citizen science initiatives (MCSI) in Europe's ocean observation and data management landscape. In line with the objectives of the EU Mission Ocean & Waters, citizen science contributes valuable complementary data to traditional monitoring programmes, enhancing spatial and temporal coverage while engaging society in ocean knowledge generation.

Beyond data collection, there is increasing recognition of the potential of citizen-generated data to contribute to **European data infrastructures** such as **EMODnet** and the **Digital Twin Ocean (DTO)**, provided that data are managed, standardised, validated and shared in a consistent and interoperable way.

Within this broader framework, Work Package 2 (WP2) focuses on understanding how MCSI currently manage their data, from collection and storage to sharing and long-term accessibility. The ultimate goal is to identify common practices, gaps, and challenges, and to provide a factual evidence base for improving data flow, interoperability and FAIR (Findable, Accessible, Interoperable and Reusable) data stewardship across the European MCSI community, thereby supporting the integration of citizen science data into European data systems and policy-relevant applications.

In parallel with this assessment, CS-MACH1 organised the inaugural **workshop of the Marine Citizen Science Data Network (MCSDN)** on 3–4 February 2026 in Ostend, Belgium, in a hybrid format. The workshop brought together marine citizen science initiatives, data managers, technology developers, researchers, and representatives of European marine data infrastructures to discuss practical challenges and opportunities for improving marine citizen science data flows. The workshop and this deliverable are closely connected: while D2.2 provides an evidence-based assessment of current data management practices through survey and interview results, the workshop offered a broader community perspective on how these challenges are experienced across the marine citizen science data ecosystem. The workshop conclusions (Breviere et al., in preparation) therefore reinforce the findings of this deliverable, particularly regarding the need for practical FAIR guidance, improved metadata and standardisation, scalable validation approaches, and stronger connections between citizen science initiatives and European data infrastructures.

1.2. Objectives and scope of this Deliverable 2.2

This deliverable, D2.2 – Final assessment report on data sharing and management requirements of MCSI and communities, provides a **comprehensive overview** of how marine and coastal citizen science initiatives currently manage their data across Europe and neighboring countries.

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The deliverable builds on a **mixed-methods approach**, combining quantitative data obtained through a structured Europe-wide survey (117 respondents), with qualitative insights collected through semi-structured in-depth interviews with 10 selected initiatives from the 117 that answered the survey. Together, this complementary approach provides a more complete understanding of how citizen science initiatives collect, manage, validate and share their data, as well as the challenges they encounter.

The survey component maps the current landscape of **data management practices** across a broad set of initiatives, while the interview phase allows for a deeper exploration of organisational, technical and governance aspects influencing data practices in citizen science projects.

Specifically, this deliverable aims to:

- Characterise the **diversity of data management practices** within marine and coastal citizen science initiatives across Europe and neighbouring countries;
- Identify **strengths, challenges and barriers** in the way these initiatives acquire, manage and disseminate data;
- Explore the **practical realities** behind these practices through qualitative insights from selected initiatives;
- Assess how current practices enable or limit the **integration** of citizen science data into European data infrastructures such as EMODnet and the Digital Twin Ocean.

Although the dataset may not represent the entire European landscape exhaustively, the combined survey and interview results provide a robust overview of how data are currently handled in practice within marine and coastal citizen science initiatives, and how these practices can evolve to better support European policy objectives and data ecosystems.

2. Methodology

2.1. Overview

The methodological framework of Deliverable D2.2 was designed to produce a comprehensive assessment of data management practices among marine and coastal citizen science initiatives in Europe and neighboring countries.

- Compilation of a database of relevant initiatives through the integration of existing European citizen science and marine data infrastructures;
- Design and dissemination of a structured survey to collect information on current data practices;
- Semi-structured interviews with selected initiatives to gain deeper qualitative insights into data management practices;
- Systematic processing and analysis of **both quantitative and qualitative data** to identify trends, challenges, and capacity needs.

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This mixed-methods approach combines large-scale quantitative mapping with qualitative insights, enabling both an overview of current practices and a deeper understanding of the factors influencing them.

The methodology ensures transparency and compliance with Horizon Europe standards for open and responsible research.

2.2. Rationale for a mix-methods approach

Given the fragmented and diverse nature of the marine citizen science community across Europe, a survey-based approach was identified as the most effective way to gather standardised and comparable information from a large number of initiatives.

The survey captures quantitative data, providing measurable indicators of current practices, and qualitative insights through open-ended responses. However, surveys alone cannot fully capture the contextual and organisational factors shaping how initiatives manage their data. Therefore, a complementary interview phase was conducted to explore these aspects in greater depth.

Together, the survey and interview components allow WP2 to:

- Map the current landscape of data handling and sharing within MCSI;
- Identify common bottlenecks in achieving FAIR and interoperable data flows;
- Understand the organisational, technical and social factors influencing data management practices;
- Identify capacity needs and potential support mechanisms for improving citizen science data management.

2.3. Compilation of the project database

VLIZ developed a consolidated database of **1,233 Marine and Coastal Citizen Science Initiatives (MCSI)** operating in Europe and neighbouring countries (hereafter referred to as European MCSI). The complete database is provided in **Annex 3**.

This database was created by merging and harmonising information from seven infrastructures and projects identified in the CS-MACH1 proposal, alongside 478 additional individual initiatives that were subsequently added through desk research:

- WaveLinks: repository that served as the baseline for the list.
- OTTERS: their dataset was merged with WaveLinks.
- The following structures were contacted to provide input on marine citizen science projects: SCOOP, Cos4Cloud, CitSci-X, ECSA and Blue-Cloud.

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2.4. Target population and inclusion criteria

The survey targeted citizen science initiatives with a marine, coastal, or estuarine focus. To be included, an initiative had to meet all the following criteria:

- Actively collect or generate data through citizen participation;
- Make use of some form of technology, tools, or sensors to support data collection or engagement;
- Operate within marine or coastal environments in Europe and neighboring countries;
- Maintain publicly accessible information (e.g. website, description, or contact details);
- Self-identify as a citizen science initiative or an organisation employing citizen science approaches.

This approach ensures that the assessment reflects the operational reality of projects directly contributing to marine data generation and sharing.

2.5. Survey design and distribution

The questionnaire was developed using Google Forms and structured around thematic sections reflecting the **full data lifecycle** and associated challenges. It combined closed-ended questions (single- and multiple-choice) with open-ended fields to capture context and nuance.

The survey was distributed by email to the 1,233 identified initiatives in early September 2025. The collection period lasted approximately two weeks, during which a single reminder was sent to maximise participation.

Responses were automatically recorded and exported for analysis. Participation was voluntary, and respondents were informed that their contributions would be anonymised and presented in aggregate form.

The complete survey questionnaire is provided in **Annex 1**.

2.6. Qualitative interviews

To complement the survey results and gain deeper insights into the practical realities of data management within marine and coastal citizen science initiatives, a qualitative interview phase was conducted.

The initiatives selected for the interviews were drawn from the pool of survey respondents. All ten initiatives had previously completed the survey and were selected based on their responses in order to capture a diversity of practices, geographical coverage, thematic focus, and levels of data management maturity. This targeted selection allowed the interviews to further explore specific aspects of data management practices identified in the survey results.

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Table 1. Overview of the selected initiatives which summarises their geographical coverage, thematic focus, and assessed level of data management maturity.

Interviewed initiatives	Geographical coverage	Thematic focus	Data management maturity
BioMARathon	Southern Europe	Biodiversity observations and/or species monitoring	Advanced
Explore Your Shore!	Ireland	Biodiversity observations and/or species monitoring	Advanced
Turtle Watch Egypt 2.0	Egypt	Biodiversity observations and/or species monitoring	Early-stage
Sandwatch	Worldwide	Currents, Salinity, Sea level, Sea state, Water temperature, Ocean color / plankton / harmful algal blooms, Oxygen, Nutrients, Coastal erosion, Weather observations, Sandwatch groups monitor a cross section of data to observe the state of their beach and changes in it	Developing
Plastic Pirates - Go Europe!	Europe	Marine pollution	Advanced
Citizens of Surf	Portugal	Salinity, Water temperature, Marine habitats, Biodiversity observations and/or species monitoring, DNA-derived biological occurrences, Marine pollution, pH	Early-stage
Sailing4Science	Northern Europe, Southern Europe, Africa (Ghana, Tanzania)	Salinity, Water temperature, Ocean color / plankton / harmful algal blooms, Oxygen, Greenhouse gases, DNA-derived biological occurrences, Marine pollution	Developing
SeaWatch-B	Belgium	Water temperature, Biodiversity observations and/or species monitoring, Marine pollution, Human pressure on beach	Advanced
The Fishing Vessel Ocean Observing Network (FVON)	Worldwide	Water temperature, Fisheries / sustainable fishing	Advanced
Water Rangers	Worldwide	Water temperature, Oxygen, Nutrients	Advanced

Geographical coverage refers to the spatial scope of the initiative, ranging from single-country projects to broader regional or global initiatives.

Thematic focus describes the primary environmental domain or type of data collected by the initiative (e.g. biodiversity monitoring, marine pollution, or physico-chemical parameters).

Data management maturity reflects the level of development of data management practices within each initiative, based on survey responses related to data storage, standardisation, accessibility, and alignment with FAIR principles. Three categories were distinguished:

- **Early-stage**: data management practices are limited or still being established, with data often stored locally or not yet standardised or publicly accessible.

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- **Developing**: structured data collection and management practices are in place, but limitations remain in terms of standardisation, interoperability, or accessibility.
- **Advanced**: data are standardised, well-documented, and shared through recognised platforms, with clear alignment to FAIR principles.

Two researchers from VLIZ conducted the interviews in English through online meetings between January and February 2026. With the consent of the interviewees, each interview was recorded to allow accurate transcription and analysis. The recordings were subsequently transcribed using AI-based tools and reviewed for accuracy and analysed to identify recurring themes related to data management practices, challenges, and capacity needs.

Each interview followed a semi-structured format, allowing a consistent set of core questions to be addressed while enabling participants to elaborate on their specific experiences and practices.

The interview guide covered several thematic areas, including project context, data collection methods, data management practices (including awareness of Data Management Plans and FAIR principles), data validation procedures, and perceived needs for support and training.

The complete interview guide is provided in **Annex 2**.

2.7. Data processing and analysis

After closure of the survey, responses were downloaded, cleaned and harmonised.

Quantitative survey responses were analysed using descriptive statistics, including frequency counts, percentages and distributions. These analyses allowed the identification of trends and patterns in current data management practices across initiatives.

Qualitative data obtained from the interviews were analysed using thematic analysis (Braun & Clarke, 2006), enabling the identification of recurring themes and insights related to data collection practices, data management strategies, barriers to FAIR data implementation and training needs.

All analyses were conducted by VLIZ.

2.8. Ethical considerations

The study complies fully with **GDPR and Horizon Europe ethical requirements**. Respondents were informed about the purpose of the survey and interviews, the voluntary nature of their participation and the confidentiality of their responses.

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No personal data were retained beyond optional contact details, which were stored securely on VLIZ infrastructure.

2.9. Limitations

While the study provides valuable insights into the data practices of European marine and coastal citizen science initiatives, certain limitations must be acknowledged:

- **Response bias:** initiatives with more developed data infrastructures may have been more inclined to participate in the survey or interviews;
- **Language constraint:** both the survey and interviews were conducted in English;
- **Self-reporting:** results rely on participants' descriptions of their practices;
- **Coverage:** some small or emerging initiatives may not have been captured in the initial database.

Despite these limitations, the combination of survey data and qualitative interviews provides a robust and informative overview of current data management practices within marine and coastal citizen science initiatives

3. Survey structure

This chapter provides an overview of the structure and internal logic of the WP2 survey instrument.

The questionnaire was developed by VLIZ, in close consultation with all WP2 partners (SMHI, ECSA, OutBe, MARIS, SSBE, Ifremer, CSIC, ETT, CMCC), to obtain a structured and comparable overview of how marine and coastal citizen science initiatives (MCSI) in Europe and neighbouring countries currently manage and share their data. The survey combines factual multiple-choice items with selective open questions to capture both the diversity and the depth of practices in data acquisition, management, sharing, and capacity needs. The survey is composed of four thematic sections, followed by a short closing block.

3.1. General characteristics of the project

Purpose

This section gathers contextual information to profile each participating initiative. These descriptors enable stratified analysis (e.g. by region, maturity, or topic) and ensure that subsequent results can be interpreted in context.

Topics covered

- Identification: project name, coordinator, website, contact details.
- Data collection technology: use of sensors, mobile applications, online tools, or manual recording.
- Geographical scope: country and region of activity, marine basin.
- Temporal dimension: start and end year of the initiative.

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- Scale and participation: approximate number of participants per year, type of participants (wider public, divers, tourists, students, …).
- Operational pattern: frequency of activities or events.
- Main thematic focus: e.g. biodiversity, litter, water quality, habitats.

Expected insights

A clear **typology of initiatives** (national vs. transnational, long-running vs. new, thematic clusters) that will contextualise all subsequent findings.

3.2. Data flow

Purpose

To capture how citizen science data are currently handled, from **storage** to **accessibility** and **hosting platforms**, thereby mapping the existing *as-is* data lifecycle.

Topics covered

- Experience with data management: whether projects possess relevant expertise.
- Data storage: where and how data are stored (e.g. locally, within institutional systems, or using external/cloud storage).
- Standardisation of data and metadata: whether the data are raw, converted, partially converted, or unknown.
- FAIR awareness: familiarity with the FAIR principles and their practical implementation.
- Use of best practices: adoption of standard methods, guidelines, or protocols for data management.
- Findability of the data: whether the project's data are findable, and if so, where/
- Accessibility of the data: where and to whom the data are accessible (only to the respondent, within their institution, to project partners, or publicly).
- Hosting platforms: repositories or databases used for publication and potential connections to infrastructures such as OBIS, EMODnet, or GBIF.
- Recognition systems: mechanisms for tracking, attribution, or providing feedback to participating citizens (formally, informally, or not at all).

Expected insights

A baseline understanding of technological diversity, maturity in data stewardship, and existing gaps in the application of FAIR and standardised practices.

3.3. Challenges and training needs in data management

Purpose

To identify the **concrete obstacles** that hinder effective, FAIR, and interoperable data management, and to determine the related **training needs** of marine and coastal citizen science initiatives.

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Topics covered

Respondents were invited to select from a predefined list of technical, organisational, and legal challenges and to indicate their training needs across various aspects of data management. Open comment fields allowed participants to describe context-specific issues or capacity gaps.

Expected insights

This section provides a quantitative overview of the most frequent barriers encountered by MCSI, such as limited resources, insufficient expertise, or lack of guidance on FAIR implementation, and highlights where targeted capacity-building and training interventions are most urgently required.

The findings formed the evidence base for qualitative follow-up interviews in D2.2, which explored in greater depth the underlying causes of these challenges and refine the design of the CS-MACH1 training and support strategy.

3.4. Engagement

Purpose

To identify priority areas for **capacity-building** and the willingness of initiatives to engage in future collaborative activities.

Topics covered

- Network participation: interest in joining our marine citizen science data network.
- Community engagement: interest in participating in joint events, being featured in newsletters, or communication activities.
- Follow-up opportunities: consent to be contacted for interviews or workshops.

Expected insights

A summary of the level of interest and readiness among initiatives to collaborate through the marine citizen science data network, shared communication and events. The results indicated preferred formats for engagement, identified potential partners for joint actions, and highlighted opportunities for building a **sustainable network** of marine citizen science data actors.

3.5. Feedback and consent

Purpose

To collect feedback on the survey process and obtain consent for follow-up communication.

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Topics covered

- Open comments.
- Confirmation of voluntary participation and consent for future contact.

Expected outputs

A structured summary of respondent feedback on the survey.

3.6. Analytical perspective

The modular structure of the questionnaire allows for both quantitative analysis and qualitative interpretation of open fields.

Together, these outputs formed the empirical backbone of Deliverable D2.1: a factual representation of the current data management landscape in European marine citizen science.

4. Results of the survey

4.1. General characteristics of the project

Of the **1 ,233 marine and coastal citizen science initiatives (MCSI)** identified**, 117 projects (≈9%)** completed the survey. While not exhaustive, this sample provides a representative snapshot of the European MCSI landscape. The responses capture a broad geographic spread, with a slight bias toward Western and Northern Europe.

Overall, the surveyed initiatives reveal a **vibrant and diverse community**: most are ongoing, increasingly digital in their approach, and active across all major marine regions (from the Mediterranean and North Sea–Baltic basins to global initiatives). Common themes include biodiversity monitoring, pollution tracking, and habitat assessment, often combining volunteer-driven observations with modern technologies such as apps, GPS tools, and cameras.

The following sections present these results in greater detail, outlining the general characteristics of the participating initiatives, including their geographical scope, duration, participant composition, technological tools, and thematic focus.

4.1.1. Data-collection technologies

Survey question: “Are any technologies or tools used in the project to collect scientific data?” (Multiple answers possible)

A total of 117 projects responded to this question, where multiple answers were possible. The results demonstrate that **digital and image-based methods dominate** marine citizen science data collection. Over four-fifths of initiatives use mobile devices and apps, selected by 98

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projects (82%), reflecting the widespread adoption of app-based reporting systems that facilitate georeferenced submissions. GPS-enabled mapping (63%) and cameras are frequently used alongside these, enabling precise localisation and visual validation of observations.

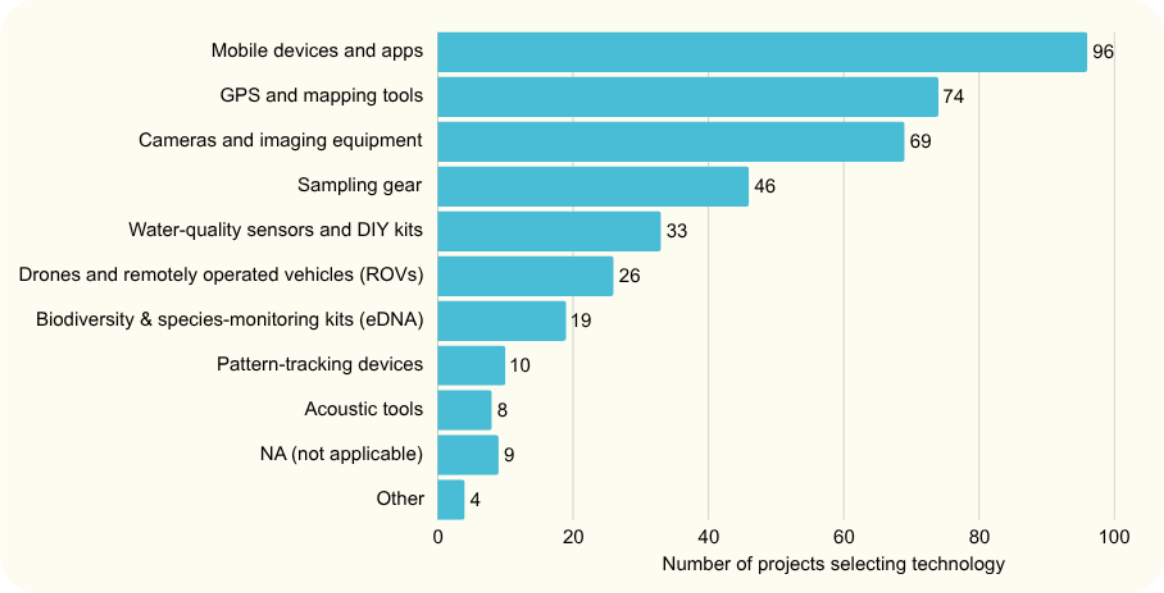

Figure 1. Data-collection technologies used in marine and coastal citizen science initiatives. *Horizontal bar chart showing the number of initiatives using each data-collection technology (n = 117; 390 total selections; multiple answers possible).*

A substantial proportion of projects employ sampling gear (39%) and DIY water-quality sensors (28%). The use of drones, eDNA kits, and acoustic or pattern-tracking devices highlights the diverse range of technological tools applied in citizen science operations, bridging community observation with professional oceanographic methods.

Approximately 8% of the projects reported that no specific tools were used (*NA*). A small additional share (≈ 3%) relied on auxiliary materials, such as printed identification cards, litter-collection kits, or online governance-evaluation platforms, classified as "Other" due to their supporting rather than technological role in data acquisition.

Together, these findings underline the diversity, adaptability, and advancing sophistication of data-collection practices across European marine and coastal citizen science initiatives.

4.1.2. Geographical scope of the project

Survey question: "Does the project take place in a single country or a broader region?" (Single answer)

A total of 117 initiatives responded to this question. The results show an **almost even division** between projects that operate within **national borders** and those that extend across **multiple regions**:

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- Single-country initiatives: 49%
- Broader-regional or transnational initiatives: 51%

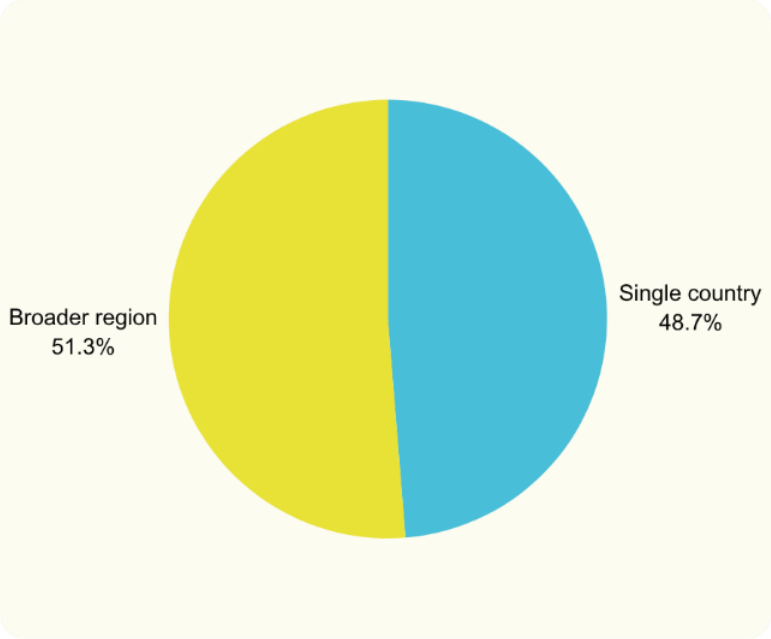

Figure 2. Geographical scope of initiatives. *Pie chart illustrating the near-equal distribution of single-country (48.7%) and broader-regional (51.3%) projects among the 117 survey respondents.*

This balanced distribution confirms that both locally anchored and multinational activities are well represented within the survey. Such diversity provides a valuable basis for later comparisons of data-handling environments operating under different regulatory and institutional frameworks.

4.1.3. Country of operation

Survey question: “In which country does the project take place?”
(Single answer)

This question was addressed to respondents who indicated in the previous item that their initiative operates within a **single national context**. A total of **57 projects** provided a valid country response.

The participating initiatives represent a wide geographical range, encompassing **23 countries** across Europe and neighbouring regions. The highest number of projects were reported from the United Kingdom, possibly reflecting a language bias due to the survey being conducted in English, followed by Spain, France, Italy, and the Netherlands. Additional representation was recorded from Portugal, Belgium, Germany, Greece, Romania, Norway, Denmark, Sweden, Finland, Croatia, Latvia, Ireland, and Malta. A limited number of contributions were also received from Tunisia, Lebanon, and Egypt reflecting collaborations extending beyond the European Union.

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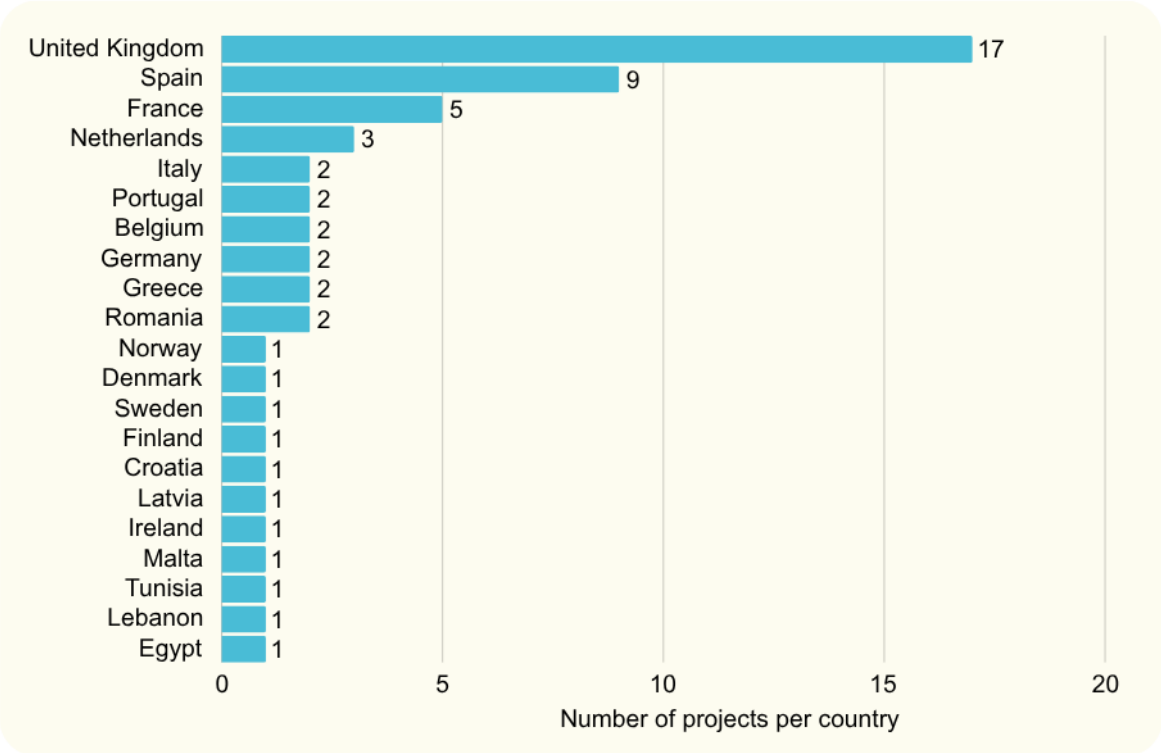

Figure 3. Distribution of initiatives by country. *Horizontal bar chart showing the number of projects per country (n = 57 ; single answer).*

4.1.4. Region of operation

Survey question: “In which region does the project take place?”
(Multiple answers possible)

This question was presented to respondents who indicated that their initiative operates across a **broader region** rather than a single country. A total of **60 projects** provided valid responses. Because multiple options could be selected, the total number of regional mentions exceeds the number of projects.

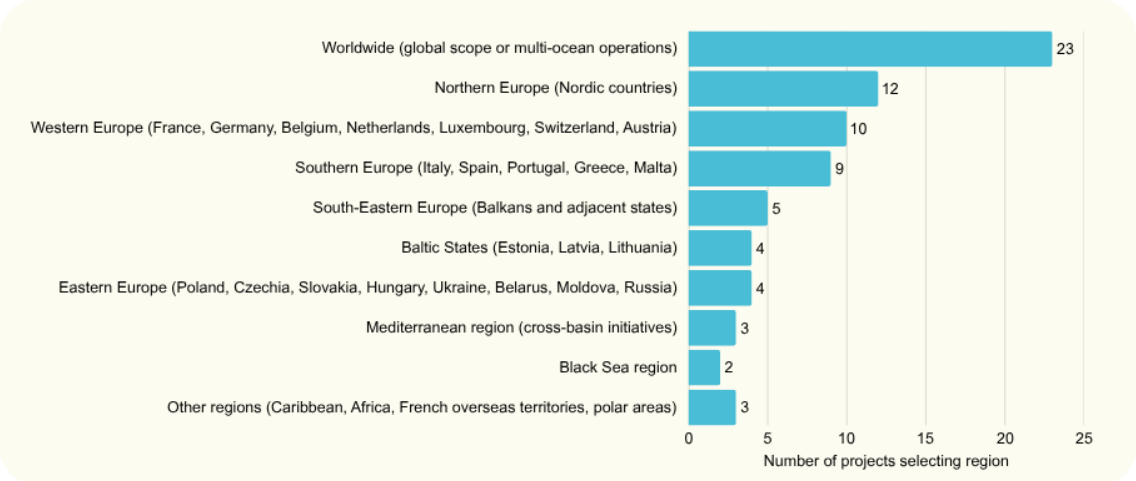

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Figure 4. Regional distribution of broader-region initiatives. *Horizontal bar chart showing the number of broader-region projects per European or global region. (n = 60; 75 total selections; multiple answers possible).*

The responses show that **European-scale and global initiatives** are well represented in the sample. **Over one-third (43%)** of respondents indicated a **worldwide operational scope**, reflecting initiatives that collect observations across multiple ocean basins or in polar regions.

Combinations of Northern, Western, and Southern Europe were also frequently selected, showing that many projects operate across several European marine basins simultaneously. This multi-regional pattern demonstrates that interoperability challenges extend beyond national borders.

4.1.5. Marine regions

Survey question: "In which marine region does the project take place?"
(Multiple answers possible)

A total of 117 projects responded to this question, collectively reporting **288 instances of activity** across 18 marine basins, indicating that many initiatives operate in more than one region.

As shown in Figure 5, the **North Sea** was the **most frequently mentioned** area of activity (36%), followed by the North Atlantic Ocean (including the North-East Atlantic) (31%) and the Mediterranean Sea (general) (25%). Other important sub-regions included the English Channel (17%), Celtic Sea (15%), Baltic Sea (14%), and Western Mediterranean (12%). Around 22% of the total responses referred to worldwide or global ocean coverage, demonstrating the participation of European initiatives in broader ocean observation networks.

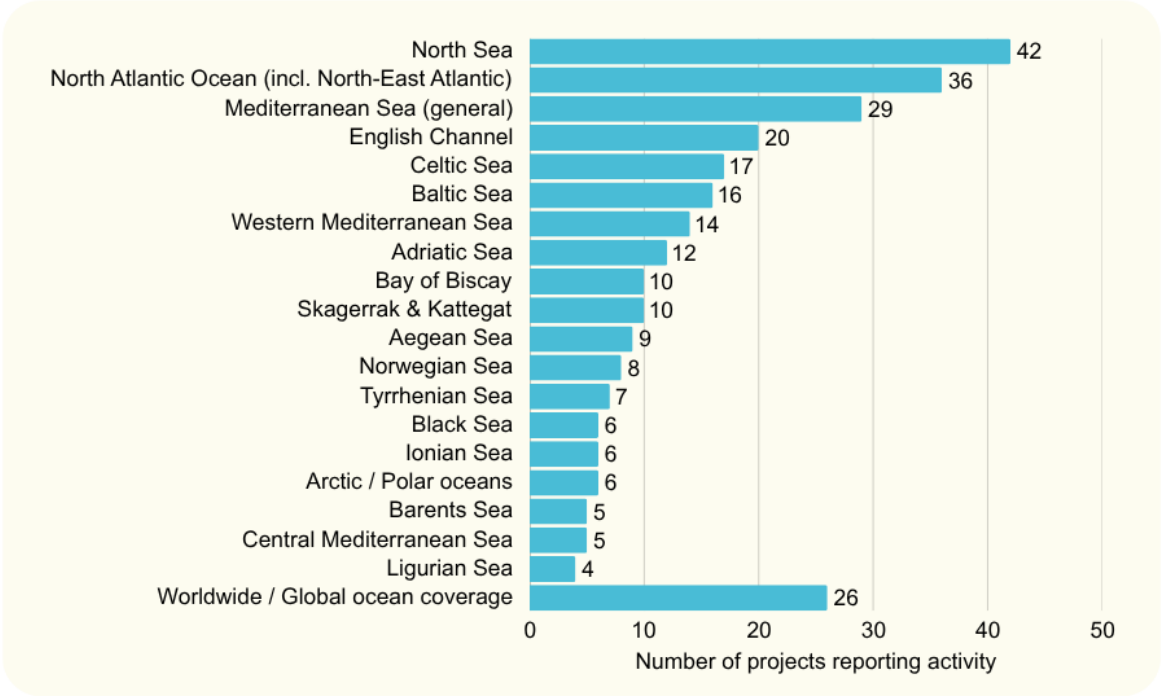

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Figure 5. Distribution of initiatives across marine regions. *Horizontal bar chart showing the number of initiatives reporting activity in each marine region (n = 117; 288 total selections; multiple answers possible).*

When aggregated according to the regional classification used under the **EU Mission "Restore Our Ocean and Waters"**: North Sea–Baltic (≈ 65%), Mediterranean (≈ 66%), Atlantic–Arctic (≈ 63%), and Other (≈ 27%), the distribution appears relatively balanced. However, the North Sea–Baltic and Mediterranean regions together account for roughly half of all reported activity, confirming these as the primary focal areas for marine citizen science in Europe.

Overall, the pattern indicates **broad geographical engagement** combined with regional concentration in Europe's most accessible and heavily monitored marine basins. This distribution reflects both existing research infrastructure and active coastal communities that facilitate citizen science participation.

4.1.6. Project duration

Survey questions:
"What is the start year of the project?"
"What is the end year of the project?"
(Single answer)

A total of 117 projects provided information on their start and end years. The start years range from before 2000 to 2025, with the median start year being 2020, indicating a marked increase in newly established initiatives during the last five years.

Approximately 80% of projects are ongoing, while 20% reported a defined end date between 2020 and 2025. The data suggest two main cohorts within the European marine and coastal citizen science landscape:

- **Established programmes (pre-2015):**

These represent long-term monitoring initiatives, many of which began before 2010 and continue to operate, reflecting stable institutional and community engagement.

- **Recent and emerging initiatives (2018–2025):**

This period constitutes the peak establishment phase, with more than 60% of all initiatives founded between 2018 and 2025. These projects highlight a strong expansion in marine citizen science, driven by increased digitalisation of data collection and a growing policy emphasis on citizen involvement in marine observation frameworks. This dynamic growth has been further supported by EU programmes such as Horizon 2020.

4.1.7. Participant categories

Survey question: "Who are the participants collecting the data in the project?"
(Multiple answers possible)

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Respondents were asked to identify all groups contributing to data collection within their initiatives. This question aimed to clarify the demographic and community composition of the European marine and coastal citizen science landscape

A total of 117 projects responded, with **multiple participant types** often indicated per initiative. The vast majority of projects reported a **combination** of **citizen volunteers**, **students**, and **professionals** contributing to observation and sampling activities

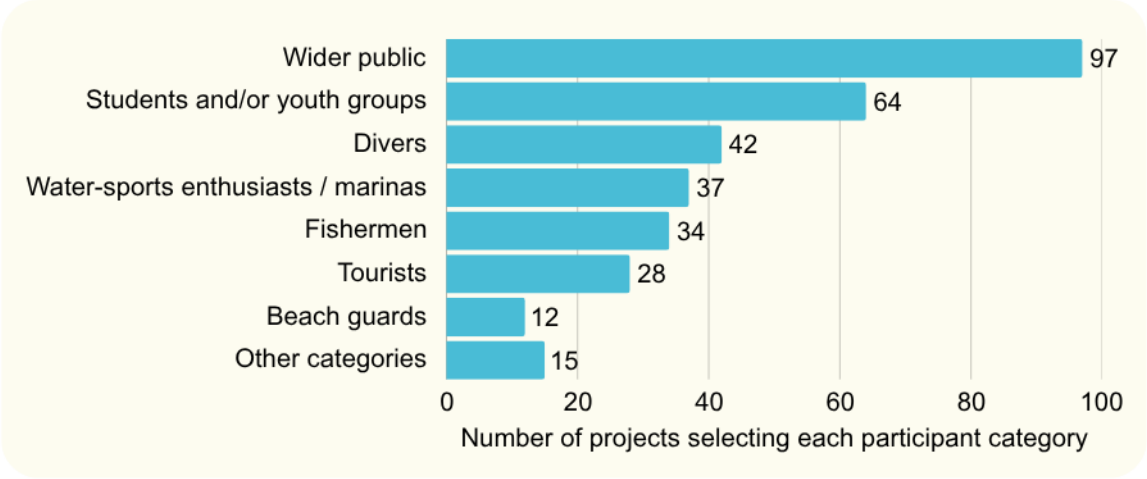

Figure 6. Participant types. *Horizontal bar chart showing the number of projects selecting each participant category (n = 117; 329 total selections; multiple answers possible).*

The data reveal that the **wider public**, selected by 97 projects (83%), constitutes the **backbone of marine and coastal citizen science initiatives**, participating both individually and through organised associations. Students and youth groups (55%) form the second-largest category, underscoring the strong educational dimension of marine citizen science. Specialised participant types such as divers (36%), water-sports enthusiasts (32%), and fishermen (29%) play essential roles in underwater and nearshore monitoring, providing observations that would otherwise be logistically or financially difficult to obtain through institutional programmes.

A smaller yet important share of projects involve professional or institutional actors, such as scientists, staff of a non-governmental organization (NGO), rangers of a marine protected area (MPA), nature guides, and coastal professionals, who support data validation, coordination, and capacity building. This “other participants” (13%) group also includes skilled volunteers and citizen experts (e.g. benthic samplers and amateur naturalists), as well as initiatives engaging social inclusion groups such as persons with disabilities and migrants through participatory frameworks.

Their involvement demonstrates that marine citizen science extends well beyond public volunteering, operating as a multi-stakeholder collaboration that bridges citizens, professionals, and organised civil-society actors. Such diversity contributes not only to the credibility and continuity of data collection but also to the social inclusiveness of the broader marine observation ecosystem.

4.1.8. Scale of participation

Survey question: “What is the approximate number of participants per year?”

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(Single answer)

A total of 117 projects responded to this question, revealing wide variation in the size of participating communities. As shown in Figure 7, participation levels range from small to large-scale programmes.

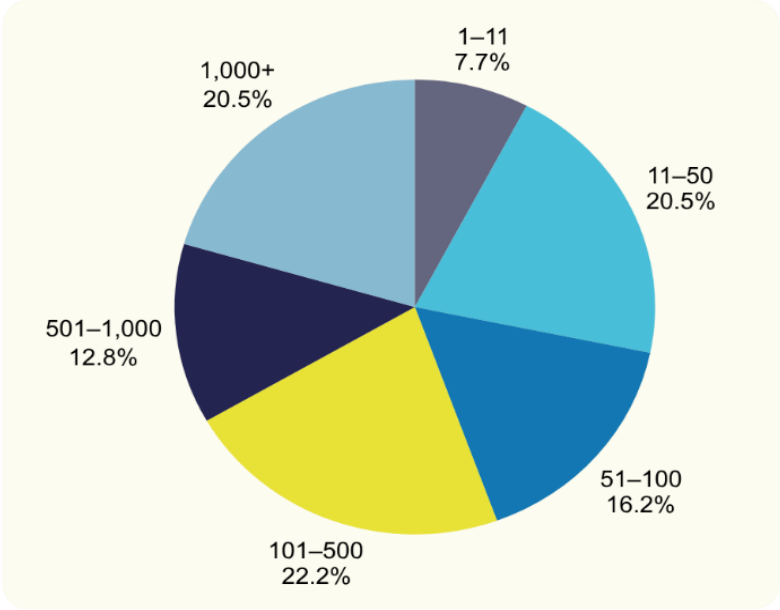

Figure 7. Approximate number of participants per year. *Pie chart showing the percentage of initiatives by annual number of active participants (n = 117; single answer).*

Roughly one-fifth of initiatives (21%) reported having more than 1,000 participants per year, indicating the presence of large, well-established citizen science networks. An equal share (21%) reported 11–50 participants, while 22% involved 101–500 contributors annually. About 16% of projects counted 51–100 active participants, and 13% reached between 501 and 1,000 participants. Only a small fraction (8%) represented very small initiatives with fewer than a dozen volunteers.

Overall, these figures point to a broadly balanced distribution of project sizes rather than a clear bimodal pattern. The majority of initiatives (≈60 %) involve between 11 and 500 participants, forming a strong middle tier of medium-sized efforts that combine community involvement with organised data collection.

4.1.9. Frequency of activities or events

Survey question: “What is the frequency of the activity or event?”
(Single answer)

A total of 117 projects provided responses, revealing diverse temporal patterns in how citizen science activities are organised and implemented across marine and coastal initiatives.

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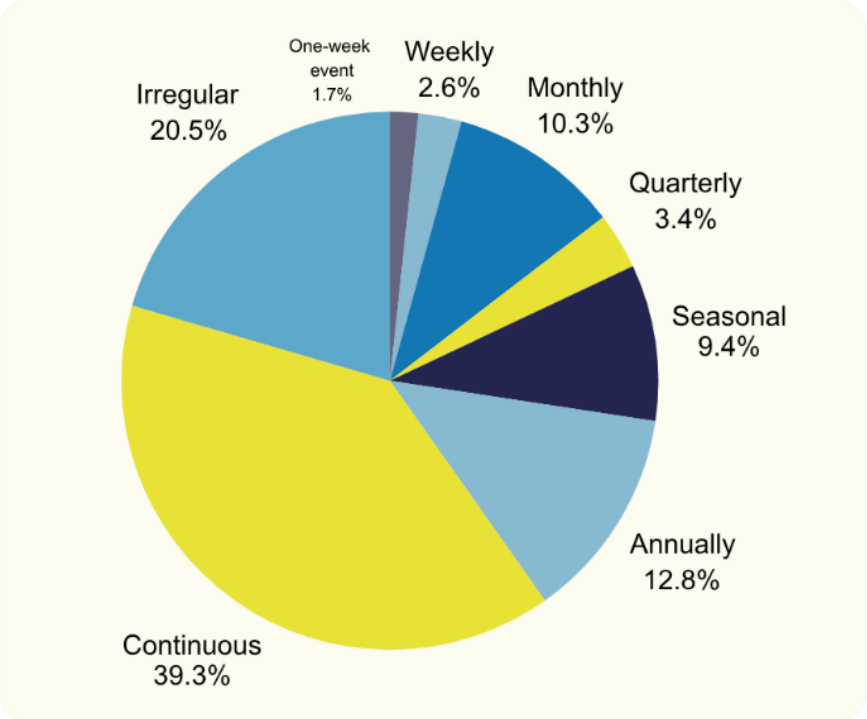

Figure 8. Frequency of activities and events. *Pie chart illustrating the proportion of initiatives by frequency of activity (n = 117; single answer).*

The **majority** of initiatives operate either on a **continuous basis (39%)** or with irregular activity patterns (21%), reflecting the highly flexible nature of marine citizen science engagement.

Roughly one-third of projects follow seasonal, annual, or monthly schedules, typically corresponding to biological or environmental monitoring cycles (e.g. breeding seasons, beach-litter campaigns, phytoplankton sampling). Shorter-term initiatives, such as one-day or weekly events, account for only a small proportion (3%).

4.1.10. Main topics of the projects

Survey question: "What is the main topic of the project?" (Multiple answers possible)

A total of 117 projects responded to this question. Because many initiatives address several aspects of the marine environment simultaneously, respondents were allowed to select multiple thematic areas. The response categories were developed in alignment with the **Essential Ocean Variables (EOVs)** defined by the Global Ocean Observing System (GOOS), ensuring consistency with internationally recognised observation frameworks.

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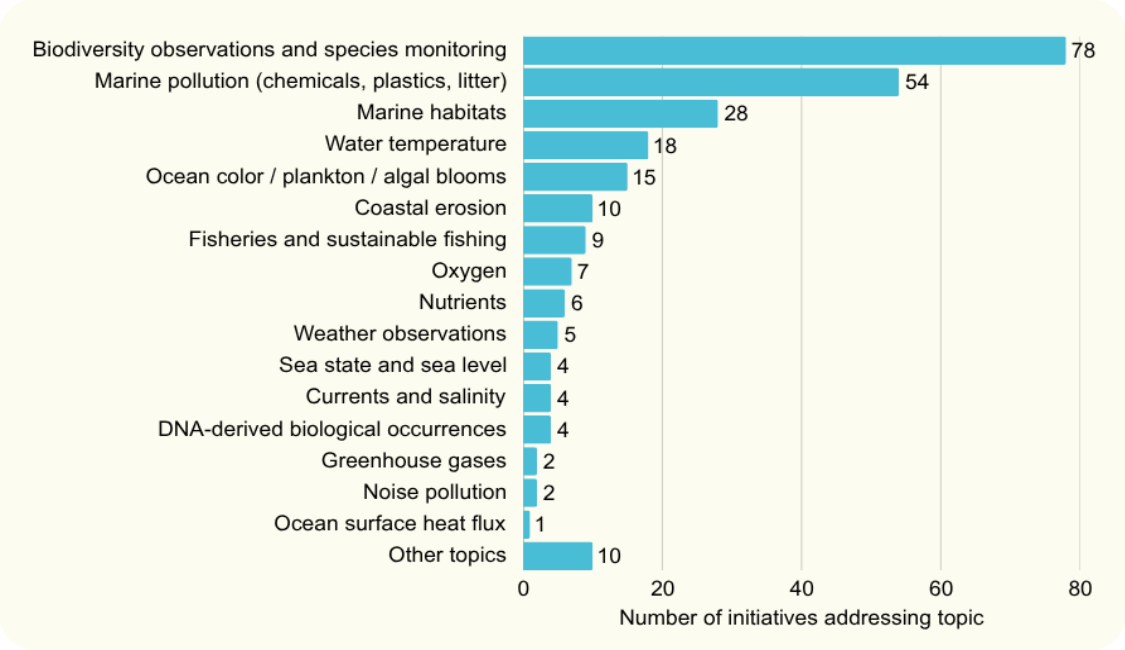

Figure 9. Main project topics. *Horizontal bar chart showing the number of initiatives addressing each main topic (n = 117; 257 total selections; multiple answers possible).*

The results reveal that **marine biodiversity, pollution, and habitat monitoring dominate** the European marine and coastal citizen science landscape, complemented by contributions to physical and chemical ocean observation.

The analysis highlights that biodiversity observations and species monitoring, selected by 78 projects (67%), remains the cornerstone of marine and coastal citizen science in Europe, with two-thirds of all initiatives involved in species identification, population monitoring, or habitat assessment. The strong representation of marine pollution-related projects (46%) underscores the prominence of public engagement in tackling marine litter and chemical contamination, topics that resonate widely with citizens and policy makers alike.

Physical and chemical ocean parameters such as temperature (15%), oxygen (6%), and nutrients (5%) are also monitored by a smaller but significant subset of projects. Finally, a limited number of projects focus on climate and atmospheric processes, such as greenhouse gases and weather observations, or on socio-economic and governance dimensions, reflecting the diversity of approaches within the European marine citizen science landscape.

4.2. Data flow

This section examines how marine and coastal citizen science initiatives currently **manage, store, and disseminate their data**. The results show a community that increasingly recognises the importance of sound data stewardship and is gradually adopting more structured and interoperable practices, while notable variability persists among projects.

Overall, most initiatives report a solid foundation in data management, with a considerable proportion already applying elements of the FAIR principles and standardised methodologies. The widespread use of **cloud-based and hybrid storage** solutions reflects an emerging emphasis on **accessibility, collaboration, and scalability**. At the same time, a

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significant share of projects continues to rely on locally managed or institution-specific storage systems, which poses ongoing challenges for long-term preservation and interoperability.

Progress towards **data standardisation** is also evident. Many initiatives have begun to harmonise their datasets and metadata in accordance with recognised marine and biodiversity data frameworks, such as **EMODnet, GBIF, and EurOBIS**. Nevertheless, disparities remain in the extent of metadata documentation, the openness of data publication practices, and the formal recognition of citizen contributions.

In summary, the current dataflow landscape of European marine and coastal citizen science is characterised by both advancement due to the increased value of citizens collecting data and the use of growing technologies like smartphones and AI and heterogeneity because of varied data quality, challenges in standardizing data and ensuring clear policies for data exist.

4.2.1. Experience with data management

Survey question: "Do you have experience in managing data?"
(Single answer)

A total of 117 projects responded to this question. The results indicate that the majority of marine and coastal citizen science initiatives have a relatively high level of data management experience.

The data show that over two-thirds **(68%)** of initiatives have **direct experience** in managing datasets, suggesting that citizen science practitioners are not merely data collectors but also engage in aspects of curation, storage, and sharing. Another **30%** report having **partial experience.**
Only a very small number **(≈2%)** indicated having **no experience**. Overall, the responses reflect a maturing citizen science landscape in which community-led projects are increasingly aware of the technical and organisational demands of responsible data stewardship.

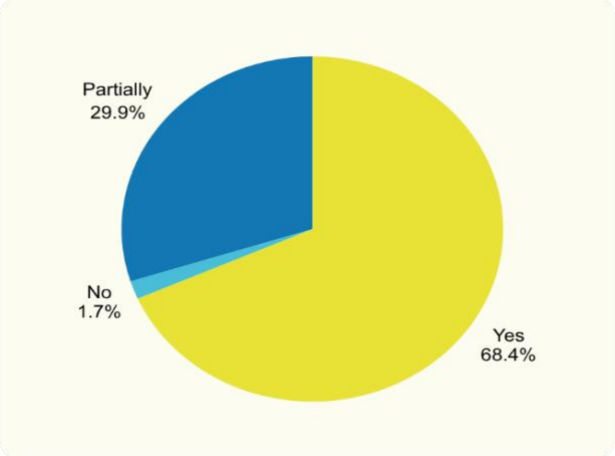

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Figure 10. Experience with data management. *Pie chart showing the proportion of initiatives reporting experience in data management (n = 117; single answer).*

4.2.2. Data storage

Survey question: "Where is the project data stored?"
(Multiple answers possible; responses normalised to 100%)

A total of 117 projects responded to this question. Because multiple answers were possible, respondents could indicate more than one storage environment. To help interpret the results, the three storage categories are defined as follows:

- **Local storage**: data saved directly on personal devices, such as laptops, desktops, smartphones, or external hard drives used by project contributors.
- **Internal storage**: storage environments provided and managed by the institution running the project (e.g. institutional servers, on-premise systems, internal network drives).
- **External storage**: systems hosted outside the institution, such as commercial cloud services (e.g. Google Drive, Dropbox), third-party repositories, or platforms managed by external partners.

The results are presented in two complementary ways:

1. The **pie chart** shows the normalised percentages of all storage configurations, summing to 100%, and thus representing the *relative distribution* of how different storage types and combinations are used across projects.
2. The **bar chart** shows the *absolute number of selections* for each storage category, independent of combinations between options.

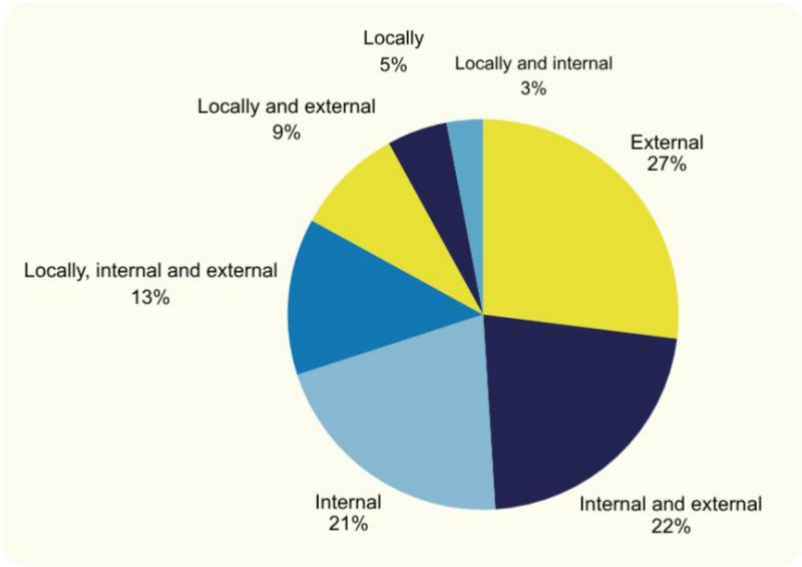

Figure 11. Storage environments used for citizen science data (normalised to 100%). *Pie chart showing the relative distribution of storage configurations among projects (117 respondents; multiple answers possible; normalised to 100%).*

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The results indicate a **heterogeneous landscape of data storage practices** among marine and coastal citizen science initiatives. No single environment is dominant. The most frequent configuration is external/cloud-only storage (27%), followed by internal institutional servers (21%) and combined internal–external systems (22%). Other mixed arrangements include local + internal + external (13%), local + external (9%), and local + internal (3%), while only 5% of projects rely exclusively on local storage.

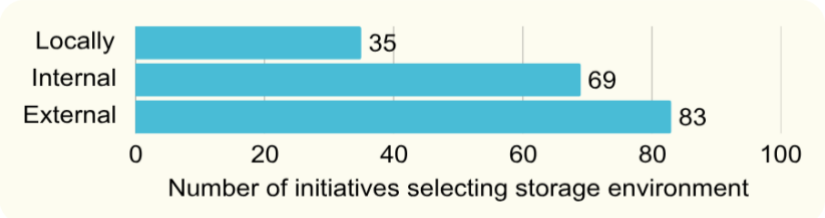

Figure 12. Storage environments used for citizen science data (total selections). *Horizontal bar chart showing the number of initiatives using each type of storage environment (n = 117; 187 total selections; multiple answers possible).*

When looking at the total counts, external storage was selected 83 times, internal storage 69 times, and local storage 35 times. This highlights that external or cloud-based systems are the most prevalent overall, but many projects still combine them with institutional or local solutions.

4.2.3. Standardisation of data and metadata

Survey question: “At this moment, the data of the project are raw, converted or partially converted?”
(Single answer)

A total of 117 projects responded to this question. The results indicate a heterogeneous level of progress in standardising citizen science data and metadata.

As shown in Figure 13, **39%** of initiatives report that their data are already **converted** into a consistent, standard format. Another **33%** indicate that their data are **partially converted**, suggesting that harmonisation efforts are underway but not yet complete.

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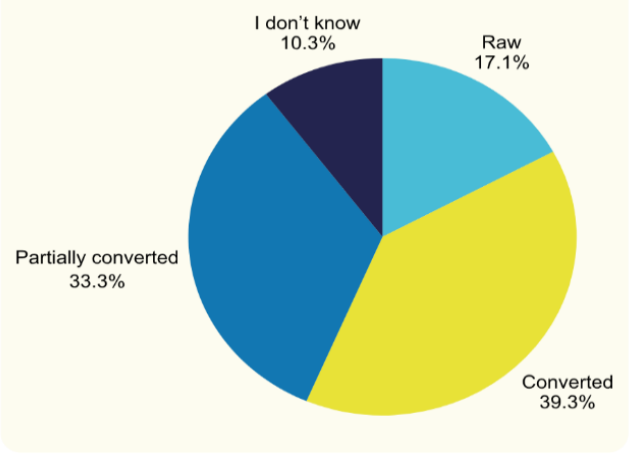

Figure 13. Standardisation status of citizen science data. *Pie chart showing the proportion of initiatives reporting their current data standardisation level (n = 117; single answer).*

These findings show that while a majority of projects (over 70%) have made at least partial progress towards standardisation, a substantial portion still manage non-harmonised or raw data, limiting interoperability with other datasets and infrastructures. The 10% of respondents who were uncertain about their standardisation status likely represent projects without dedicated data management expertise or formalised metadata documentation.

Overall, these results underscore the need for **targeted training and guidance** on data-standardisation workflows and the use of recognised marine data vocabularies to align citizen science outputs with FAIR principles and existing marine data systems.

4.2.4. FAIR awareness

Survey question: "Have you ever heard of the FAIR principles for data management?" (Single answer)

A total of 117 projects responded to this question. The results show that most initiatives are at least familiar with the FAIR principles and actively attempt to apply them.

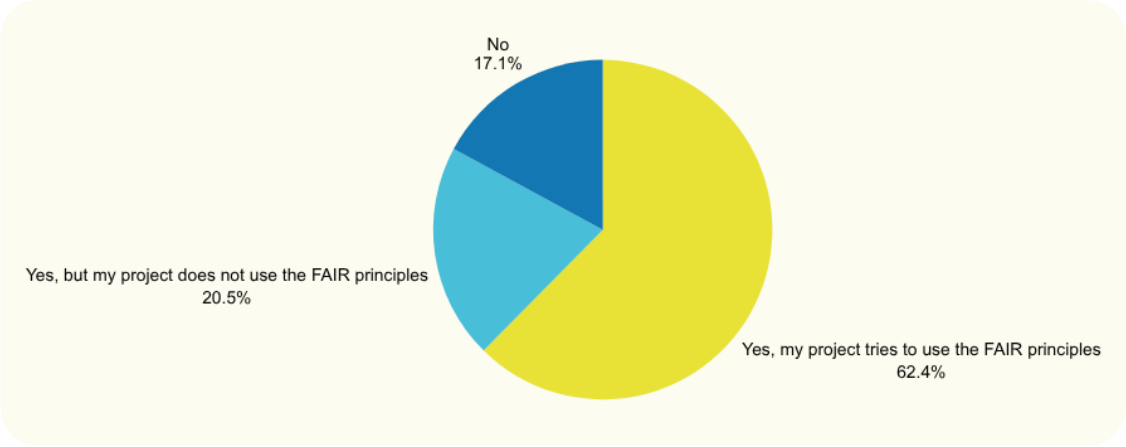

Figure 14. Awareness and application of FAIR principles. *Pie chart showing the proportion of initiatives reporting awareness and application of the FAIR principles (n = 117; single answer).*

The data reveal a **strong awareness** of the **FAIR framework (Findable, Accessible, Interoperable, and Reusable)** across European marine and coastal citizen science initiatives.

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Nearly two-thirds of respondents (62%) actively strive to implement FAIR principles, reflecting a growing culture of responsible and open data management within the community. An additional 20% are aware of FAIR but have not yet adopted the approach, often citing limited technical capacity, infrastructure access, or uncertainty about how to operationalise FAIR in small-scale projects.

Only 17% of projects reported no familiarity with FAIR principles, highlighting a clear opportunity for capacity building and training. These results emphasise that, while awareness is high, implementation remains uneven and would benefit from targeted guidance on metadata standards, repository integration, and open-data workflows.

4.2.5. Use of best practices and standardised protocols

Survey question: "Does the project currently use or document any best practices, standardised methods, protocols, tools, or guidelines for citizen science data collection, management, or sharing?"
(Single answer)

A total of 117 projects responded to this question. Nearly **seven out of ten initiatives (69%)** reported **using or documenting best practices, protocols, or standardised methods**, indicating a widespread awareness of the importance of methodological consistency and data reliability in citizen science workflows. These practices encompass a wide range of approaches, from defined sampling methodologies and structured data-submission formats to alignment with recognised marine observation frameworks.

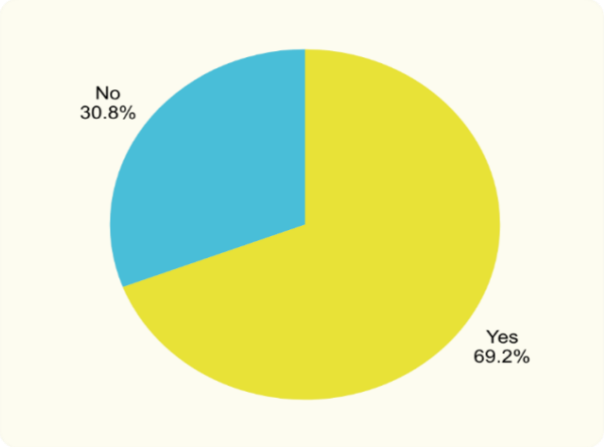

Figure 15. Use of best practices and standardised protocols. *Pie chart showing the proportion of initiatives using or documenting best practices, standardised methods, or protocols (n = 117; single answer).*

Among those that provided further detail, many cited the **use of international standards**, such as the Darwin Core format and the FAIR principles, and integration in bigger data infrastructures (GBIF, EurOBIS, EMODnet). Others adhere to formal guidelines such as the Marine Strategy Framework Directive (MSFD), OSPAR protocols, and the Joint Cetacean Data Protocol (JCDP), demonstrating that citizen science data are increasingly compatible with professional marine and biodiversity monitoring systems.

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Several respondents described the use of custom-developed protocols and tools, such as iNaturalist, MINKA, or bespoke mobile applications featuring fixed geographic zones, photographic validation, and expert review. Others reported structured training materials, species-identification cards, and video tutorials designed to ensure consistent data collection by volunteers.

In addition, a number of projects highlighted national or thematic frameworks, including Plastic Pirates, Artportalen, TurtleWatch Egypt 2.0, and Plages Vivantes, which each provide tailored guidelines for their participant communities. Some respondents also shared links to published protocols and datasets on Zenodo, GitHub, or in peer-reviewed journals, underscoring their commitment to open and reproducible science.

Conversely, around 31% of respondents indicated that they do not yet apply such frameworks. This finding underscores the continued need for shared templates, training materials, and harmonised guidance to ensure that data collected through diverse citizen science efforts can be aggregated and compared effectively across Europe.

Overall, the responses illustrate that methodological standardisation is already well embedded in a large share of marine and coastal citizen science initiatives, but that there remains scope for greater interoperability and capacity-building to consolidate these advances across the broader community.

4.2.6. Data findability

Survey question: "Is the project data findable at this moment?"
(Single answer)

A total of 117 projects responded to this question. Slightly more than half (**56%**) indicated that their data are currently **findable**, while 44% reported that their datasets are not yet discoverable through public or institutional channels.

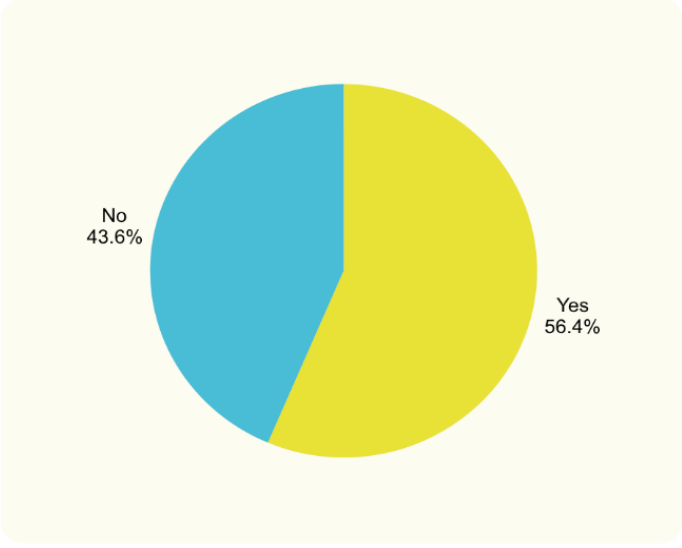

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Figure 16. Data findability. *Pie chart showing the proportion of initiatives reporting whether their project data are currently findable (n = 117; single answer).*

Among the initiatives confirming data findability, the qualitative answers reveal a wide variety of publication environments and visibility mechanisms. Many projects host their datasets on **institutional websites, thematic data portals, or open repositories** such as GBIF, Zenodo, EMODnet, EurOBIS, and PANGAEA. Several others make data accessible through project-specific dashboards or interactive mapping interfaces (e.g. *MarineInfo*, *MINKA*, *Happywhale*, *Eye on Water*, *The Ocean Movement Dashboard*), providing users with visual insights or download options for observation data.

A number of initiatives rely on **national or regional biodiversity databases**, including Artportalen (Sweden), iRecord and NBN Atlas (UK), or the National Biodiversity Data Centre (Ireland), which facilitate data discovery through structured metadata and Darwin Core–compliant records. In other cases, data is integrated into citizen science platforms such as *iNaturalist* or *Observation.org*, ensuring both visibility and standardisation across projects.

Several respondents highlighted that their datasets are findable but with controlled or **partial access**, particularly where sensitive species information or privacy considerations apply. Some projects therefore use metadata truncation, coordinate rounding, or request-based download systems to balance transparency with data protection. Others reported ongoing transitions, such as migrating data to EMODnet, GBIF, or institutional servers, to strengthen findability and interoperability in the near future.

Conversely, the remaining 44% of initiatives reported that their data are not yet discoverable, often because they are in an early developmental phase or rely on internal storage without metadata publication. This gap underscores that, while awareness of the FAIR data principles is relatively high, the "Findable" component remains only partially implemented across the marine and coastal citizen science landscape. To address this, future capacity-building efforts should prioritise training in data-publication workflows, including metadata creation, assignment of persistent identifiers (DOIs), and linking to established open-data infrastructures.

4.2.7. Data accessibility

Survey question: "The data of the project are accessible by…"
(Multiple answers possible; responses normalised to 100%)

A total of 117 projects responded to this question. The vast majority (**73%**) of initiatives make their data **accessible for everyone**, reflecting a strong alignment with open-data principles within the marine and coastal citizen science community. Smaller shares of projects limit access to project partners (11%), their own institute (7%), or both the institute

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and project partners (7%). Only 2% of projects indicated that their data are accessible only to themselves.

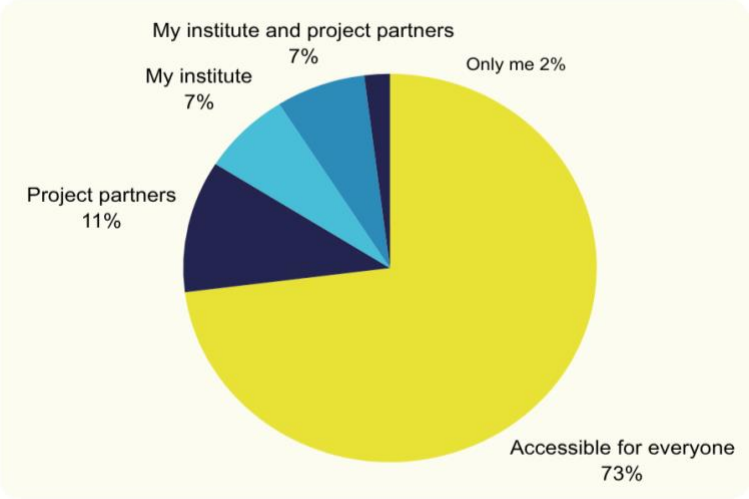

Figure 17. Data accessibility. *Pie chart showing the relative share of data accessibility levels among projects (n = 117; multiple answers possible; normalised to 100%).*

These results show a clear tendency toward openness and public accessibility. Most initiatives embrace transparency and shared access to support collaboration and reuse of citizen science data. However, the presence of restricted and institution-based access in a subset of projects suggests that organisational policies, technical limitations, or ethical considerations still influence data-sharing practices within the community.

4.2.8. Data publication platforms

Survey question: "If the data of the project are already (publicly) accessible, on which platforms are they available?"
(Multiple answers possible)

A total of 117 projects responded: 14% of respondents this question is not (yet) applicable for their project, meaning their data are not yet publicly accessible. This highlights the **transitional stage of data stewardship** within the MCSI community, where many projects are progressing from internal data storage toward open dissemination. When a project dedicated website exists 41% of initiatives already make their data available. However, the data sharing practices do not always align with the FAIR principles in these cases. Some examples are lack of metadata or even non existing, unclear access protocols, not interoperable formats, lack of domain-specific standards and missing or unclear licenses.

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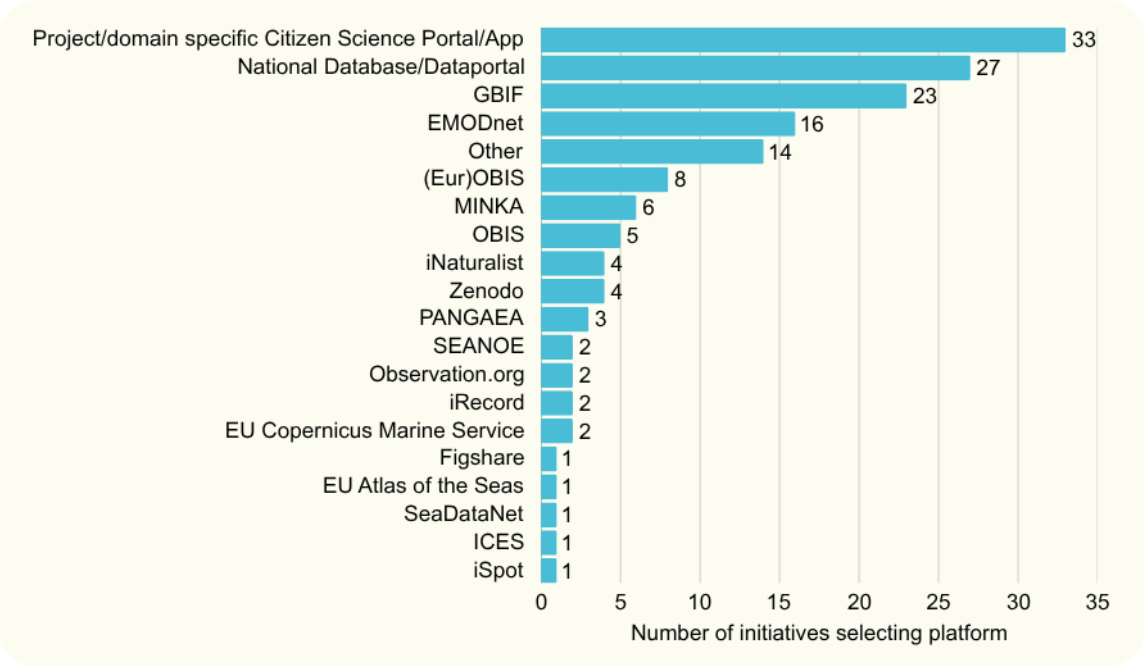

Figure 18. Publication platforms used by projects. *Horizontal bar chart showing the number of initiatives addressing each platform (n = 117; 156 total selections; multiple answers possible).*

The number of citizen-science tools, collaborative platforms and mobile apps facilitates data collection by citizen scientists. A total of 50 respondents (43%) currently use apps or platforms that are dedicated to, or designed for, specific projects or domains (environmental science, biodiversity, public and social sciences). The apps specifically used to monitor the marine and coastal environment are:

- The Shark Trust, Whale Track, Sea Watcher: observations on marine megafauna
- CoastSnap: monitoring changes to coastlines
- Mini Secchi, Secchi, EyeonWater colour: observations on water clarity and colour temperature
- Beach Explorer, Marnoba, EAA Marine LitterWatch, The Ocean Cleanup Survey: observations on marine litter pollution
- Fish & Click: observations of lost or abandoned fishing gear

Next to specific marine apps, citizen science projects frequently use global biodiversity citizen science data platforms such as iNaturalist, Observation.org, iRecord and iSPOT. All research grade observations from these platforms are published in GBIF.

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Notable fractions (5%) reference the MINKA Citizen Science Observatory as their marine data platform. MINKA is a platform acting as a participatory citizen science observatory on biodiversity data. 23% of projects generally store data in their **national databases,** which are made available in **national data portals**.

Looking into publishing biodiversity data in (marine) international data portals and databases, the most frequently mentioned are GBIF (20%), EMODnet (14%) and (Eur)OBIS (7%) underscoring their importance as key nodes for the integration of European marine and coastal citizen science data. Next to these Zenodo and Figshare are used as general data repositories. Also, PANGAEA and SEANOE are used as international oceanographic data portals for storing and sharing datasets. This shows that citizen science data are increasingly connected to established marine and biodiversity data networks.

Last, 3% of projects contribute to EU initiatives (EU Copernicus Marine Service and EU Atlas of the Seas) which provide data about the marine environment.

4.2.9. Tracking and recognition of citizen contributions

Survey question: "Does the project use any form of tracking or recognition to give credit to participating citizens?"
(Multiple answers possible; responses normalised to 100%)

A total of 117 projects responded to this question. Respondents could select more than one option, as some initiatives apply both formal and informal recognition practices. To ensure comparability, results were normalised to 100%, showing the relative share of each recognition type.

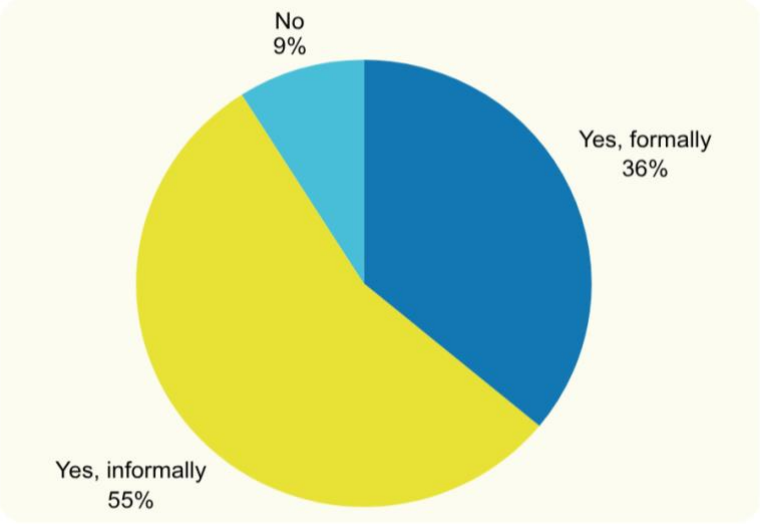

Figure 19. Tracking and recognition of citizen contribution. *Horizontal bar chart showing the proportion of initiatives applying different recognition mechanisms (117 respondents; multiple answers possible; normalised to 100 %).*

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The results reveal that the majority of marine and coastal citizen science initiatives (91%) implement some form of credit or recognition for participants. **Informal recognition** dominates, applied by **around 55%** of projects, typically through thank-you messages, community acknowledgements, or public appreciation via social media or newsletters. **Formal recognition** mechanisms are used by **36%** of initiatives, for instance through authorship, certificates, acknowledgements in publications, or digital tracking systems.

A smaller share of projects (**9%**) report **no formalised recognition system**, often citing anonymisation requirements, privacy regulations, or limited administrative capacity as reasons.

Overall, these findings indicate that recognition of citizen contributions is a widespread but heterogeneous practice within European marine and coastal citizen science. While structured credit systems remain less common, the strong prevalence of informal recognition reflects the social and motivational importance of acknowledging volunteers' efforts and fostering long-term engagement.

4.3. Challenges and training needs in data management

This section explores the main obstacles and capacity gaps encountered by marine and coastal citizen science initiatives (MCSI) in handling their data. Respondents were invited to identify both the challenges that hinder effective, FAIR, and interoperable data management, and the training needs required to overcome these barriers. Together, these results provide a diagnostic overview of the community's current limitations and priorities for capacity-building, serving as a foundation for the targeted actions foreseen in WP2 Deliverable 2.2.

4.3.1. Major challenges in data management

Survey question: "What are currently the project's major challenges in terms of data management?"
(Multiple answers)

A total of 117 projects responded to this question, identifying a wide range of obstacles that affect how MCSI manage their data.

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Figure 20. Major challenges in data management. *Horizontal bar chart showing the number of projects identifying specific challenges in data management (n = 117 respondents; 309 total selections; multiple answers possible).*

By far the most frequently reported barrier is **lack of funds**, cited by **71 projects (61%)**. This confirms that financial constraints remain the single most significant obstacle to sustaining data workflows, from collection to publication. **Limited time availability**, mentioned by **51 respondents (44%)**, follows closely, reflecting the dependence of many initiatives on volunteers or part-time staff who struggle to maintain regular data-management routines.

Other common issues include data-quality and consistency problems (27%), interoperability challenges with external systems (22%), and technical barriers such as insufficient storage or inadequate tools (16%). Together, these highlight the **need for stronger technical infrastructure** and clearer methodological guidance.

Human-capacity constraints are also evident: limited institutional support (20.5 %), lack of data-science expertise (19%), and insufficient training (5%) point to gaps in available skills and support mechanisms. Legal or ethical concerns (11%), including data protection (GDPR) and licensing, were also mentioned by several respondents.

A small number of initiatives noted no major challenges (4%), while unclear roles or responsibilities (3%) were least frequently reported. Overall, these results depict a landscape where financial, temporal, and technical limitations continue to hinder progress toward

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robust and FAIR-aligned data stewardship. Addressing these barriers will require not only targeted funding but also sustained investment in skills development, interoperability, and institutional support.

4.3.2. Training needs in data management

Survey question: "What are the project training needs in terms of data management?" (Multiple answers possible)

A total of 117 projects responded to this question, identifying clear areas where further training is needed to strengthen data-related workflows within MCSI.

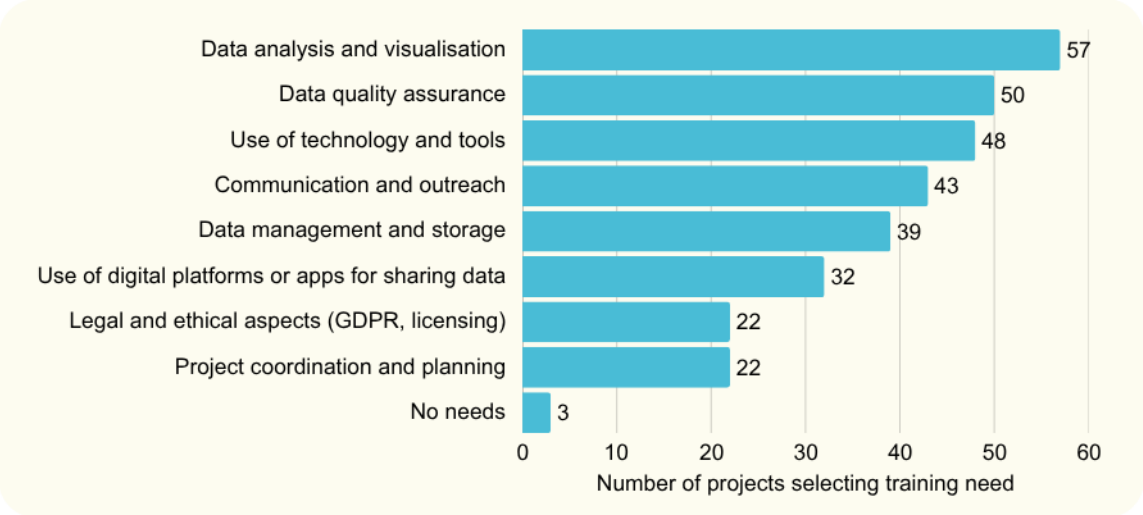

Figure 21. Training needs in data management. *Horizontal bar chart showing the number of projects identifying specific training needs in data management (n = 117; 316 total selections; multiple answers possible).*

The most frequently expressed need concerns **data analysis and visualisation**, selected by **57 projects (49%)**, indicating strong demand for capacity building in transforming raw citizen science data into interpretable and policy-relevant insights. **Data quality assurance (43%)** and **use of technology and tools (41%)** follow closely, underlining the importance of ensuring methodological rigour and technological proficiency across initiatives.

Further training needs are identified in communication and outreach (37%) and data management and storage (33%), reflecting ongoing efforts to professionalise data stewardship and enhance interoperability between systems. Use of digital platforms or apps for sharing data (27%) also features prominently, illustrating the increasing focus on open data and online dissemination practices.

More specific topics, such as legal and ethical aspects (19%) and project coordination and planning (19%), are less frequently cited but remain relevant, particularly for initiatives dealing with cross-border collaboration or sensitive information. Only 3 initiatives (3%) reported no current training needs, suggesting that nearly all respondents recognise the value of further skill development in one or more areas of data management.

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Overall, the findings confirm a community-wide call for practical, hands-on training, especially in data processing, quality control, and digital tool usage, complemented by growing attention to communication and ethical data handling within the European marine and coastal citizen science landscape.

4.4. Engagement

A total of 117 projects responded to the questions on engagement and willingness to collaborate within the marine and coastal citizen science community.

The results reveal **a remarkably high level of interest in networked collaboration and communication** across the surveyed initiatives. An overwhelming 93% of respondents expressed interest in joining an informal marine citizen science data network, while 92% indicated they would like to participate in joint online or physical events with other project coordinators, data managers, and technology developers. Similarly, over 90% of projects wish to receive the CS-MACH1 newsletter, and 87% are open to having their project featured through CS-MACH1's communication channels.

When asked about future collaboration and follow-up, 69% of respondents agreed to take part in a one-hour follow-up interview, showing a strong willingness to contribute more in-depth insights. Among those using sensors or other data-collection technologies, 54% consented to being contacted for more technical discussions, while 43% marked this as not applicable to their work.

These findings collectively demonstrate broad enthusiasm for cooperation, visibility, and knowledge exchange within the European marine citizen science community. They provide a solid foundation for establishing a community of practice under WP2, supporting sustained dialogue, capacity building, and coordinated data management improvement across initiatives.

4.5. Feedback and consent

The closing section invited participants to share open feedback, suggestions, or further comments on the survey and its broader objectives. Responses reveal a high degree of engagement and constructive reflection among the participating initiatives.

Several respondents **expressed appreciation** for the initiative, describing it as timely, relevant, and valuable for strengthening collaboration within the marine citizen science community. Many projects indicated a strong willingness to stay informed about upcoming developments, to participate in future activities, or to contribute to the emerging network.

Feedback also pointed to **practical and structural challenges** faced by initiatives. Respondents highlighted persistent limitations in **funding, time, and personnel**, as well as specific needs for **communication and outreach support**, particularly to engage broader

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audiences such as tourists and local communities. Others noted technical and organisational barriers, such as maintaining data quality, ensuring interoperability, and finding sustainable hosting or data management solutions suited to citizen science contexts.

Several contributions offered thoughtful suggestions for the future direction of the CS-MACH1 network. These included calls for more thematic focus areas (e.g. marine biodiversity or marine litter), translation of key materials, and dedicated capacity-building efforts tailored to varying levels of expertise. Some respondents shared detailed project experiences or ongoing innovations, from school-based monitoring systems to sophisticated cloud-based architectures, underscoring the diversity and creativity within the community.

Finally, multiple projects expressed explicit interest in future collaboration, joint funding applications, and knowledge exchange under the CS-MACH1 umbrella. Collectively, this feedback confirms both the enthusiasm and the readiness of the European marine citizen science community to move toward greater coordination, mutual support, and shared learning in the coming phases of WP2.

5. Qualitative interviews structure

This chapter provides an overview of the structure and internal logic of the WP2 interview instrument.

To complement the findings of the survey, a series of semi-structured interviews was conducted with representatives of marine and coastal citizen science initiatives (MCSI). The interviews aimed to obtain a deeper qualitative understanding of current practices related to data collection, management, validation, and sharing in citizen science projects.

The interview guide was developed by VLIZ and designed as a semi-structured conversation format. This structure allowed the interviewers to ensure comparability across interviews while also leaving space for respondents to elaborate on their experiences and context-specific practices.

The interview instrument is composed of five thematic sections focusing on different stages of the citizen science data lifecycle, followed by a block addressing challenges, needs, and training requirements.

A total of ten semi-structured interviews were conducted with the following initiatives:

1. BioMARathon | biomarato.org
2. Citizens of Surf | ecopdecade.org/citizensofsurf
3. Explore Your Shore! | exploreyourshore.ie
4. FVON | fvon.org
5. Plastic Pirates - Go Europe! | plastic-pirates.eu
6. Sailing4Science | sailing4science.org

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7. Sandwatch | sandwatchfoundation.org
8. SeaWatch-B | citizen-science.vliz.be/strandobservatienetwerk
9. Turtle Watch Egypt 2.0 | turtlewatchegypt.net
10. Water Rangers | data.waterrangers.com/

5.1. General characteristics of the initiative

Purpose

This section provides contextual background information about the interviewee and their citizen science initiative. These introductory questions help situate the subsequent discussion of data management practices within the organisational and thematic context of the project.

Topics covered

- Role and background of the interviewee within the citizen science project.
- Overview of the project's objectives and scope.
- General description of the initiative and its activities.

Expected insights

Basic contextual information about the interviewed initiatives and their coordinators.

5.2. Data collection practices

Purpose

This section explores how citizen science data are collected within the initiative and which tools, protocols, and procedures are used to guide participants in collecting observations or samples.

Topics covered

- Data collection methods and tools used by citizen scientists (e.g. mobile applications, sensors, sampling equipment, manual observations).
- Protocols and guidelines provided to participants.
- Training activities or instructional materials for participants.
- Field supervision by scientists or experienced volunteers.
- Calibration procedures for sensors when applicable.
- Types of data collected (e.g. images, numerical observations, qualitative observations, sensor readings).
- Handling of raw data after collection (automatic data transfer, manual upload, or submission of samples).
- Level of interpretation or calculations required from citizen scientists.

Expected insights

Insights into how data are collected within citizen science initiatives, including the level of standardization, participant support, and quality assurance measures, as well as the tools

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(traditional sampling vs digital alternatives) and protocols used. This helps assess the reliability, consistency, and scientific robustness of the collected data.

5.3. Data management and FAIR awareness

Purpose

To investigate how citizen science initiatives manage their data and to assess their familiarity with key concepts in research data management such as Data Management Plans (DMP) and the FAIR principles.

Topics covered

- Awareness of Data Management Plans (DMP).
- Existence of a DMP within the project.
- Tools or templates used to develop a DMP.
- Accessibility of the DMP (public or internal).
- Awareness of the FAIR principles.
- Implementation of FAIR-related practices within the project.
- Perceived usability of the data for different end users such as scientists, policy makers, or the public.

Expected insights

Insights into the level of maturity of research data management practices within citizen science initiatives and their awareness of FAIR data principles.

5.4. Data validation and quality control

Purpose

To understand how citizen science initiatives ensure the reliability and scientific usability of the data collected by volunteers.

Topics covered

- Data quality assurance procedures.
- Role of citizens, trained volunteers, scientists, or automated tools in validating data.
- Use of software, applications, or expert review for data validation.

Expected insights

An overview of the mechanisms used by citizen science initiatives to ensure the quality and credibility of citizen-generated data.

5.5. Bottom-up perspectives on an ideal MCSI information platform

Purpose

To explore the needs and expectations of citizen science initiatives regarding a potential information platform supporting citizen science data flows and data management.

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Topics covered

- Desired information topics on a potential information platform for marine citizen science data flows.
- Essential functionalities or tools that such an information platform should provide.
- Perceived added value of an information platform for citizen science initiatives.
- Examples of existing portals that could serve as inspiration.
- Interest in information on sensors, training materials, existing projects, and connections to data infrastructures (e.g. OBIS, GBIF, EMODnet).

Expected insights

Identification of potential requirements for an information platform on CS data flows that supports better data management, knowledge exchange, and integration with marine data infrastructures.

5.6. Challenges and training needs for improved data flow

Purpose

To identify the main challenges faced by citizen science initiatives in managing and sharing their data and to determine their capacity-building needs.

Topics covered

- Challenges related to data collection, sensor calibration, data quality control, FAIR implementation, and data sharing.
- Assessment of the most critical challenges encountered by the project.
- Impact of these challenges on project operations.
- Evolution of challenges over time.
- Training needs related to citizen science data management.
- Preferred training formats (online training, in-person workshops, or documented guidance).
- Preferred training modalities (one-off events or self-paced courses).

Expected insights

A qualitative understanding of the key barriers that citizen science initiatives encounter in implementing effective data management practices and the types of training and support that would best address these needs.

6. Results of the interviews

The results are presented according to the six thematic sections of the interview guide.

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6.1. General characteristics of the initiatives

The ten interviews cover a diverse set of marine and coastal citizen science initiatives, differing in thematic focus, geographical scope, and organisational setup.

The initiatives address a wide range of topics, including:

- biodiversity monitoring (e.g. BioMARathon, Explore Your Shore!, SeaWatch-B)
- water quality monitoring (e.g. Water Rangers)
- marine litter (e.g. Plastic Pirates - Go Europe! , SeaWatch-B)
- coastal and beach monitoring (e.g. Sandwatch, Citizens of Surf)
- species-focused conservation (e.g. Turtle Watch Egypt 2.0)
- multi-parameter environmental observations at sea (e.g. Sailing4Science, FVON)

They also differ in scale and structure. Some initiatives are embedded in larger research or institutional contexts, while others operate as smaller, community-driven or volunteer-based projects.

Across all interviews, initiatives typically combine **data collection objectives** with broader goals such as:

- raising awareness
- supporting education or ocean literacy
- informing conservation or local decision-making

Quotes from the interviews

"Our main objective is to collect essential data about marine turtles in the Egyptian Red Sea."

"We support community-based water monitoring... so groups can collect data about water quality."

"There are really two main sides to it. One is educational... the second is more scientific."

"Fishing vessel-based ocean observing represents the largest latent source of ocean data."

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6.2. Data collection practices

SUMMARY

Overall, data collection in marine citizen science is characterised by a continuous balance between scientific robustness and participant accessibility. Projects that successfully sustain participation tend to prioritise simplicity, clear protocols, and practical usability, while adapting methods to their specific context and target group.

Key findings

- Projects use a wide range of methods, from **simple observations and images** to **structured protocols and measurement tools**.
- Simplicity is often a deliberate choice to **lower barriers to participation**.
- **Training and guidance** are essential, especially for more complex data collection tasks.
- Data collection approaches are designed to be **accessible and adaptable** to different participant groups with different levels of science literacy.

Main patterns

A central finding across the interviews is that data collection methods are strongly shaped by the need to engage participants without overburdening them. Many initiatives deliberately design their workflows so that participants can contribute using tools they already have or can easily learn to use.

Several biodiversity-focused projects rely primarily on photo-based observations, allowing participants to document species without needing prior expertise. This approach enables broad participation while shifting more complex tasks, such as species identification, to experts or AI and machine learning methods at a later stage.

Other initiatives use **simple, standardised field protocols**, often supported by low-cost equipment such as measuring tools or water quality kits. These approaches provide more structured data, while still remaining accessible to non-experts.

More advanced setups also exist, where data collection is embedded in professional or semi-professional activities, or supported by dedicated equipment. However, even in these cases, there is a strong preference for tools that are easy to deploy and do not interfere with normal activities.

Across all approaches, a key design principle emerges: **the easier it is to participate, the more sustainable the data collection effort becomes**. At the same time, increasing complexity requires **additional training, support, and coordination.**

Common approaches to data collection

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Across the interviews, three broad approaches can be identified:

- **Observation-based contributions**
  Participants collect data through photos, videos, or simple observations, often without specialised equipment.
- **Protocol-based fieldwork**
  Participants follow structured guidelines using basic tools or kits to collect comparable data.
- **Instrument-supported measurements**
  Data is collected using sensors or more advanced devices, sometimes integrated into existing professional activities.

These approaches are not mutually exclusive, and several initiatives combine them depending on context and target groups.

Quotes from the interviews

"The only thing we ask for is photos of biodiversity."

"The most important thing is how easy and hands-off these systems are... you kind of set it and forget it."

"One big challenge is people being unfamiliar with species... more rigorous protocols were deterring people."

"We simplified because we needed to meet users where they are."

"We want people to be involved in the data collection and interpretation... so they can confirm right away: this looks right, this doesn't."

"Ideally, sensors should be easy to tow behind the boat, dip into the water, or attach without interfering with sailing."

6.3. Data management and FAIR awareness

SUMMARY

Overall, the interviews show that while many initiatives are committed to making their data useful and reusable, data management remains a key bottleneck. The main issue is not a lack of awareness, but the difficulty of translating FAIR principles into operational workflows within the constraints of time, resources, expertise, and in some cases data governance requirements.

Key findings

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- Data management practices vary significantly across initiatives.
- Some projects are supported by **established platforms or institutional infrastructures**, while others rely on **local, project-based solutions**.
- Awareness of FAIR principles is generally present, but **implementation remains uneven**.
- The main challenge is not awareness, but the **translation of principles into practical workflows**.

Main patterns

A clear pattern emerging from the interviews is that data management capacity depends strongly on access to expertise, infrastructure, and time.

Several initiatives operate with **relatively structured data workflows**. These projects typically benefit from dedicated platforms, internal expertise, or collaboration with data infrastructures. In such cases, data are stored in standardised formats, accompanied by metadata, and in some cases shared with larger repositories or data portals.

At the same time, other initiatives rely on more **lightweight or decentralised approaches**, where data is stored locally, shared upon request, or managed through simpler systems. These approaches often reflect practical constraints rather than a lack of interest in data sharing.

Across both groups, **FAIR principles are generally recognised as important**. However, many interviewees highlighted that applying these principles in practice is complex. Challenges include understanding standards, preparing data for publication, ensuring interoperability, and dealing with legal or organisational constraints.

In several cases, projects already implement elements of FAIR, such as making data accessible or reusable, without formally framing their approach in those terms.

Key challenges in practice

Across the interviews, several recurring challenges related to data management were identified:

- **Lack of dedicated data expertise** within the project team.
- **Limited time and resources** to organise and publish data.
- Difficulty translating **FAIR principles into concrete steps.**
- Challenges with **data storage, backup, and long-term preservation.**
- Legal or organisational constraints related to **data ownership and sharing.**

Quotes from the interviews

“We’re lucky in that sense: the platform does a lot of the work.”

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"Everything we collect is open access... and published through existing biodiversity platforms."

"I thought that building our web-based application meant we were making our data open and FAIR, but I now realise we're not fully there yet."

"We don't have a proper online backup... most is on a hard drive, which isn't enough."

"We do a ton of data management... metadata, quality control, data serving... that's more than half of what we do."

"We wanted to make sure that community-based water monitoring data could be seen and reused."

6.4. Data validation and quality control

SUMMARY

Validation plays a decisive role in determining whether citizen science data can be reliably used by scientists, policymakers, or other stakeholders. While current approaches often ensure high data quality, they also create significant bottlenecks. Improving validation workflows, through better protocols, training, and selective automation, remains a key challenge for many initiatives.

Key findings

- Data validation is a **central and often resource-intensive step** in citizen science workflows.
- Most initiatives rely on **expert-based validation**, especially for biodiversity data.
- Automated quality control is emerging, but remains **limited to specific data types and platforms**.
- Validation capacity is a key factor influencing **data usability and scalability**.

Main patterns

Across the interviews, validation is consistently identified as one of the most critical and challenging parts of the data workflow. While data collection can often be scaled through citizen participation, validation typically depends on limited expert capacity.

For biodiversity-focused initiatives, validation is usually based on **manual review of submitted observations**, particularly images. Experts verify species identification and assess data quality, often in direct interaction with participants. While this ensures a high level of reliability, it is also time-consuming and difficult to scale.

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Other initiatives apply **validation of measurements** which are already structured in a **fixed** and **standardized** format (such as output of sensor readings). In these cases, quality control focuses on checking completeness, consistency, and plausibility of the data.

A smaller number of initiatives have implemented **automated quality assurance systems**, where data are flagged based on predefined thresholds or expected ranges. These systems can support validation processes, but do not replace the need for human oversight.

The interviews also revealed important differences in validation capacity between initiatives. Smaller or community-driven projects with limited funding often lack dedicated data scientists or technical staff, making them more dependent on external expertise, simplified workflows, or additional support for quality control. In contrast, larger or institutionally embedded initiatives are generally more likely to have access to specialised personnel, technical infrastructure, and established validation procedures, allowing them to implement more structured and scalable quality control workflows.

Across all approaches, validation is not a single step at the end of the process. Instead, it is closely linked to how protocols are designed, how participants are trained, and how data are submitted. Simpler protocols and clearer guidance can significantly reduce the validation burden.

Common validation approaches

The interviews highlight three main approaches to validation:

- **Expert-based validation**
  Manual review of observations, often supported by images or additional context.
- **Protocol-based quality checks**
  Validation of structured datasets based on completeness, consistency, and adherence to protocols.
- **Automated quality assurance**
  System-based checks that flag unusual or implausible values for further review.

In practice, many initiatives combine these approaches.

Quotes from the interviews

"Data validation is time-consuming."

"We're always short of experts... there are too few taxonomists in the world."

"The citizens collect the data and then it gets validated by experts in the different countries."

"Quality control is applied going out, not going in... all raw data is stored so we can always redo the quality control."

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"Validation is done by scientists... based on photos and in dialogue with our volunteers."

"The photo-ID processing is extremely slow. Doing everything manually shouldn't be the model."

6.5. Bottom-up perspectives on an ideal MCSI information platform

SUMMARY

Interviewees described an ideal marine and coastal citizen science information platform primarily as a support and coordination tool rather than a centralised data repository. They particularly highlighted the need for practical guidance on data collection, validation, sharing, and FAIR data practices, alongside improved visibility and networking opportunities for existing initiatives.

Key findings

- Interviewees primarily viewed a citizen science information platform as a **support and coordination tool** rather than as a **centralised data repository**.
- A strong need was expressed for greater **visibility and discoverability** of marine and coastal citizen science initiatives.
- Respondents highlighted the importance of **practical and accessible guidance**, including concrete examples, workflows, protocols, and step-by-step explanations.
- Many interviewees emphasised the value of **networking opportunities** and access to experts, peer initiatives, and support contacts.
- Support needs were identified across the **full project lifecycle**, including project design, data collection, validation, participant engagement, and data sharing.

Main patterns

Although the development of an information platform is not **the primary aim of this project**, interview participants were asked to reflect on what an "ideal" platform for marine and coastal citizen science initiatives would look like. The responses provide useful insights for the development of the project roadmap in terms of guidance and trainings and for the development of D2.3 under Task 2.2 in terms of finding information on the data management and sharing of other MCSI.

Across the interviews, respondents consistently described the value of a platform in terms of **reducing fragmentation** and helping projects navigate existing resources, expertise, and practices. Rather than functioning as a new standalone system, the envisioned platform was

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seen as a place where initiatives could more easily find **information, examples, contacts, and relevant support**.

A recurring theme was the need for improved discoverability of existing initiatives. Interviewees expressed interest in a **searchable overview** of marine and coastal citizen science projects that would allow users to identify similar initiatives, methodologies, geographic areas, or thematic focuses.

Another major expectation concerned access to **practical guidance**. Interviewees referred to the need for concrete and experience-based resources such as protocols, workflows, templates, examples, and step-by-step explanations. Several respondents specifically mentioned "cookbooks" or flowcharts that explain how data moves from collection to publication.

Accessibility and clarity were also highlighted repeatedly. Interviewees noted that concepts related to data standards, FAIR principles, and repositories are often difficult to interpret for coordinators without a technical background. As a result, respondents stressed the importance of understandable and accessible explanations.

In addition, many interviewees emphasised the importance of **human interaction and networking**. Access to experts, peer initiatives, and support contacts was described as valuable for addressing practical questions and exchanging experiences. Several respondents also highlighted the importance of **community building and collaboration** within the broader citizen science landscape.

Quotes from the interviews

"I think having a directory of other projects in one place will be super helpful."

"Information about existing projects is really important... so they don't have to reinvent things."

"The greatest value of a network is that people doing the same thing can connect and share ideas."

"There is just a big opportunity to kind of set up cookbooks or flowcharts of outlining, okay, this goes here, that goes there."

"What parameters are relevant in a given context? Which tools are meaningful and fit for purpose?"

"You'd want summaries of data collections and links... a central place to discover similar groups."

"We need clear explanations in accessible language, not only IT or data-management jargon."

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"Examples of engagement strategies would be valuable, what worked, in what context."

"Short feedback lines, someone who can guide you step by step, would help a lot."

"It's not just about collecting data... it's about belonging to a place and a community."

6.6. Challenges and training needs for improved data flow

SUMMARY

The interviews highlight that improving citizen science data practices requires more than technical solutions. The main barriers are related to capacity, continuity, and support structures. Addressing these challenges will require not only training, but also sustained investment in validation processes, data management expertise, and long-term infrastructure.

Key findings

- Challenges are primarily **structural rather than technical**, often linked to limited time, funding, and capacity.
- Data validation and data management are the most frequently cited bottlenecks.
- Many initiatives lack **dedicated data expertise**, even when data collection is well established.
- Training is most effective when it is **practical, accessible, and directly applicable to project workflows**.
- Several initiatives require not only training, but also **ongoing support and guidance**.

Main patterns

Across the interviews, a consistent picture emerges: while data collection is often successfully established, the steps that follow, validation, management, and publication, remain significantly more challenging.

One of the most prominent challenges is the **time and expertise required for validation**. Many initiatives depend on a small number of experts to review data, particularly for biodiversity observations. This creates bottlenecks that can delay or limit the usability of the data.

A second key issue is the **lack of structural capacity for data management**. Even when initiatives recognise the importance of FAIR principles and data publication, they often lack the resources or expertise to implement these practices consistently. In many cases, data management tasks are added on top of existing responsibilities rather than being supported as a core activity.

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Funding constraints further reinforce these challenges. Several interviewees noted that while funding may be available for launching new activities, it is much harder to secure support for ongoing tasks such as data maintenance, validation, and storage.

In addition, some initiatives face challenges related to **infrastructure and tools**, including data storage, backup, and platform limitations. Others highlighted difficulties in translating theoretical concepts, such as FAIR principles, into practical workflows.

Training and support needs

Interviewees expressed a clear preference for training that is:

- **Practical and hands-on**, rather than purely theoretical.
- Tailored to **specific data types and project contexts.**
- Based on **real examples and workflows.**
- Supported by **documentation and follow-up opportunities.**

Importantly, several respondents emphasised that training alone is not sufficient. There is a need for **accessible support mechanisms**, such as contact points or guidance services, to assist with challenges as they arise.

Quotes from the interviews

"Keeping a data management plan updated… keeping it alive as a working document is something I struggle with."

"We're kind of at the stage where we're asking: what's the whole point, and what happens next?"

"What tends to happen is people collect data for years and then suddenly realise they have a huge backlog and no idea what to do with it."

"What experts mentioned several times is that validation is very time-consuming."

"Our biggest issue is hands-on support… our major hurdle is money, money and time."

"The 'making data open' step isn't structurally embedded in the project."

"We don't have a proper online backup… most of the data is on a hard drive, which isn't enough."

"When you apply for funding, people want new projects… it's much harder to get funding for maintenance and storage."

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7. Conclusion

This deliverable provides a structured assessment of how marine and coastal citizen science initiatives (MCSI) across Europe and neighbouring countries currently acquire, manage, validate, and share their data. Based on a Europe-wide survey of 117 initiatives and 10 in-depth interviews, the findings confirm that MCSI form a highly diverse and increasingly mature data-generating community, with clear potential to contribute to European marine knowledge systems. At the same time, this potential is not yet fully realised because data management practices remain heterogeneous and are often constrained by limited financial and personal resources, technical capacity, and uneven integration with established data infrastructures.

An important strength of this study is the **mixed-methods approach**, which combined quantitative survey data with qualitative interview insights. The survey component provided a broad and structured overview of current practices across a large and geographically diverse group of initiatives, allowing patterns, trends, and recurring challenges to be identified at European scale. The 10 interviewees were selected from among the 117 survey respondents based on their responses and to ensure representation across different domains, disciplines, and types of citizen science initiatives. This targeted selection strengthened the qualitative complementarity of the study by enabling a deeper exploration of specific practices and contexts. The interviews provided valuable insights into how and why data management approaches are implemented in practice, complementing the broader survey findings. Together, both methods allowed not only the identification of common trends, but also a better understanding of the organisational, technical, and social factors shaping data stewardship within citizen science initiatives. The mixed-methods approach proved particularly valuable in distinguishing between formal data-management ambitions and the practical realities faced by projects operating with limited time, expertise, and resources.

The results show that the diversity of data management practices within MCSI is substantial. Initiatives differ widely in scale, thematic focus, geographical scope, participant profile, technologies used, and level of data management maturity. Some projects operate as long-standing monitoring programmes embedded in institutional infrastructures, while others are smaller, community-driven initiatives with lighter and more flexible workflows. Data collection ranges from simple photo-based observations and manual field protocols to sensor-supported measurements, mobile applications, GPS-based mapping, eDNA kits, and other digital tools. This diversity is a major strength of the European MCSI landscape, as it enables citizen science to contribute observations across marine basins, topics, and scales that would be difficult to cover through institutional monitoring alone.

Several strengths are evident in the way initiatives currently acquire, manage, and disseminate data. A large share of initiatives already has experience with data management, uses standardised methods or protocols, and makes data accessible beyond the project team. Awareness of FAIR principles is relatively high, and many projects already publish data through project websites, biodiversity platforms, national databases, or recognised

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infrastructures such as GBIF, EMODnet, EurOBIS, and OBIS, as well as repositories such as Zenodo, PANGAEA, or SEANOE. These findings demonstrate that marine citizen science is no longer limited to informal or isolated data collection, but is increasingly connected to broader European and international data ecosystems.

At the same time, important barriers remain. The most prominent challenges identified in the survey are lack of funding, lack of time, data-quality and consistency issues, interoperability challenges, limited institutional support, and lack of dedicated data expertise. The interviews confirm that these barriers are often **structural rather than purely technical**. Many initiatives are able to collect data successfully, but struggle with the more resource-intensive steps that follow: validation, documentation, standardisation, long-term storage, publication, and maintenance. Data validation is a particularly important bottleneck, especially for biodiversity observations that require expert review. Similarly, several initiatives recognise the importance of FAIR data but find it difficult to translate FAIR principles into practical and sustainable workflows.

Qualitative interview insights further illustrated the practical realities behind these practices. The interviews show that data management decisions are shaped by the everyday realities of citizen science work. Projects must balance scientific quality with accessibility for participants. Many initiatives deliberately simplify protocols to lower barriers to participation, while shifting more complex tasks such as validation, species identification, or data harmonisation to experts, platforms, or project coordinators. This approach supports engagement but can create pressure later in the data lifecycle. The interviews also show that data management is often dependent on a small number of individuals, temporary funding, or specific institutional partnerships. As a result, practices that appear technically feasible may remain difficult to sustain in the long term without dedicated support.

A final focus of this assessment concerned the extent to which current practices enable or limit the integration of citizen science data into European data infrastructures such as EMODnet and the Digital Twin Ocean. The findings indicate that MCSI already provide a valuable foundation for such integration. Many initiatives collect observations that are relevant to European marine monitoring, including biodiversity, pollution, habitat, water quality, and physical or chemical parameters. The use of digital tools, georeferenced observations, photographic evidence, standard protocols, and established publication platforms increases the potential usability of these data. Existing links with infrastructures such as GBIF, EMODnet, EurOBIS, and OBIS demonstrate that integration is already happening in parts of the MCSI community.

However, the integration potential remains uneven. Data that are not standardised, not findable, poorly documented, stored only locally, or validated inconsistently are difficult to reuse in European data systems. The Digital Twin Ocean and EMODnet require data that are not only collected, but also reliable, interoperable, well described, accessible under clear conditions, and maintained over time. This assessment shows that many citizen science initiatives are moving in that direction, but that the pathway from local citizen-generated

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observations to European-scale data infrastructures is still fragmented. The limiting factors are not a lack of willingness, but rather gaps in capacity, guidance, interoperability, validation resources, and long-term sustainability.

Interview insights additionally provided valuable **bottom-up perspectives** on the characteristics of an **ideal and supportive MCSI information platform**. Participants consistently described the value of an information platform not primarily as a centralised data repository, but rather as a practical support and coordination space where initiatives can more easily discover similar projects, access concrete guidance and workflows, exchange experiences, and connect with experts or peer communities. Respondents particularly emphasised the need for accessible explanations, practical examples, step-by-step guidance, and opportunities for networking and mutual support across the full project lifecycle. Although these reflections emerged from a limited number of interview participants, they align closely with the broader objectives of CS-MACH1 regarding the development of the Marine Citizen Science Data Network, its online directory, and the roadmap activities under WP6 focused on long-term sustainability, guidance, and community support.

At the same time, some limitations should be considered when interpreting the findings of this assessment. Initiatives with more developed data infrastructures or stronger organisational capacity may have been more inclined to participate in the survey and interviews. As a result, the overall levels of FAIR awareness, standardisation, and interoperability observed in this study may partially overrepresent the more mature segment of the marine citizen science community. Smaller or emerging initiatives with limited resources may therefore face even greater barriers related to data management, interoperability, validation capacity, and long-term sustainability than reflected in the present assessment, reinforcing the need for targeted guidance, support, and capacity-building efforts across the sector.

Overall, D2.2 demonstrates that marine and coastal citizen science initiatives constitute an important and growing source of marine and coastal data within Europe's observation landscape. The assessment highlights both the strong commitment of many initiatives to data sharing and stewardship, and the persistent practical barriers related to FAIR implementation, interoperability, metadata standardisation, long-term preservation, and technical capacity. To fully realise the potential of MCSI data within European data infrastructures, **future progress will depend on building on existing good practices while providing targeted support, guidance, and capacity building for initiatives operating with limited resources**. The evidence collected in this deliverable therefore provides a solid basis for the next steps in CS-MACH1, particularly those aimed at improving FAIR data flows, strengthening interoperability, and enabling the sustainable integration of MCSI data into European marine data systems.

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9. Annexes

9.1. Annex 1: survey questionnaire

The following annex contains the full set of questions used in the CS-MACH1 Survey.

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CS-MACH1 survey: help shape the future of marine citizen science data!

* Indicates required question

CS-MACH1

Marine Citizen Science Data Horizon

This survey is part of the CS-MACH1 project, funded by the EU Horizon Europe programme. The project aims to strengthen the **marine citizen science data community** and improve how data is collected, managed, and shared across Europe and beyond.

With this questionnaire we want to learn how marine/coastal citizen science projects are currently handling their data — from collection to storage and sharing — and where additional support or training could be useful.

Completing the survey will take about **15–20 minutes**. If you coordinate more than one project, please fill in a separate form for each. This survey is intended for projects collecting data in the **marine or marine–riverine environment** (no other purely freshwater bodies).

Your responses will be processed in line with the **EU General Data Protection Regulation (GDPR)**. All personal data will be treated confidentially, used only for project purposes, and stored securely. Participation is voluntary, and you may access, correct, or request deletion of your data at any time. For questions, please contact csmach1@vliz.be.

Thank you in advance for your time and valuable contribution!

IDENTIFICATION OF THE PROJECT AND COORDINATING PERSON

1. What is the name of the project? *

2. What is the name (first name and last name) of the main coordinator? *

3. What is the email address of the main coordinator?

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4. What is the URL of the project's website? *

GENERAL CHARACTERISTICS OF THE PROJECT

5. Are any technologies or tools used in the project to collect scientific data? If yes, please select all that apply from the list below. *

Tick all that apply.

- [ ] Mobile devices and apps
- [ ] GPS and mapping tools
- [ ] Drones and remotely operated vehicles
- [ ] Cameras and imaging equipment
- [ ] Water quality sensors and DIY kits measuring physico-chemical water parameters
- [ ] Sampling gear
- [ ] Acoustic tools
- [ ] Pattern tracking devices (e.g., currents, waves, sea level)
- [ ] Biodiversity & species monitoring kits (e.g., eDNA)
- [ ] NA (not applicable for the project)
- [ ] Other:

6. Does the project take place in a single country or a broader region? *

If the project takes place in a single country (e.g., only in Belgium), select 'single country'. If you coordinate a project that covers more countries or a broader region (e.g., Western Europe, Eastern Europe), please select 'broader region'.

Mark only one oval.

- ◯ Single country *Skip to question 7*
- ◯ Broader region *Skip to question 8*

GENERAL CHARACTERISTICS OF THE PROJECT

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7. In which country does the project take place? *

Mark only one oval.

- Albania *Skip to question 9*
- Algeria *Skip to question 9*
- Andorra *Skip to question 9*
- Armenia *Skip to question 9*
- Austria *Skip to question 9*
- Azerbaijan *Skip to question 9*
- Belarus *Skip to question 9*
- Belgium *Skip to question 9*
- Bosnia and Herzegovina *Skip to question 9*
- Bulgaria *Skip to question 9*
- Croatia *Skip to question 9*
- Cyprus *Skip to question 9*
- Czech Republic *Skip to question 9*
- Denmark *Skip to question 9*
- Egypt *Skip to question 9*
- Estonia *Skip to question 9*
- Finland *Skip to question 9*
- France *Skip to question 9*
- Georgia *Skip to question 9*
- Germany *Skip to question 9*
- Greece *Skip to question 9*
- Hungary *Skip to question 9*
- Iceland *Skip to question 9*
- Iran *Skip to question 9*
- Ireland *Skip to question 9*
- Italy *Skip to question 9*
- Kazakhstan *Skip to question 9*
- Kosovo *Skip to question 9*
- Latvia *Skip to question 9*
- Lebanon *Skip to question 9*
- Liechtenstein *Skip to question 9*
- Lithuania *Skip to question 9*
- Luxembourg *Skip to question 9*
- Malta *Skip to question 9*
- Moldova *Skip to question 9*
- Monaco *Skip to question 9*
- Montenegro *Skip to question 9*
- Morocco *Skip to question 9*
- Netherlands *Skip to question 9*
- North Macedonia *Skip to question 9*
- Norway *Skip to question 9*
- Poland *Skip to question 9*
- Portugal *Skip to question 9*
- Romania *Skip to question 9*

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- ◯ Russia *Skip to question 9*
- ◯ San Marino *Skip to question 9*
- ◯ Serbia *Skip to question 9*
- ◯ Slovakia *Skip to question 9*
- ◯ Slovenia *Skip to question 9*
- ◯ Spain *Skip to question 9*
- ◯ Sweden *Skip to question 9*
- ◯ Switzerland *Skip to question 9*
- ◯ Syria *Skip to question 9*
- ◯ Tunisia *Skip to question 9*
- ◯ Turkey *Skip to question 9*
- ◯ Ukraine *Skip to question 9*
- ◯ United Kingdom *Skip to question 9*
- ◯ Other: _____

GENERAL CHARACTERISTICS OF THE PROJECT

8. In which region does the project take place? *

Tick all that apply.

- ☐ Baltic States (Estonia, Latvia, Lithuania)
- ☐ Eastern Europe (Poland, Czechia, Slovakia, Hungary, Ukraine, Belarus, Moldova, Russia)
- ☐ Northern Europe (Nordic countries: Denmark, Finland, Iceland, Norway, Sweden)
- ☐ South-Eastern Europe (Balkans: Albania, Bosnia and Herzegovina, Croatia, Montenegro, North Macedonia, Serbia, Bulgaria, Romania, Greece, Slovenia, Kosovo)
- ☐ Southern Europe (Italy, Spain, Portugal, Greece, Malta)
- ☐ Western Europe (France, Germany, Belgium, Netherlands, Luxembourg, Switzerland, Austria)
- ☐ Worldwide
- ☐ Other: _____

GENERAL CHARACTERISTICS OF THE PROJECT

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9. In which marine region does the project take place? *

Tick all that apply.

- [ ] It's a river-based project
- [ ] Adriatic Sea
- [ ] Aegean Sea
- [ ] Baltic Sea
- [ ] Barents Sea
- [ ] Bay of Biscay
- [ ] Black Sea
- [ ] Celtic Sea
- [ ] Central Mediterranean Sea
- [ ] Eastern Mediterranean Sea
- [ ] English Channel
- [ ] Greenland Sea
- [ ] Ionian Sea
- [ ] Ligurian Sea
- [ ] Mediterranean Sea (general)
- [ ] North Atlantic Ocean
- [ ] North Sea
- [ ] Norwegian Sea
- [ ] Skagerrak & Kattegat
- [ ] Tyrrhenian Sea
- [ ] Western Mediterranean Sea
- [ ] White Sea
- [ ] Other: _____

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10. What is the start year of the project? *

Dropdown

Mark only one oval.

- 2025
- 2024
- 2023
- 2022
- 2021
- 2020
- 2019
- 2018
- 2017
- 2016
- 2015
- 2014
- 2013
- 2012
- 2011
- 2010
- 2009
- 2008
- 2007
- 2006
- 2005
- 2004
- 2003
- 2002
- 2001
- 2000
- Before 2000

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11. What is the end year of the project? * Dropdown

Mark only one oval.

- The project is ongoing
- 2025
- 2024
- 2023
- 2022
- 2021
- 2020
- 2019
- 2018
- 2017
- 2016
- 2015
- 2014
- 2013
- 2012
- 2011
- 2010
- 2009
- 2008
- 2007
- 2006
- 2005
- 2004
- 2003
- 2002
- 2001
- 2000
- Before 2000

12. Who are the participants collecting the data in the project? *

Tick all that apply.

- [ ] Wider public
- [ ] Water sports enthusiasts / marinas
- [ ] Divers
- [ ] Beach guards
- [ ] Fishermen
- [ ] Students and/or youth groups
- [ ] Tourists
- [ ] Other: _____

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13. What is the approximate number of participants per year? * Dropdown

Mark only one oval.

- 1–11
- 11–50
- 51–100
- 101–500
- 501–1,000
- 1,000+

14. What is the frequency of the activity or event? * Dropdown

Mark only one oval.

- One-day event
- Weekly
- Monthly
- Quarterly
- Seasonal
- Annually
- Continuous
- Irregular

15. What is the main topic of the project? *

Tick all that apply.

- Currents
- Salinity
- Sea level
- Sea state
- Ocean Surface Heat Flux
- Water temperature
- Ocean color / plankton / harmful algal blooms
- Oxygen
- Nutrients
- Green house gases
- Marine habitats
- Biodiversity observations and/or species monitoring (e.g., fish, birds, mammals, ...)
- DNA-derived biological occurrences (DNA from individual organisms, but also from environmental DNA)
- Marine pollution (chemicals, plastics, ...)
- Coastal erosion
- Fisheries / sustainable fishing
- Weather observations
- Noise pollution
- Other: _____

DATA-FLOW NOW

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16. Citizen science is hot! All over the world we are collecting all types of data. * Dropdown
Do you have experience in managing data?

Mark only one oval.

- Yes
- Partially
- No

17. Where is the project data stored? *

Tick all that apply.

- [ ] Locally (e.g., PC, laptop, external drive, USB)
- [ ] Internal institutional storage (e.g., shared network drives, institutional servers)
- [ ] External/cloud storage (e.g., Google Drive, Dropbox, OneDrive, SharePoint)
- [ ] Other: _____

18. Standardization of data and metadata makes information understandable, interoperable, and readily exchangeable with other datasets. It refers to the process of converting raw (meta)data into a consistent, standard format. *

At this moment, the data of the project are:

Mark only one oval.

- Raw
- Converted
- Partially converted
- I don't know

19. Have you ever heard of the FAIR principles for data management? *

The FAIR principles are international guidelines for research data management that aim to maximize the reuse of research data. FAIR data are data that are **Findable (F), Accessible (A), Interoperable (I),** and **Reusable (R).**

Mark only one oval.

- No
- Yes, but my project does not use the FAIR principles
- Yes, my project tries to use the FAIR principles
- Other: _____

20. Does the project currently use or document any best practices, standardized methods, protocols, tools or guidelines for citizen science data collection, management, or sharing? *

E.g., standardized protocols for water quality measurements, guidelines for recording species observations, metadata templates for marine data, tools for managing coastal monitoring results, or policies for sharing datasets according to FAIR principles.

Mark only one oval.

- Yes *Skip to question 21*
- No *Skip to question 22*

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21. You answered 'yes' to the question: *Does the project currently use or document any best practices, standardized methods, protocols, tools, or guidelines for citizen science data collection, management, or sharing?* Please specify or provide links if available: *

22. Is the project data findable at this moment? *

Data is discoverable via search engines and catalogues with the help of a rich set of metadata allowing its discovery. Metadata are always openly accessible, even if the data are restricted or under embargo.

Mark only one oval.

- ◯ Yes *Skip to question 23*
- ◯ No *Skip to question 24*

23. You answered 'yes' to the question: *Is the project data findable at this moment?* Please specify or provide links if available: *

DATA-FLOW NOW

24. The data of the project are accessible by: *

Tick all that apply.

- ☐ Only me
- ☐ My institute
- ☐ Project partners
- ☐ Accessible for everyone
- ☐ Other: _____

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25. If the data of the project are already (publicly) accessible, on which platforms are they available? *

Tick all that apply.

- [ ] Dropbox
- [ ] (Eur)OBIS
- [ ] EDITO
- [ ] EMODnet
- [ ] GBIF
- [ ] Google Drive
- [ ] ICES
- [ ] OneDrive
- [ ] PANGAEA
- [ ] SeaDataNet
- [ ] SharePoint
- [ ] Zenodo
- [ ] NA (not applicable for the project)
- [ ] Other: _____

26. Does the project use any form of tracking or recognition to give credit to participating citizens? *

Tick all that apply.

- [ ] Yes, formally (e.g., authorship, digital badges, acknowledegments)
- [ ] Yes, informally (e.g., thank-you messages, community recognition)
- [ ] No, we do not track or recognize contributions
- [ ] Other: _____

CHALLENGES AND NEEDS WITH REGARDS TO DATA MANAGEMENT

27. What are currently the project major challenges in terms of data management? *

Tick all that apply.

- [ ] Dirty data
- [ ] No time
- [ ] Unavailability or difficult access to data
- [ ] Lack of own knowledge
- [ ] Lack of guidelines
- [ ] Lack of funds to do the work
- [ ] Limited support in the project
- [ ] Lack of data science talent or experts in the project
- [ ] No training
- [ ] Unclear responsibilities or roles within the project
- [ ] Technical barriers (e.g., storage, tools)
- [ ] Data quality or consistency issues
- [ ] Legal or ethical concerns (e.g., privacy, licensing)
- [ ] Interoperability with (integration in) other data systems or platforms
- [ ] Other: _____

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28. What are the project training needs in terms of data management? *

Tick all that apply.

- [ ] Data collection methods
- [ ] Data quality assurance
- [ ] Data management and storage
- [ ] Use of technology and tools
- [ ] Data analysis and visualization
- [ ] Use of digital platforms or apps for sharing data
- [ ] Communication and outreach
- [ ] Legal and ethical aspects (e.g., GDPR, licensing)
- [ ] Project coordination and planning
- [ ] Other: _____

CITIZEN SCIENCE DATA NETWORK

29. Are you interested in being part of an informal citizen science data network? *

CS-MACH1 aims to establish a long-lasting network of stakeholders to enhance the use of marine citizen science data for societal benefit. The network seeks to connect (1) marine citizen science project coordinators, (2) low-cost technology developers, (3) data managers, and (4) potential users of the data (scientists and policy makers). As a coordinator of a marine citizen science project, are you interested in joining the network? You should be part of it!

Mark only one oval.

- ◯ Yes
- ◯ No

30. Are you interested in participating in a joint physical or online event with other marine/coastal citizen science project coordinators, data managers, designers of low-cost technology, and potential users of your data? *

The workshop will take place on February 3 and 4, 2026, in Ostend. Please note: this does not count as a registration, but merely indicates your interest.

Mark only one oval.

- ◯ Yes
- ◯ No

31. Would you like your marine or coastal citizen science project to be considered for featuring in the CS-MACH1 communication channels (newsletter, social media, etc.)? *

Mark only one oval.

- ◯ Yes
- ◯ No

32. Are you interested in receiving the CS-MACH1 newsletter? *

Mark only one oval.

- ◯ Yes
- ◯ No

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33. If your project uses sensors/technologies/tools, may we contact you for more detailed information about this aspect? *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Not applicable

34. Would you be open to discussing your answers in a one-hour (maximum) follow-up interview? *

Mark only one oval.

- ◯ Yes
- ◯ Preferably not

LAST PART!

35. Questions, suggestions, or feedback? We'd love to hear from you!

DISCLAIMER & CONSENT

Purpose of data collection

- Your data will be used for project purposes within CS-MACH1.
- The collected information may be included in reports, publications, and presentations related to the project.
- If needed, your data may be shared in open-access repositories, but only in anonymized form.

Data protection & confidentiality

- All personal data will be stored securely and handled in accordance with the GDPR (EU 2016/679).
- If any personal information is collected, it will be anonymized or pseudonymized when used in project activities and research.
- Your data will not be shared with third parties beyond CS-MACH1 project partners without your additional consent.
- Your email will only be used to share relevant updates, resources, and results within the CS-MACH1 project and will not be shared outside.

Your rights

- You have the right to access, rectify, or request the deletion of your data.
- You can withdraw consent at any time without providing a reason.

36. By ticking the boxes below, you confirm that: *

Tick all that apply.

- ☐ You have read and understood this information.
- ☐ You voluntarily agree to participate.
- ☐ You understand your rights regarding your data.
- ☐ You understand that the CS-MACH1 team will use your email to share only relevant resources and results from the CS-MACH1 project to support and upscale your marine citizen science project.

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9.2. Annex 2: interview questions

General questions

1. First, could you please briefly introduce yourself and describe your role within the citizen science project?
2. Could you tell us a bit more about the scope and the objectives of your citizen science?

Data collection

1. What type of methods and tools are citizens using for observing, sampling or collecting data? [Digital sensors, apps, sampling devices such as a Secchi disk, sampling net, thermometer, bucket…].
2. Do you provide protocols or guidelines for these methods or tools? Are these publicly available and in which format? [Online document, leaflet, app instruction…].
3. Is hands-on training taking place for citizens on how they should use sensors/apps or sampling devices, so it is clear for them what to do in a correct way? In what format? [Online training, downloadable instructions, on-site training support…].
4. In case sampling takes place in the field, is there always a scientist or experienced volunteer (who has had training) joining?
5. In case sensors are used: are these sensors calibrated regularly and who is responsible for calibration?
6. What type of data are citizens collecting? [Images, numerical data from visual observations, numerical data from sensors, qualitative data from visual observations, sensor readings, excel files…]
7. What happens next with the raw or non-processed data? For example: Data is automatically retrieved via an app or tool? Data needs to be uploaded in a project environment by the citizens on a website, a cloud? Do they need to send samples for further analysis?
8. Do the citizens need to make any interpretation or calculations on collected data?

General questions on data management in the project

1. Have you ever heard of the short term 'DMP' when talking about data management, and do you know what this abbreviation stands for?
2. If **YES** on Q1: Do you currently have a DMP for your citizen science project?
3. If **NO** on Q1: (short explanation) Now I have explained briefly what a Data Management Plan is: maybe you already have in place or covered some of the topics in your citizen science project?
4. If **NO** on Q2: Would you think of setting up a DMP? What are your challenges or difficulties in this? Would you need help or training?
5. If **YES** on Q2: Do you use any tools or existing templates for writing your DMP? [DMP online.be, Horizon DMP template…]

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6. If **YES** on Q2: Is the Data Management Plan publicly available or only shared within the project?
7. A good DMP should contain information on how to be compliant with the FAIR data principles. Have you ever heard of the FAIR principles, and do you know what it stands for? F is for…, A is for…, I is for… and R is for… YES or NO?
8. If **YES** on Q1: Do you already have some of the FAIR principles in place or covered in your citizen science project?
9. If **NO** on Q1: (short explanation of the FAIR principles). Now that I have explained in short what FAIR is: maybe you already have in place or covered some of the FAIR topics in your citizen science project?
10. Thinking about FAIR principles: in your opinion do you think end users such as scientists, policy makers, public or others could use the data of your citizen project? Do you think they have enough information to work with the data?

Data validation and quality control

1. Following data collection, how is the quality of data assured? Do citizens or educated volunteers do any type of quality control, or is it done by scientists? Is data validated by scientists or by specific software or using an app?

Ideal information platform on Citizen Science dataflows

With CS-MACH1 we are aiming at the setup of a network of stakeholders involved in CS dataflows: citizen science coordinators, sensor developers, data managers and users of data (scientists, policy makers, society). That network would like to offer an information platform to enhance the CS dataflow, in support of the needs of all these stakeholders.

If you lived in a perfect world with the existence of the perfect information platform for all your questions on citizen science projects and dataflows, what would it look like for your citizen science project?

1. What information and on which topics would you want to find on the portal?
2. What functionalities or tools would be essential for you?
3. In what way would such a platform or support structure be of added value for your project? How would you use it?
4. Can you give an example of an already existing information portal which could be evaluated, explored, and possibly expanded towards a MCS data network portal?
5. If no idea on Q1: Would it be important for you to include info on: sensors, existing CS projects, training materials for data management within citizen science projects, info and access to data portal (e.g. EurOBIS, GBIF, EMODNET…) most suitable for your citizen science project, citizen science data platforms, other?

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Challenges and needs

1. Have you experienced any challenges in the project when thinking about data collection, sensor calibration, FAIRness of data, quality control, validation of data, or data sharing?
2. Which one of the above-mentioned challenges would you consider critical or the most important one to consider in general?
3. Have these challenges impacted the project?
4. Have these challenges changed over time as the project evolved?
5. Taking into account the challenges you have, would your CS benefit from data management training? On what topic would you need extra training?
6. What kind of training format would work out best for you?
    - online
    - in person
    - Documented training
7. Do you prefer the training to be a:
    - one-off event (organized at a fixed time and place)
    - available at any time (e.g. an online course which you can start and continue any time you want)
8. A mix

9.3. Annex 3: list of contacted projects survey

This annex provides the complete alphabetical list of projects that were contacted to participate in the survey. The annex also indicates whether each project participated in the survey and/or in the qualitative interview phase.
The complete list is available at: https://acrobat.adobe.com/csmach1

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