Universitat de les Illes Balears

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Early Steps for an Effective Governance Framework to Adapt Urban Beaches to Climate Change Regarding Ecosystems and Ecosystem Services: the case of Cala Millor

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Abstract

The effects caused by climate change on coastal systems, especially in terms of sea level rise and associated extreme events, are a major concern for coastal management and society. When implementing management strategies, a lack of information can lead to the alteration of natural systems with an important role in coastal protection, leading to the need for new mitigation, monitoring and/or adaptation projects. However, reaching solutions agreed by the entire community can be challenging. Cala Millor (Balearic Islands, Spain) is an example of a transformed coastal ecosystem where land development has led to the modification of a dune system and consequent erosion of a beach system, leaving buildings exposed to storm events and coastal flooding. This risk affects not only the environment, but also the entire settled population, including two municipalities, hotels, schools and associations for the elderly, among others. Adaptation climate change plans of urban beaches should be elaborated considering all public administrations and taking into account society needs and requirements, in order to minimize the risks associated with sea level rise and coastal flooding. To this end, this Master Thesis proposes a multilevel governance perspective with a two-way communication and participatory approach. On one hand, the creation and involvement of the Working Group using the Think-Reason-Understand-Share-Test (TRUST) method aims to apply a practical and hands-on approach, to obtain and use information to influence change. On the other hand, the 'communication, listening and involvement' method is selected for engaging society, being active and respectful, useful and adding value. In this work, the early steps of involving the public administration representatives and society perception are presented establishing three specific objectives: i) to develop a protocol to lay the foundations for the creation of a participatory mechanism of public administrations for the design of climate change adaptation plan; ii) to analyze the perceptions, attitudes and opinions of policy makers at local, island and regional level, regarding the effects of climate change on coastal ecosystems and ecosystem services at Cala Millor; iii) to analyze the perception of changes in coastal ecosystems and knowledge of climate change among society of Cala Millor, focusing, in this work, on scholars that will be potentially affected by the adaptation plan. The methodology used for the creation of the participatory mechanism for public administration was the development of documents and the collaboration with governmental entities for the review, as well as the Interest-Influence relation analysis of the potential members. For the study of the public administration's perception of the effects of climate change in Cala Millor and scholars group's perception and knowledge analysis, a survey method was implemented for the data collection and the analysis was carried out by means of the software R v.4.1.4. Results present all needed documentation produced for settling the participation mechanism. Regarding the analysis of the surveys, the main results show that sociodemographic data and the relationship of the representatives of the public administrations with Cala Millor can influence the perception of the effects of climate change in the study area and also their behaviours and attitudes. On the other hand, most scholars do not seem to perceive the effects of climate change at Cala Millor regarding ecosystems and do not know what 'climate change' concept is. Also, significant differences between their knowledge regarding the age and their parents' position have been found. Future designed awareness campaigns should include basic knowledge and emphasize on the differences between climate change and sustainability.

1. Introduction

Humans have colonised marine and coastal ecosystems, transforming the land and altering natural cycles (Vitousek *et al.*, 1997). Human activities, principally through emissions of greenhouse gases, have caused global warming, with global surface mean temperature reaching 1.1°C between 1850-1900 and 2011-2020 (IPCC, 2023). Accelerating short-term climate change has been reported to rapidly change the ecological, physiological, genetic and behavioural physiological and genetic changes in species, constraining their survival and their environment (Weiskopf *et al.,* 2020). In addition, humans are also directly affected by these modifications due to climate change: humans suffer the negative impacts on food security, water resources and health, and they are exposed to climate-related hazards like tropical cyclones, floodings or marine heat waves (Cooley *et al*., 2022). In coastal urban areas, the effects of climate change are mainly related to sea-level rise and extreme storm events (Morales-Márquez *et al.*, 2018; Luque *et al*., 2021). Trends show effects related to urban beaches have increased exponentially over the last 40 years, and models predict that they will continue to grow if climate change is not addressed (Church and White, 2011; EASAC, 2018). When coastal ecosystems are properly managed, they can mitigate these climate change effects by adapting their morphology and maintaining a dynamic balance between the factors affecting the land-sea interface (e.g. tides, waves, wind, etc.). Since these environments are heavily transformed and their adaptation capacity is limited by the lack of accommodation space, urban beaches are susceptible to recede or temporarily disappear, increasing the exposure and hazard vulnerability of coastal regions (Hanley *et al*., 2014; Vitousek *et al*., 2017). Apart from acting as a natural defence, they provide many other services: ecological hotspots, water infiltration, recreational and tourist industry, and scientific and living laboratories for schools, among others. The beach is the most visited landscape in the urban area, moreover it is a complex administrative environment (Soy and Rusch, 2015). The number of ecosystem services and their relevance reflect the importance of coastal environments for society (Heckbert *et al*., 2021). Thus, beach narrowing also implies a loss of ecosystem services, which are fundamental to the economy of tourist destinations, as leisure activities depend on the functional surface of the beach's shoreline (e.g., Valdemoro and Jiménez, 2006; Ballesteros *et al.*, 2017).

The European Union calls on European regions to take climate change actions through implementing strategies to increase resilience to the effects of climate change, improving their adaptive capacity and baseline monitoring, and increasing communication climate risk by organising a dialogue with local communities (European Union, 2021). Goal 13 of the 2030 Agenda of the United Nations, “take urgent action to combat climate change and its impacts”, sets 5 specific targets to fulfil this objective: i) strengthen resilience and adaptive capacity to climate related disasters; ii) integrate climate change measures into national policies, strategies and planning; iii) build knowledge and capacity to meet; iv) implement the United Nations Framework Convention on climate change; v) promote mechanisms to raise capacity for planning and management (United Nations, 2015). In Arora and Mishra (2023) report, some examples of great global implementations in order to meet Goal 13 targets were provided. As an example, Nature-Based Solutions have been implemented in several ecosystems reducing emissions, and also removing a minimum of at least 5 gigatonnes of carbon dioxide equivalent per year (GtCO2e) per year and maximum of 11.7 GtCO2e per year (United Nations Environment Programme and International Union for Conservation of Nature, 2021). Also, the

European Union reduced GHG (GreenHouse Gases) emissions by 60% compared to 1990 by investing in research in hydrogen fuel, advanced biofuels and renewable synthetic fuels and by promoting electrification (World Trade Organization, 2021). Regarding policies and country strategies for climate change action, the United Nations Environment Programme (UNEP) was created and has assisted over 60 countries to integrate climate change adaptation into medium and long-term national planning and financing. However, Arora and Mishra (2023) highlights an example where "build knowledge and capacity to meet climate change" has not been fulfilled. In 2021, UNESCO (United Nations Educational Scientific and Cultural Organization) provided survey results from 100 countries showing that only 53% of the national education curricula mentions climate change and also that the subject is mostly given very low priority (UNESCO, 2021). Thus, adaptation to climate change spans a wide range of empirical concerns, such as avoiding land degradation and biodiversity loss, especially nature-based solutions are considered for adaptation (UNFCCC, 2007). However, there is a need to improve awareness and integrate effective participatory processes.

Public administration representatives and society support is the key for conservation, adaptation, mitigation to elaborate management strategies (Thiault, 2021). Different users and spheres of citizenship may have different perceptions of common environmental concerns management, leading to a gap and resistance in supporting strategies designed to respond to threats to the social and ecological development of an environment (Oberg and Aronsson, 2022; Ruano-Chamorro *et al*., 2023). Therefore, the concept of engagement takes on significant relevance when talking about climate change adaptation processes. In everyday usage, "engagement" refers to involvement or commitment. In the field of well-being and health, it refers to the good mental and physical state of people. Vargas and Estrada (2016), taking as a baseline the definition of Schaufeli *et al*. (2002) and considering the contributions of Bakker *et al.* (2011), offer a comprehensive definition, describing it as: "the mental, psychological and affective-cognitive state that is characterised by effort, enthusiasm, energy and passion, as a metaphor in which an organisation manages to capture 'the hands, head and heart of its employees''. In terms of planning climate change adaptation in urban beaches we could adapt this definition as "the mental, psychological and affective-cognitive state that is characterised by effort, enthusiasm, energy and passion, as a metaphor in which a governance framework manages to capture 'the hands, head and heard of stakeholders'".

Establishing an effective governance framework is essential to achieve this state of engagement simultaneously among multiple sectors of society and different geographical scope and fields of public administrations and society (Leck and Simon, 2012; Bruijn and Dieperink, 2022). In broad terms, governance can be defined as the policies, actions, processes adopted by society to reach collective agreements and solutions to common concerns (Dogson *et al.*, 2002). The first time the concept of climate change appeared on the international public agenda was in the mid-1980s. Since then, the concept was popularised, being no longer the exclusive domain of science, but becoming the main topic in politics, social and economic sectors (Rahman, 2012; Franz, 1997). This connection between climate change and policy has been deeply explored by many authors and in 2015, the Paris Agreement signed by 193 countries entered into force. The goal of the agreement is to strengthen the global response to the threat of climate change by keeping the global temperature increase this century well below 2 degrees Celsius (e.g. above

pre-industrial levels), and to continue efforts to further limit the temperature increase to 1.5 degrees Celsius (United Nations, 2016).

In urban beaches, many areas come into play at different scales of public administration in which policy makers play a very important role in decision-making for climate change adaptation (Therville *et al*., 2018). However, governance not only relies on public administrations but also demands an effective organisation of societal groups (Bruijn and Dieperink, 2022). Regarding the society participation, in 1969, Arnstein defined different categories of participation using the metaphor of a ladder: each rung "corresponds to the extent of citizens' power". Also, this author developed a vivid and widely spreaded metaphor of citizen participation: "The idea of citizen participation is a little like eating spinach, no one is against it in principle because it is good for you". Her model influenced many later authors in developing other citizen participation frameworks. As an example, Hart (1992) developed "Children's Participation: From Tokenism to Citizenship" published by the International Child Development Centre of the United Nations Children's Fund (UNICEF) and where the author applied the conceptual framework of Arnstein (1969) to the participation of children in adult projects, programs, and activities. The same year that Hart's (1992) essay was published, the importance of public participation was explicitly noted for the first time at international level for climate action in The Rio Declaration (1992) at the United Nations Conference on Environment and Development (UNCED). The document included explicit goals for citizen participation and engagement in climate actions (Principle 10) (Hügel and Davies, 2019). From then on, issues related to public participation in climate action have long been a concern for researchers (Brown and Tompkins, 2007). Although a paucity of empirical work in relation to public participation in adaptation planning is often lamented (Burton and Mustelin, 2013; Sarzynski, 2015; Wamsler, 2017), many others have succeeded in climate change adaptation (Naumman, 2011; Knieling, 2016).

The Mediterranean region is home to nearly 522 million people, one-third of whom live along its coastal regions (Mokos *et al*., 2020). The population fraction distributed up to 10 m above MSLR reaches 34%, in contrast to 10% worldwide (Lionello, 2012). In the Balearic Islands, from the 1960s the economic development attributed to both tourism and a residential construction boom promoted an uncontrolled urban sprawl leading to effects on ecosystems and changing the local identity of coastal areas (García and Servera, 2003; Pons and Rullan, 2014). Sandy coastal environments attract higher numbers of tourists increasing the risks of climate change effects on both the environment and the economy of numerous coastal settlements (Roig-Munar *et al*., 2019). Environmental degradation and effects of climate change at short- and long-term has been studied at Cala Millor along the last two decades with the aim of finding solutions to these concerns (Luque *et al*., 2021; Fernández-Mora *et al.*, 2023). However, to date, no action strategies to adapt the coast and reduce risk of climate change effects have been implemented in Cala Millor, as in many other urban beaches in Europe.

Bringing all these insights together, there is an urgent need to develop and implement climate change adaptation plans for urban beaches. These plans must be approached based on scientific knowledge and from a perspective of renaturalization of ecosystems, promoting their conservation and protection, in order to minimise the effects of climate change and ensure the ecosystem services that these habitats and species offer. Furthermore, the design of these plans

must involve collaboration and cooperation between public administrations and the involvement of citizens.

2. Objectives

This Master Thesis is focused on proving methodologies and protocols to promote an effective governance framework through a participatory decision-making scheme to adapt urban beaches to climate change, considering the effects and impacts on the ecosystems and ecosystems services. Developed methodological procedures are applied and validated at the urban beach of Cala Millor in Mallorca, in order to extrapolate these methods to any urban beach at the Mediterranean Sea or worldwide, aiming to have a participatory adaptation climate change plan.

The general goal is to achieve the early and necessary steps to develop an effective governance framework for adapting Cala Millor to climate change, focusing on ecosystems and ecosystem services.

In order to achieve the general objective, the specific objectives are detailed below:

- Establishing a participatory mechanism at Cala Millor to share knowledge and experiences and to decide among all public administrations with competences a sound and integrated climate adaptation plan, based on natural and ecosystem solutions.
- Analysing the perceptions, attitudes and opinions of policy makers at local, island and regional level, regarding the effects of climate change on coastal ecosystems and ecosystem services at Cala Millor.
- Analysing the perception of changes in coastal ecosystems, attitudes and behaviour and knowledge of climate change among scholars of Cala Millor, that will be potentially affected by the adaptation plan.

3. Description of the study site

Cala Millor is a tourist station in the north-eastern coast of Majorca (Balearic Islands, Spain) in the Western Mediterranean Sea (Figure 1). Cala Millor is bounded by two rocky headlands, Cap Pinar northwards and Punta de n'Amer southwards, and is characterised by nearly 1700 m long and up to 35 metres wide carbonate sandy beach divided in 4 sections: Platja des Moro, Estanyol d'en Roig, Sa Màniga and Cala Nau (Figure 1). Morphologically, it is an intermediate beach with a concave shape and with a configuration of transverse and crescentic bars (Gómez-Pujol *et al*., 2007; Tintoré *et al.*, 2009). The beach sediments from the mid-Holocene constitute a regressive barrier that prograded landward through a foredune and a field of parabolic dunes (Fernandez-Mora *et al*., 2023). The dune system backes the beach, where a boulevard wall, hotels and residential houses have been settled due urban coastal development (Tintoré *et al*., 2009). Coastal dunes are one of the natural formations that best represent the dynamism and fragility of this type of environment. Attending to the degree of evolution, the dunes of Cala Millor were embryonic, living or mobile dunes characterised for being young, in movement and having a little vegetation cover. In embryonic dunes and beaches, a specific

pioneer vegetation develops capable of retaining and partially fixing the sand. This vegetation is influenced by exposure to the saline spray and the wind. However, at present dunes only remain in the Punta de n'Amer sector. In the sector where Cala Millor's tourist resort is located, the dune ecosystem was completely covered by the urban settlement and degraded until disappearing. Other vegetation capable of resisting coastal conditions constitute the coastal forest (e.g. *Juniperus phoenice*, *Pinus halepensis, Ammophila arenaria*, *Pancratium maritimum*, etc.) and the rocky shore (e.g. *Limonium spp, Crithmum maritimum, Launaea cervicornis, etc.)* (Consorci de Turisme de Son Servera i Sant Llorenç des Cardassar, n.d). In the marine environment the seabed is composed by jagged rocks reefs and at depths from 6 to 35 m appear paleochannels and a seagrass meadow of *Posidonia oceanica* which acts as a cover to sediment exchange and as a friction obstacle to waves (Infantes *et al.*, 2009).

Figure 1. Location of Cala Millor on the northeast coast of Majorcar (Source: Tintoré *et al*., 2009).

In summary, the coastal environment of Cala Millor can be classified in 6 main natural ecosystems: i) coastal forest; ii) dune system; iii) beach; iv) leak flow; v) rocky shore; and vi) *Posidonia oceanica* meadow (Figure 2).

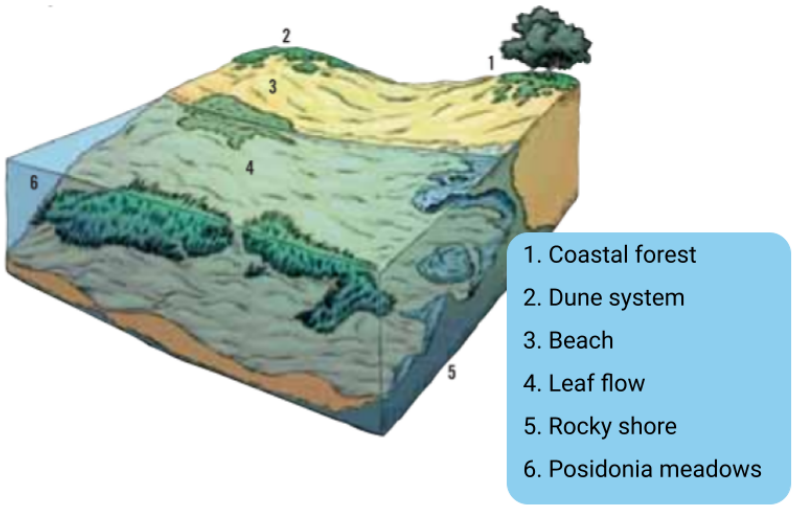

Figure 2. Natural ecosystems of Cala Millor (Source: Consorci de Turisme de Son Servera i Sant Llorenç des Cardassar, nd).

Considering the urban system (e.g. socioeconomic), Cala Millor is located between two municipalities (Son Servera and Sant Llorenç des Cardassar) and is managed by 5 government bodies at 4 different levels of public administration: the Spanish Government, the Government of the Balearic Islands, the Island Council of Mallorca, the Town Council of Sant Llorenç des Cardassar and the Town Council of Son Servera. Local municipalities have a resident population of 20 787 people (11 752 people in Son Servera and 9 035 people in Sant Llorenç des Cardassar) and can receive an estimated number of 820 819 tourists per year (max. value since 2009)(IBESTAT, 2023). This implies more than 8 496 employees of the tourist sector (max. value by means of hotel visits since 2009) (IBESTAT, 2023). Son Servera and Sant Llorenç des Cardassar have also 6 schools (CEIP Jaume Fornaris i Taltavull, CEIP Na Penyal, CEIP Mestre Guillem Galmés, CEIP Punta de n'Amer, CEIP Sant Miquel) and 1 high school (*IES Puig de sa Font*), with a total of 2211 schoolchildren and students (Dirección de Energía y Cambio Climático, 2021). Each school and high school has a parents association. Also, 16 other association groups are found in both municipalities: 6 elder associations and and 10 neighbourhood associations.

4. Data and materials

4.1. Data collection and analysis

Different descriptive surveys were applied during the July and August 2023 for achieving the objectives of the research. The purpose of the surveys focus in a systematic and orderly manner on obtaining information on the variables involved in an investigation from a given sample (Sierra, 1985). The surveys were classified as descriptive, personal, factual, opinion and asynchronous according to the criteria established by Visatuta (1989): first, *descriptive,* because aimed to determine the population's perception of climate change regarding coastal ecosystems. Second, *personal,* because the answers were obtained through forms designed and applied by the interaction of an interviewer and an interviewed. Third, *factual,* because the groups selected to answer the surveys were selected regarding specific characteristics. In this case, the public administrations were selected considering the potential competences in coastal climate change adaptation, and the scholars considering the potential affection of climate change to their environment. Fourth, *opinion*, because verbal statements regarding subjective perceptions of climate change at Cala Millor. Finally, attending to the temporal dimension was *asynchronous* because the studies do not focus on a specific moment.

The surveys generated included short, multiple-choice, Likert (e.g. preference rating scales of responses to measure opinions, perceptions and behaviours in a given situation) and dichotomous questions adapted from a bank of more than 400 questions of 17 different reports, studies and surveys, produced by different institutions (EMODnet, n.d.; EuroGOOS, n.d.; JPI Climate & JPI, n.d.; Oceans, n.d.; Universidad de Salamanca, n.d.; Times Higher Education, n.d.; Junta de Andalucía, 2010; Lara-San Martín, 2013; Tesfai, 2016; Booth et al., 2020; Areia *et al.,* 2021; Bustelo et al., 2021; Morote et al., 2021; Copernicus Marine Service, 2022; EuroSea, 2022; Sjöblom et al., 2022; *Correa et al.,* 2023; FECYT, 2023). Specific questions linked to the effects of climate change on the ecosystems and ecosystem services were developed.

Based on the specific objectives of the study, three adapted surveys were developed:

1) to analyse the interest and influence of the members of the participatory mechanism, by designing a guideline to conduct individual interviews by phone calls, video calls and face-to-face interviews;

2) to analyse perceptions, attitudes and opinions on public administration representatives regarding the effects of climate change effects on coastal ecosystems and ecosystems services, using also a guideline to conduct individual interviews by phone calls, video calls and face-to-face interviews;

3) to study the perception of changes in coastal ecosystems, attitudes and behaviour and knowledge of climate change of scholars, through a participatory and dynamic face-to-face activity at summer schools.

In this study, the independent variables were the sociodemographic and relation of users with Cala Millor data included in *Section 1* of surveys (see section 4.3 and 4.4). Whereas, the dependent variables were the questions that interviewed people provided with responses and were included in different sections depending on the group studied (see section 4.3 and 4.4).

To perform the analysis of the significance relationships between the independent and dependent variables, data gathered from surveys were tabulated in MS Excel spreadsheet and estimation generalised linear models (GLM) in R v.4.1.4 software (Crawley, 2007) were employed for the analysis. For individual models, the function glm() works with GLM in R and the family function allows to select whether the dependent variable is binomial (dichotomic; Eq. 1) or poisson (polytomic; Eq. 2) :

$$glm(Y \sim x1 + x2 + x3 + \ldots + xn, family = binomial) \text{ (Eq. 1)}$$
$$glm(Y \sim x1 + x2 + x3 + \ldots + xn, family = poisson) \text{ (Eq. 2)}$$

Where GLM means generalized linear model, Y is the dependent variable and x1 + x2 + x3 + … + xn are independent variables, while “family=binomial” implies the binomial dependent variable and “family=poisson” implies independent variables of positive numerical counts.

In order to ensure the inferences from the use of count data models were appropriate, the existence of overdispersion of dependent variables, conditional to the explanatory variables, were tested.

$$overdisp(dt, dependent.position = NULL, predictor.position = NULL)$$

Where overdisp is the function of overdispersion, dt is the dataset, $dependent.position = NULL$ specifies the position of the dependent variable in the user dataset and $predictor.position = NULL$ is the number or the set of numbers giving the position of independent variables in the dataset.

4.2. Development a participatory mechanism for public administration

The suitable mechanism selected for the construction of a participatory and effective governance framework for the involvement of public administrations, with competences on climate change and coastal ecosystems, is the creation of a Working Group (WG).

The creation of a WG is a methodology widely implemented in projects in which involvement and participation of different sectors of society is needed (Meadowcroft, 2009) (e.g. González and Numer, 2020; Climate Alliance, 2023; International Council on Monuments and Sites, 2022). According to Zlate (2008) and Zoltan and Vancea (2015), a WG has to satisfy five conditions in order to succeed: i) to have a certain number of members; ii) to establish a minimal interaction between members: the relationship between them to be direct; iii) to centre the interaction of members on the completion of common activities or goals; iv) to exist a minimal articulation between statuses and roles of members, therefore a psychosocial structure; v) to have a specific composition, derived from the characteristics of the members therefore a face-to-face interaction.

The implementation of a WG allows to engage key relevant representatives from public administration at local, island, regional and national level on the decision-making related to management policies and climate change adaptation measures to be implemented at local level (Clemens *et al.*, 2016). Also, it provides a link between society and policy-makers and between different scope levels to promote common knowledge and collaborations to design the adaptation plan. Moreover, the Working Group is a tool that has to continue operating beyond the design of the adaptation plan in order to monitor the implementation of the participatory adaptation and to replicate and scale-up the adaptation process to other urban beaches.

Three main steps were followed to promote the creation of the Working Group at Cala Millor (Figure 3).

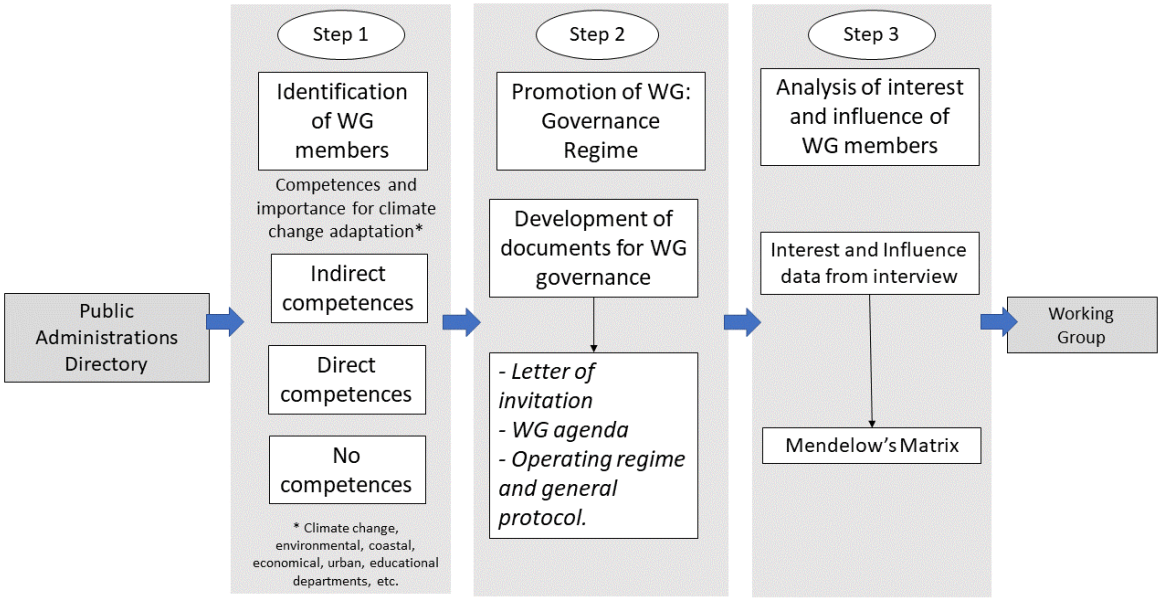

Figure 3. Steps to promote the creation of a Working Group as a participatory mechanism for public administration.

4.2.1. Identification of Working Group members

The aim is to identify all potential departments and entities from the public administration related to coastal climate change adaptation (i.e. councils, general directorates, offices or

departments of national, regional, island or local organisations). A development of a public administration directory from public administration documentation was carried out (Gobierno de España, 2023; GOIB, 2023; Consell de Mallorca, 2023; Ajuntament de Son Servera, 2023; Ajuntament de Sant Llorenç des Cardassar, 2023). A prioritised contact list of public administration representatives grouped by sector, function, position, geographical scope and importance for climate change adaptation was developed (European Environmental Agency, 2004). Also contact information was included (i.e. email, address, phone numbers, websites and DIR3 codes from public administration).

To ease the selection of potential public administration representatives, the list was divided according to geographical scope (national level, regional, island and local level) and considering the competences and importance for decision-making on coastal climate change adaptation process.

Six relevant areas were identified with direct competences on climate change adaptation: i) climate change action; ii) coastal management; iii) environmental protection; iv) economical activities; v) urban planning; vi) education. All departments at different geographical scales linked to those areas, were identified as potential members for the WG. Table 1 represents for each area if a public administration department was identified at geographical scale level.

Table 1. Areas considered to have competencies in climate change adaptation selected at each level of public administration.

Areas	Local	Island	Regional	National
Climate change action	-	-	x	x
Coastal Management	-	-	x	x
Environmental protection	x	x	x	x
Economical activities	x	x	x	x
Urban planning	x	x	x	x
Education	x	-	-	-

All representatives from public administration with direct and indirect competences were interviewed but only those with direct competences were considered to join the Working Group.

4.2.2. Promotion of Working Group: Governance regime

The generation of governance documents is necessary in order to trigger and promote a good adhesion of the identified administrations to the Working Group. All governance documents generated should be straightforward, clear and precise (Meadowcroft, 2009).

According to Law 40/2015 a General Protocols of Action (BOE-A-2015-10566) or similar instruments entail declarations of intent of general content or express the will of the subscribing Administrations and parties to act with a common objective, provided that they do not entail the formalisation of specific and enforceable legal commitments. Based and adapted from different examples of operating regimes between entities (ICANN, 2015; Community Engagement Committee, 2019), an operating regime for the Working Group was developed containing the following sections:

a) *Purpose*: objective of the document in the framework of the creation of the Working Group.
b) *Commitments of the signatory entities*: Obligation undertaken by the members of the Working Group to comply with the established agreements.
c) *Definition*: Statement defining the concept of the Working Group.
d) Functions: Mention and description of the tasks attributed to the members of the Working Group.
e) *Composition*: Description of the parties that will make up the Working Group.
f) *Coordination*: Definition of the Working Group's coordinating role.
g) *Members*: Mention and description of the tasks of the members of the Working Group.
h) *Secretariat*: Mention and description of the tasks of the Working Group secretariat.
i) *Convening of meetings*: Basis for convening the Working Group to participate in the sessions/meetings.
j) *Start and development of the sessions*: Basis for conducting the sessions of the Working Group.
k) *Minutes*: Bases for the drafting of the minutes of the Working Group sessions.
l) *Confidentiality*: Bases for the confidentiality of the sessions and the decisions taken by the Working Group.
m) *Final provisions*: Regulations and rules governing the Protocol document.

To meet these specifications, a communication and interaction strategy between public administrations is needed. The draft of the governance regime was sent to the identified members of WG in order to review and approve the final document. All considerations were taken into account through a Think-Reason-Understand-Share-Test (TRUST) method (Environmental Agency, 2004) to engage Cala Millor public administrations. A two-way communication process to apply a practical and hands on approach for getting and using information to influence change was used.

4.2.3. Analysis of interest and influence

The analysis of public administration representatives was carried out through their influence and interest, in order to classify them with the aim of knowing the degree of engagement to apply with each representative. Public administration representatives' influence refers to the actual ability of their department or entity to have an effect on other entities of public administration, while interest refers to their desire to influence. A widely used methodology to organise public administration representatives according to the degree of these characteristics is the interest-influence matrix suggested by Mendelow (1991) (Figure 4). In this matrix, two axes are established: the horizontal axis depicts the level of interest over the construction project, while the vertical axis represents the level of public administration representatives' influence. Four categories of public administration representatives are defined considering the degree of both characteristics (Rompoti *et al*., 2020):

- Category A (Minimal effort): Low level of interest and low influence.
- Category B (Keep informed): High level of interest and low level of influence.
- Category C (Keep satisfied): Low level of interest and high level of influence

- Category D (Key players): High level of interest and high level of influence

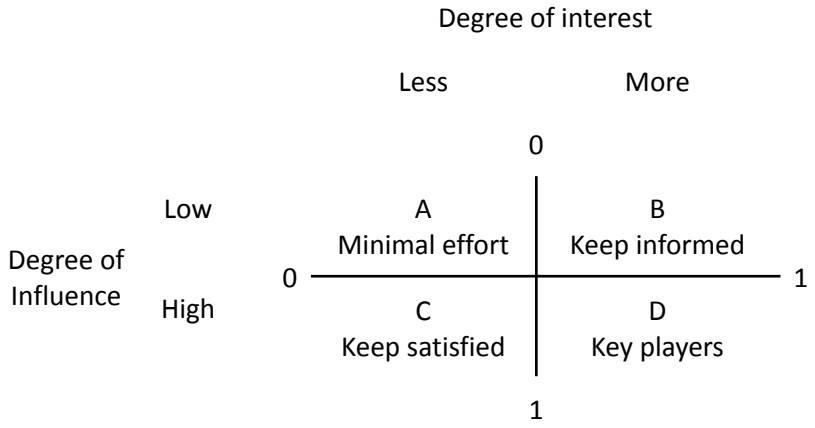

Figure 4. The Interest-Influence Matrix (adapted from Mendelow, 1991).

According to this classification, public administration representatives should be dealt with in one way or another in future stages of the governance framework (INSPIRE, 2022).

In order to establish the degree of influence and the degree of interest of public administrations, interviews were specifically designed to assess these parameters. As mentioned before (See 4.1), face-to-face, online and phone semi-structured interviews took place with representatives from public administrative departments.

The interview contained 6 key questions to define the interest and 3 key questions to define their influence. In order to get more detailed data, the interview guiding questions were relatively flexible although the interviews were consistently detailed. In terms of interview duration, most interviews took an average of 15 minutes. To make a direct assessment of the interviewees' responses, a semantic differential scale was developed (Lara-San Martín, 2013); values were given depending on the answers of the interview (Table 2). To obtain a standardised and normalised value for each parameter, the values obtained for each question were added together and divided by the number of questions, according to the following equations (Eq. 3 and Eq. 4):

$$Interest = \frac{(Q1+Q2+Q3+Q4+Q5+Q6)}{6} \quad \text{(Eq. 3)}$$

$$Influence = \frac{(Q7+Q8+Q9)}{3} \quad \text{(Eq. 4)}$$

Table 2. Semantic Differential Scale Adapted from Lara-San Martín (2013).

Mendelow's Matrix Element	**Question interview**	**Level/Degree**	**Value**
Interest	***Q1**.What degree of impact will climate change have on Cala Millor for your organisation?*	Directly affected	1.00
		Indirectly affected	0.50
		No affected	0.00
	***Q2.** How involved do you consider your organisation to be in climate change adaptation in Cala Millor?*	Very High	1.00
		High	0.75
		Intermediate	0.50
		Low	0.25
		Very Low	0.00
	***Q3**. Do you consider that the organisation to which you belong is fundamental for decision-making on climate change adaptation in Cala Millor?*	Yes	1.00
		No	0.00
	Q4. Why should your organisation be involved in climate change adaptation decision-making?	Active	1.00
		Associative	0.75
		Consultative	0.50
		Informative	0.25
		Passive	0.00
	***Q5**. What is the best way for your organisation to get involved in climate change adaptation in Cala Millor?*	Active	1.00
		Associative	0.75
		Consultative	0.50
		Informative	0.25
		Passive	0.00
	***Q6.** When would be the best time to get involved in climate change adaptation in Cala Millor?*	As soon as possible	1.00
		Later	0.00
Influence	*Q7. What influence do you consider your organisation has on other organisations?*	Very high	1.00
		High	0.75
		Intermediate	0.50
		Low	0.25
		Very low	0.00
	***Q8**. Please mention the direct partners within the administration that your organisation has.*	4 collaborator	1.00
		3 collaborator	0.75
		2 collaborator	0.50
		1 collaborator	0.25
		0 collaborator	0.00
	***Q9.** Does your organisation have experience in participating/collaborating in European projects?*	Yes	1.00
		No	0.00

4.3. Analysing public administration perception, attitudes and opinions regarding the effects of climate change on coastal ecosystems and ecosystem services

As explained before (see Section 4.1), the formula for conducting the surveys was phone calls, video calls and face-to-face interviews. In terms of interview duration, most interviews took an average of 30 minutes. The surveys were adapted to serve as guide notes for the interviews. The length of the interview had to be designed for the administrations and therefore also the sections of the survey. Twenty one questions were included in 4 sections: *Section 1*, questions about sociodemographic and the relation of the interviewee with Cala Millor; *Section 2*, questions about the effects of climate change in Cala Millor; *Section 3*, questions about the self-use and enjoyment of the beach; *Section 4*, questions about management on climate change adaptation. In Table 3 sections and questions of the survey are presented.

Table 3. Sections and questions developed for the public administration's survey.

Section	Question
Section 1: *Sociodemographic data and relation with Cala Millor*	***S1_Q1.*** *Age*
	S1_Q2. *Scope of the administration*
	S1_Q3. *Position*
	S1_Q4. *Gender*
	S1_Q5. *Visits to Cala Millor*
	S1_Q6. *Distance from Cala Millor*
	S1_Q7. *Economy related to Cala Millor*
Section 2: Perception of climate change impacts at Cala Millor	***S2_Q1.*** *Complete the sentence, I consider climate change to be a … concern*
	S2_Q2. *Do you know or have you been able to observe the effects of climate change in Cala Millor?*
	S2_Q3. *In your opinion, which of the 6 natural ecosystems of Cala Millor will be most impacted by climate change?*
	S2_Q4. *In your opinion, which of the services/goods provided by these natural ecosystems will be most impacted by climate change?*
	S2_Q5. *In your opinion, considering only the marine environment, what are the major impacts of climate change in Cala Millor?*
	S2_Q6. *In your opinion, what are the major impacts of climate change on human systems in Cala Millor?*
Section 3: Individual action and ecosystem use	***S3_Q1.*** *On the seafront of Cala Millor there are many locations that facilitate the purchase of products or other services (e.g. bars, restaurants, car rental or water activities) for beach users. If you were to visit the beach, would you mind having to go further to buy these products or access these services?*
	S3_Q2. *How often do you volunteer for conservation and/or protection of the coastal and/or marine ecosystem?*
	S3_Q3.*When you go to the beach, do you usually collect natural materials (shells, sponges, etc.)?*
	S3_Q4. *When you go to the beach, do you prefer the accumulation of leaves of marine plants (Posidonia oceanica) to have been removed from the shore?*
Section 4: Management for adaptation of Cala Millor to climate change	***S4_Q1.*** *Do you consider that the ecotax is a good mechanism for financing projects for adaptation, conservation and improvement of ecosystems?*
	S4_Q2. *Currently, the amount of the ecotax in the Balearic Islands ranges between 1.10 and 4.40 €, do you consider this amount to be adequate?*

Section	Question
	S4_Q3. *Which sector of the Balearic archipelago do you consider to have the greatest weight in the process of adaptation to climate change?*
	S4_Q4. *In your opinion, which scale of public administration has the most weight in the process of adaptation to climate change in Cala Millor?*

4.4. Analysing the perception of changes in coastal ecosystems and knowledge of climate change among scholars

Son Servera and Sant Llorenç des Cardassar have 4 summer schools (Son Servera, Sant Llorenç des Cardassar, Cala Millor and Sa Coma), with participants aged between 3 and 12 years old. Regarding the universe, according to the directors, there were 298 children aged from 6 to 11 years old estimated at Son Servera and Sant Llorenç des Cardassar summer schools. Out of that 137 sample sizes were taken at 95% confidence level and 5% sampling error. To make the sample representative from four schools, a stratified and random sampling method was employed.

As mentioned before (see Section 4.1) a face-to-face activity adapted to children was developed for the data collection (Annex II). For data collection, an age-adapted activity was developed and the 4 summer schools and 10 groups were visited to conduct questionnaires with each of the scholars.

The survey generated included 22 questions with multiresponse options (Table 4). The questions contribute to understand the children's perception of climate change and its effects in Cala Millor through 4 different sections: *Section 1*, questions about sociodemographic and the relation of the interviewee with Cala Millor *Section 2*; questions about the effects of climate change in Cala Millor; *Section 3*, questions about the use and enjoyment of the beach; and *Section 4*, questions about global climate change.

Table 4. Sections and questions developed for the scholar's survey.

Section	Question
Section 1: *Sociodemographic data and relation with Cala Millor*	***S1_Q1.*** *Age*
	S1_Q2. *Gender*
	S1_Q2. *Summer school*
	S1_Q3. *Parents position*
	S1_Q4. *Distance from Cala Millor*
	S1_Q5. *Parents economy related to Cala Millor*
Section 2: Perception of ecosystem changes at Cala Millor	***S2_Q1.*** *Do you know if there is more sand on the beach of Cala Millor than before?*
	S2_Q2. *Do you know if the sea water is warmer or warmer than before?*
	S2_Q3. *Do you know if there are more or less animals and plants in Cala Millor than before?*
	S2_Q4. *Do you know if there are more or less storms than before in Cala Millor?*
Section 3: Individual action and ecosystem use	***S3_Q1.*** *What do you like to do when you go to Cala Millor beach?*
	S3_Q2. *When you go to Cala Millor beach, do you usually pick up animals or plants from the sand, such as shells, Posidonia or sponges, and do you take them home with you?*
	S3_Q3. *When you go to Cala Millor beach, do you prefer the leaves of marine plants (Posidonia oceanica) to have been removed from the shore?*
	S4_Q1. *Have you heard about climate change?*
Section 4: Global climate change	***S4_Q2.*** *Do you think climate change is a serious problem?*

Section	Question
	S4_Q3. *Do you think climate change is something that happens naturally, or is it caused by people, or both?*
	S4_Q4. *On the cards below there are pictures of different actions that people do, can you choose 4 pictures that you think are actions that cause climate change to accelerate?*
	S4_Q5. *On the following cards there are pictures of different effects, could you choose 3 pictures of effects that you think are related to climate change?*
	S4_Q6. *Why are sea levels rising?*

5. Results and discussion

5.1. Participatory mechanism for public administration

5.1.1. Identification of Working Group members

The directory generated had 215 representatives at 4 levels of public administration: local, insular, regional and national. Sixty representatives were classified as potential public administration representatives to be interviewed and 22 administrations (considering the direct competences within the representatives) to be part of the WG. Table 5 shows all public administration entities identified as potential members of the WG.

Table 5. Public administration entities with competences on climate change adaptation (DI: Island Directorate, DG: General Directorate).

Scope	Administration	Area	Representatives	Competences
National	Ministerio para la Transición Ecológica y el Reto Demográfico	Coastal management	DG la Costa y el Mar	Direct
		Environmental protection	DG Biodiversidad y Calidad Ambiental	Indirect
			DG del Agua	Indirect
		Climate change action	Oficina Española Cambio Climático	Direct
	Ministerio de Agricultura, Pesca y Alimentación	Environmental protection	DG Pesca	Indirect
	Ministerio Ciencia e Innovación	Coastal management	Instituto Español de Oceanografía (IEO)	Direct
	Ministerio de Derechos Sociales y Agenda 2030	Environmental protection	DG Políticas Palanca para el Cumplimiento de la Agenda 2030	Direct
		Urban planning		
	Ministerio de Transportes, Movilidad y Agenda Urbana	Urban planning	DG de Agenda Urbana y Arquitectura	Indirect
			DG de Vivienda y Arquitectura	Indirect
	Ministerio de Industria, Comercio y Turismo	Economical activities	DG de Industria y de la Pequeña y Mediana Empresa	Indirect
Regional	Consejería de Economía, Hacienda e Innovación	Economical activities	DG de Innovación y Sociedad Digital	Indirect

Scope	Administration	Area	Representatives	Competences
	Consejería de Empresa, Empleo y Energía	Climate change action	DG de Economía Circular, Transición Energética y Cambio Climático	Direct
		Economical activities	DG de Empresa, Autónomos y Comercio	Indirect
	Consejería de Vivienda, Territorio y Movilidad	Urban planning	DG de Territorio y Paisaje	Direct
			DG de Coordinación y Armonización Urbanística	Indirect
			Instituto Cartográfico y Geográfico de las Islas Baleares (ICGIB)	Indirect
	Consejería de Turismo, Cultura y Deportes	Economical activities	DG de Turismo	Direct
			Agencia de Estrategia Turística de las Islas Baleares (AETIB)	Indirect
			Instituto de Estudios Baleáricos (IEB)	Indirect
	Consejería del Mar y del Ciclo del Agua	Coastal management	DG de Costas y Litoral	Direct
			DG de Recursos Hídricos	Indirect
			Puertos de las Islas Baleares	Indirect
			Agencia Balear del Agua y la Calidad Ambiental (ABAQUA)	Indirect
			Consorci d'Aigües de les Illes Balears	Indirect
	Consejería de Agricultura, Pesca y Medio Natural	Coastal management	DG de Pesca	Direct
			DG de Medi Natural i Gestió Forestal	Direct
		Environmental protection	Instituto Balear de la Naturaleza (IBANAT)	Indirect
Island	Departamento de Medio Ambiente, Medio Rural y Deporte	Environmental protection	Secretaría técnica de Medio Ambiente, Medio Rural y Deportes	Direct
			DI de Medio Ambiente	Direct
			DI de Residuos	Indirect
	Departamento de Presidencia	-	Secretaría técnica de Presidencia	Indirect
			DI de Comunicación	Indirect
	Departamento de Territorio, Movilidad e Infraestructuras	Urban planning	Secretaría técnica de Territorio, Movilidad e Infraestructuras	Indirect
			DI de Territorio y Paisaje	Direct
			DI de Urbanismo y Planeamiento Municipal	Indirect
			DI de Infraestructuras y Movilidad	Indirect
	Departamento de Turismo	Economical activities	Secretaría técnica del Departamento de Turismo	Direct
			DI de Turismo para la Oferta y la Calidad	Indirect
			DI de Turismo para la Demanda y la Hospitalidad	Indirect
			DI de Turismo para la Gobernanza y la Sostenibilidad	Direct
	Departamento de Promoción Económica y Desarrollo Local	Economical activities	DI de Promoción Económica y Producto de Mallorca	Indirect
Local	Ayuntamiento de Sant Llorenç des Cardassar	Economical activities	Alcaldía	Direct
			Concejalía de Policía local y Protección Civil	Indirect
		Urban planning	Dirección y gestión de la limpieza de las instalaciones municipales	Indirect
		Environmental protection	Concejalía de Turismo, Medio Ambiente y Comercio	Direct
		Education	Concejalía de Educación, Deportes y Fiestas	Direct
			Concejalía de Cultura	Indirect
			Concejalía de Juventud, Bienestar Social y Sanidad	Indirect
			Concejalía de Servicios Generales	Indirect
	Ayuntamiento de Son Servera	Economical activities	Alcaldía	Direct
		Urban planning	Concejalía de Urbanismo Comunicación y Relaciones Institucionales	Direct

Scope	Administration	Area	Representatives	Competences
		Environmental protection Education	Concejalía de Movilidad, Policía y Modernización	Indirect
			Concejalía de Recursos Humanos, Prevención de Riesgos Laborales y Vías y Obras	Indirect
			Concejalía de Deportes, Comercio y Mercados	Indirect
			Concejalía de Fiestas	Indirect
			Concejalía de Medio Ambiente y Personas Mayores	Direct
			Concejalía de Cultura y Juventud	Indirect
			Concejalía de Educación y Sanidad	Direct
			Concejalía de Cuentas y Hacienda, Ferias, Agricultura y Pesca y Turismo	Direct
			Concejalía de Servicios Sociales, Igualdad, LGTBI Participación ciudadana y Normalización Lingüística	Indirect
			Concejalía de Patrimonio y Cementerio	Indirect

5.1.2. Promotion of Working Group: Governance regime

Some difficulties were encountered in applying the methodology due to the change of government in 2023, when regional, island and local elections were held on 28th May 2023 and national elections on 23rd July 2023. The formation of the regional Government, by which the representatives of the public administrations were established, was published by the end of July, 2023. While the formation of the National Government was not yet published during the development of this Master Thesis.

In this regard, the representatives of the public administrations had not yet assumed their positions by the time of the functioning regime development. This situation interfered with the initially established bases of the *Protocol* in which members had to be represented and attend the meetings from the beginning until the objectives of the protocol were achieved. In this regard, the creation of the WG at due time was threatened.

In general terms, the purpose of the developed Protocol was set to establish the framework for collaboration between the signatory parties in order to promote communication and interrelation between the state, regional, island and local public administrations with powers and interests in the management and planning of the urban beach of Cala Millor.

Six commitments of the signatory parties were stipulated: i) participate in the WG through technical staff; ii) share to the signatory parties the relevant information that may be relevant to achieve the objectives of the protocol; iii) collaborate with all the signatory entities to generate the knowledge and experience to define mechanisms to promote long-term planning of the necessary investments for adaptation to climate change of urban beach of Cala Millor; iv) participate actively in the search for funding for the development of the actions and measures of the WG; v) facilitate the involvement of other public administrations; vi) enable the withdrawal or opt-out of any of the parties.

The Protocol also included a clear definition of the WG and its functions. On one hand, the WG was defined as “the body in charge of promoting an effective planning and administrative

management in relation to measures related to adaptation to climate change in the urban beach of Cala Millor". On the other hand, 4 functions of WG were established: i) to facilitate and strengthen communication and interrelation between the signatory parts of the Protocol;ii) identify and prioritise the actions to be carried out on the urban beach of Cala Millor within the framework of adaptation to climate change; iii) promote the effective administrative management of the prioritised measures in Cala Millor; iv) to submit the documentation and agreements reached by the WG to the Steering Committee. The specific functions for each WG component were also defined in each section of the different WG roles.

In the *Composition* section of the document, the election concern was addressed. As a novelty from other WG regimes, it was highlighted in this section that the WG could accept new members at any time during the governance process for climate change adaptation of Cala Millor. This stipulation gived flexibility to the functioning, ensuring the creation of the WG at due time and that relevant stakeholders would be represented at all necessary scopes and important fields for climate change adaptation. This clarification was defined in the following paragraph:

> "The Working Group will be able to incorporate new members during the development of the project, if required at the proposal of any member. Likewise, it will be able to invite, from time to time, to participate and other people with technical knowledge or experience in the field may also be invited to participate and collaborate in the meetings of the Working Group."

Under the following headings, it was established that the WG would be convened approximately every four months on a regular basis, and may organise extraordinary meetings if needed.

A detailed General Protocol document can be found in Annex II.

5.1.3. Analysis of interest and influence of Working Group members

Despite the elections, the study succeeded in interviewing 15 public administrations. Out of that, 9 were from local level, 5 from island level and 1 from regional level. Representatives at the regional level could not schedule interviews until September 2023 and at the national level the interviews were postponed until a new government was formalised. Also, 2 representatives responded to not having interest in the climate change adaptation plan at Cala Millor.

The Semantic Differential Scale allowed to assign values to the different public administration representatives and classify them according to the categories of the Mendelow's Matrix based on the elements *Interest* and *influence.* Results of the semantic scale value attribution are shown in Table 6 while Mendelow's Matrix results are shown in Figure 5.

Table 6. Semantic scale values attribution to each representative considering their responses at the interview (DI: Insland Directorate, DG: General Directorate).

Representative		Scope	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Total Interest	Total Influence
R1	Alcaldía Sant Llorenç des Cardassar	Local	1.00	0.75	1.00	0.75	1.00	1.00	1.00	1.00	0.50	0.92	0.83
R2	Concejalía de Turismo, Medio Ambiente y Comercio (Sant Llorenç des Cardassar)	Local	1.00	0.75	1.00	0.75	1.00	1.00	1.00	0.75	0.50	0.92	0.75
R3	Concejalía de Servicios Generales (Sant Llorenç des Cardassar)	Local	1.00	0.50	1.00	1.00	0.00	1.00	1.00	0.75	0.75	0.92	0.50
R4	Concejalía de Recursos Humanos, Prevención de Riesgos Laborales y Vías y Obras de Son Servera (Son Servera)	Local	0.50	0.50	1.00	1.00	1.00	1.00	1.00	0.50	0.50	083	0.67
R5	Concejalía de Deportes, Comercio y Mercados	Local	1.00	0.50	1.00	0.50	DK/NA/REF	0.75	1.00	0.75	0.50	0.79	0.63
R6	Concejalía de Medio Ambiente y Personas Mayores (Son Servera)	Local	1.00	1.00	100	1.00	1.00	1.00	1.00	1.00	0.50	1.00	0.83
R7	Concejalía de Educación y Sanidad (Son Servera)	Local	1.00	0.500	1.00	0.75	DK/NA/REF	1.00	1.00	0.75	0.25	0.88	0.50
R8	Concejalía de Cuentas y Hacienda, Ferias, Agricultura y Pesca y Turismo	Local	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.50	1.00	0.58
R9	Concejalía de Servicios Sociales, Igualdad, LGTBI	Local	0.50	0.50	0.00	0.00	0.00	0.00	1.00	0.25	0.50	0.33	0.25
R10	DI Turismo	Island	1.00	1.00	1.00	0.75	1.00	1.00	1.00	1.00	1.00	0.96	1.00
R11	Secretaría técnica del Departamento de Turismo	Island	0.50	0.50	1.00	0.5	1.00	0.50	0.00	0.75	1.00	0.50	0.92
R12	DI de Turismo para la Oferta y la Calidad	Island	1.00	0.25	1.00	0.25	1.00	0.75	1.00	0.75	1.00	0.71	0.92
R13	DI de Turismo para la Demanda y la Hospitalidad	Island	1.00	0.50	1.00	1.00	1.00	1.00	1.00	0.75	1.00	0.92	0.92
R14	DI de Turismo para la Gobernanza y la Sostenibilidad	Island	1.00	0.75	1.00	0.25	1.00	1.00	1.00	0.75	1.00	0.83	0.92
R15	DI de Promoción Económica y Producto de Mallorca	Island	1.00	0.75	1.00	1.00	1.00	1.00	1.00	0.75	1.00	0.96	0.92

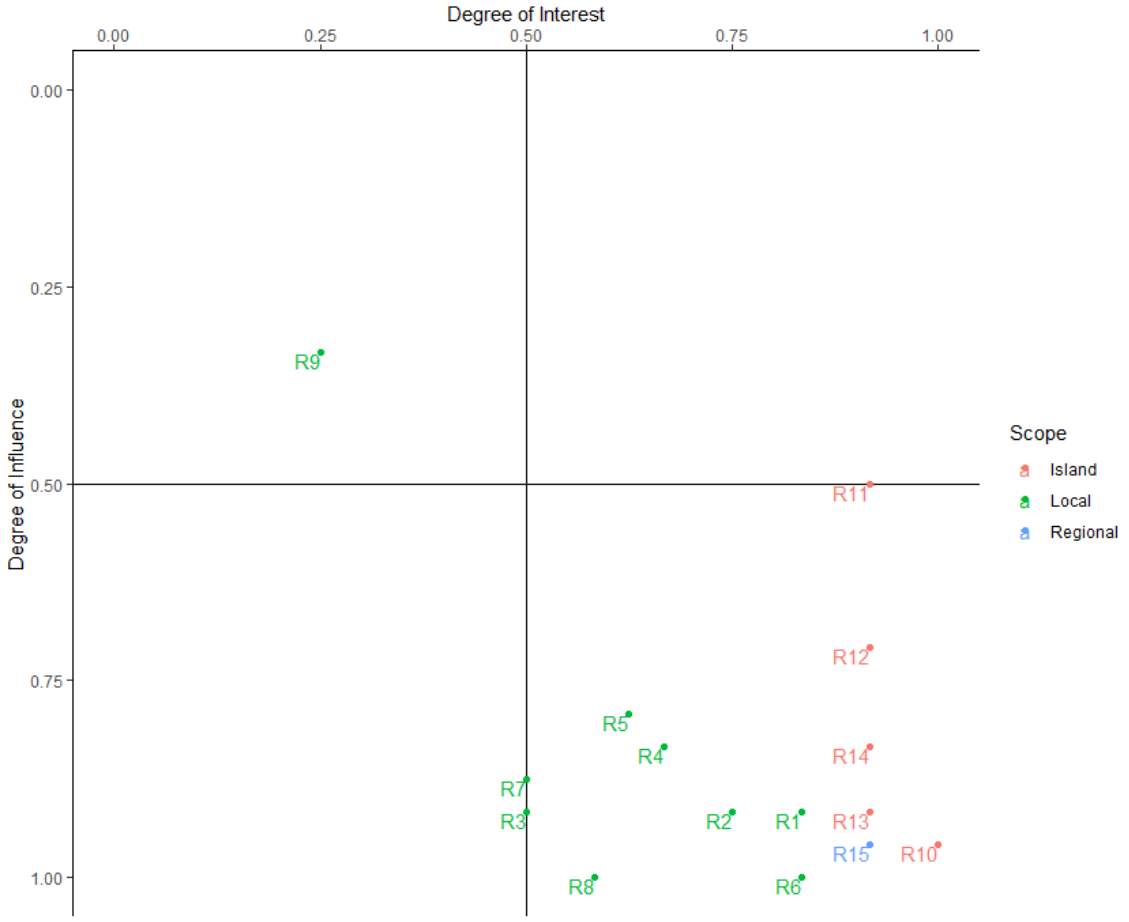

Figure 5. Interest-Influence Mendelow's Matrix of interviewed administrative representatives.

In general terms, it can be observed that island-level administrations have more influence than interest, and vice versa with local-level administrations. While the regional one has high interest and influence. One public administration representative was classified in category A, being the one with less interest and influence for the Working Group as a participatory mechanism. These public administration representatives will be monitored but not engaged. Between the limits of B category (representatives who should be informed along the participatory mechanism to develop the adaptation plan and keep an open communication with) and D (representatives who make significant efforts with) we found two public administration representatives at local level. One public administration representative who should be satisfied by working with them was revealed in the limit of category C and A. Finally, 11 public administration representatives who must be fully engaged by making significant efforts to help to deliver their outcomes were found in category D.

5.2. Public administration perception, attitudes and opinions regarding the effects of climate change on coastal ecosystems and ecosystem services

Some interviews and questionnaires on the topic or risk associated with climate change have been conducted in Spain to representatives of public administration (Lara-San Martín, 2013; García de Jalón and Quiroga, 2013). Nevertheless, the relationship of governance to climate change has evolved considerably and the information provided may have become outdated. Also, there are no reports focusing only on the coastal perception of representatives regarding climate change adaptation but, opinion polls related to climate change issues and perceptions have been conducted among local citizens of Spanish Autonomous Communities and islands. Some examples were the surveys conducted in Catalunya (Villares *et al*., 2015), Vigo (Espada *et al*., 2016), Guipúzcoa (Sideco, 2019), Gran Canaria (Corujo *et al*., 2020) and Tenerife (Correa *et al*., 2023). At the national level, there are also surveys on the overall perception of climate change among Spanish citizens (Meira *et al*., 2013; Valdor *et al*., 2019; Lázaro *et al.*, 2019; Bustelo *et al*., 2021). At the European level, the European Union conducts surveys and compares the perception in all European countries (European Union, 2023).

In this Master Thesis, the most recent reports will be used to see the differences or similarities between the opinion of local administrations and society in general. Bearing in mind that the representatives of the administrations are also citizens, the most recent reports will be used to see the differences or similarities between the opinion of the public administrations and surveys previously conducted on citizenship.

From 60 requests sent to representatives from public administration with competences in climate change, a total of 15 interviews were conducted. Table 7 presents the socio-demographic characteristics and relation with Cala Millor summary of the representatives interviewed.

Table 7. Sociodemographic characteristics of the public administration representatives interviewed.

Sociodemographic Characteristics	n= 15	Percentage (%)
Age		
25-39		13.3
40-54		66.7
≥55		20.0
Gender		
Female		40.0
Male		60.0
Position		
Regional executive director		6.7
Island executive councillor		6.7
Island technical secretariat		6.7
Island director		20.0
Mayor		6.7
Councilor		53.3

Relation with Cala Millor	n= 15	Percentage (%)
Distance from Cala Millor		
1-10		66.7
>50		33.3
Economy related to Cala Millor		
Yes		46.7
No		53.3
Visits to Cala Millor		
Everyday		53.3
Once a week		13.3
Every month/ Many times a year		6.7
Few times a year		20.0
Never		6.7

Sociodemographic Characteristics	n= 15	Percentage (%)
Scope		
Local		60.0
Island		33.3
Regional		6.7

Relation with Cala Millor	n= 15	Percentage (%)

The majority of the representatives interviewed were in the age range 40-54 years and the least young ones, with 13.3%. In terms of gender, 60% were represented by males and 40% by females. The 53% of those surveyed held positions as councillors in the town councils, with 60% of local representation in the analysis. The scope less represented was the regional with 7%. Regarding the variables of the relationship with Cala Millor, 67% of the respondents live in municipalities around Cala Millor and 53% have a related economy. The 53% of the representatives, with the highest percentage, visit Cala Millor every day and the 7% of representatives never visit Cala Millor or visit every month.

In the statistical analysis, the generalised models have found that there is no significant relationship between dependent variables and sociodemographic and the relation to Cala Millor variables ($p>0.1$).

5.2.1. Severity degree of climate change and its effects at Cala Millor

Taking into account the most recent studies at island level (Correa *et al*., 2023), national (Bustelo *et al*., 2021) and European level (European Union, 2021), more than 90% of Spanish citizens consider climate change to be really happening, being conscious that it is closely related to human activities. According to Bustelo *et al.* (2021) an equally or more important issue than the belief in climate change or the attribution of its causality is the relevance attached to it, as the consideration may depend, for example, the personal and collective attitude towards the policies of climate change action that are promoted by the administrations. On this basis, the present study questioned the degree of severity of climate change for public administrations and whether they were aware of the effects of climate change in Cala Millor.

Table 8 shows the percentage of the perception of the representatives of the administrations regarding the severity of climate change (S2_Q1).

Table 8. Answers of degree of climate change severity by public administrations

Degree of climate change severity	%
Severe	73.3
Moderately severe	20.0
Secondary	6.7

The results show that 73% of the people interviewed considered climate change to be a severe problem. On the opposite side, almost 7% expressed that it is a secondary problem. The remaining 20% considered climate change to be a moderately serious problem.

In Figure 6, the results of the severity of climate change as a function of socio-economic variables are mapped.

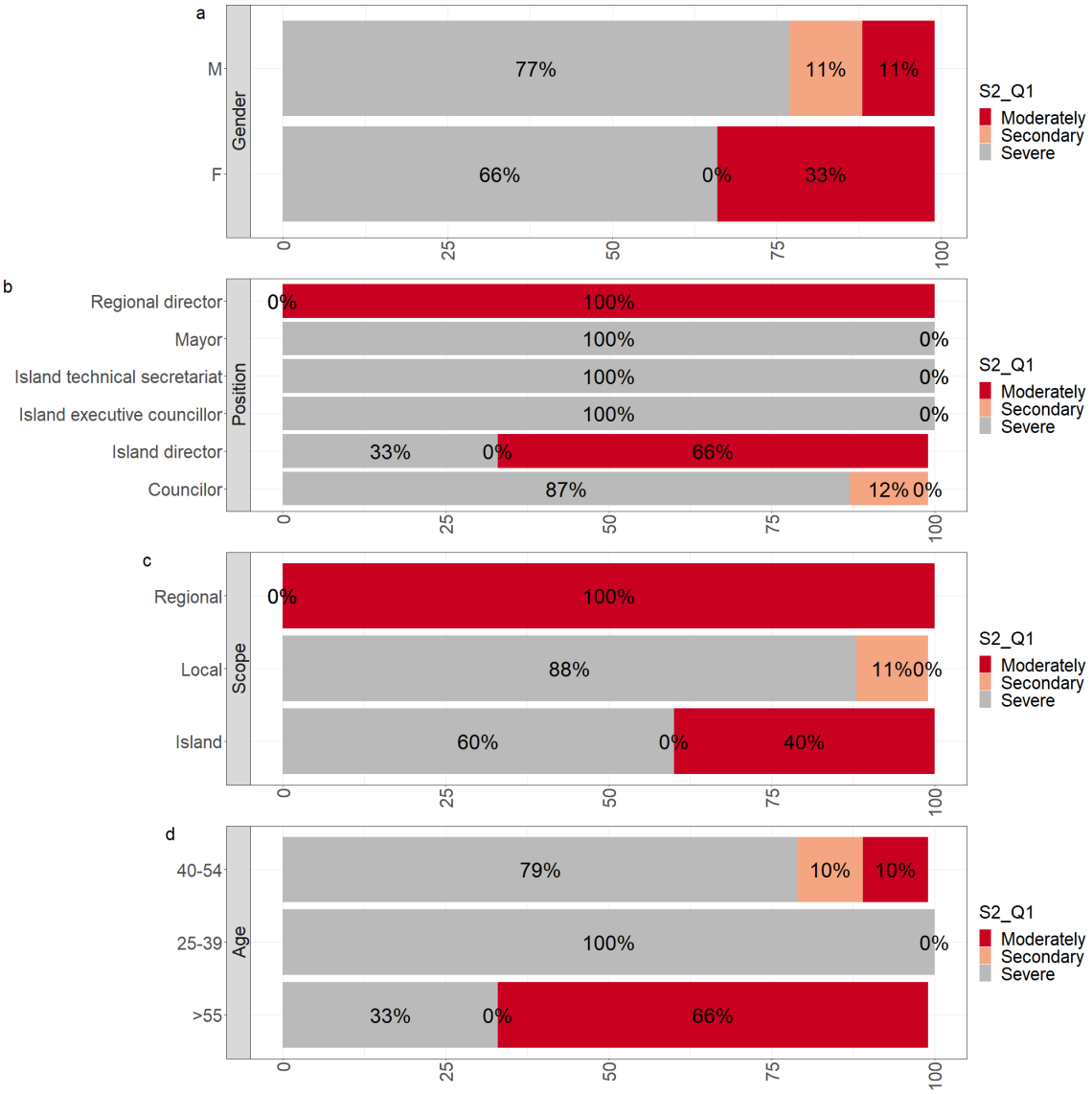

Figure 6. Demoscopy of the perception (in percentage, %) of the seriousness of climate change by public administrations by groups: a) Gender, includes the categories female (F) and male (M); b) Position, contains the categories regional director, mayor, island technical secretariat, island executive councilor, island director, councillor; c) Scope contains the categories regional, island, local; d) Age, contains the categories "40-54", "25-39" and ">55".

Classifying the data by groups, it can be seen that men seem to be more concerned about climate, with 77% of the representatives considering it as severe. Regarding the position, mayors, island technical secretariat and island executive councillors considered climate change to be a severe concern. Highlights of the island director's position were only 33% considered it to be a severe problem. The locals and the age range 25-39 years, show greater concern than the other representatives of the administration, with 88% and 100% respectively. Also it is noticeable that from representatives aged more than 55 years, only 33% considered climate change a severe concern.

Focusing on the effects of climate change in Cala Millor, Table 9 shows the percentage of representatives of the administration that were aware.

Table 9. Percentage (%) of public administration representatives aware or having observed the effects of climate change in Cala Millor

Awareness of the effects of climate change in Cala Millor	%
Yes	73.3
No	26.7

Results show that 73% of people were also aware of the effects of climate change in Cala Millor, compared to 27% who were unaware of these effects. These results raise three initial conclusions: people who live at a greater distance from Cala Millor, who have a lesser economic relationship with the case study and visit less Cala Millor, will be less aware of climate change effects at Cala Millor. In Figure 7, the awareness perception of the climate change effects grouped by the variables about the relation with Cala Millor are represented.

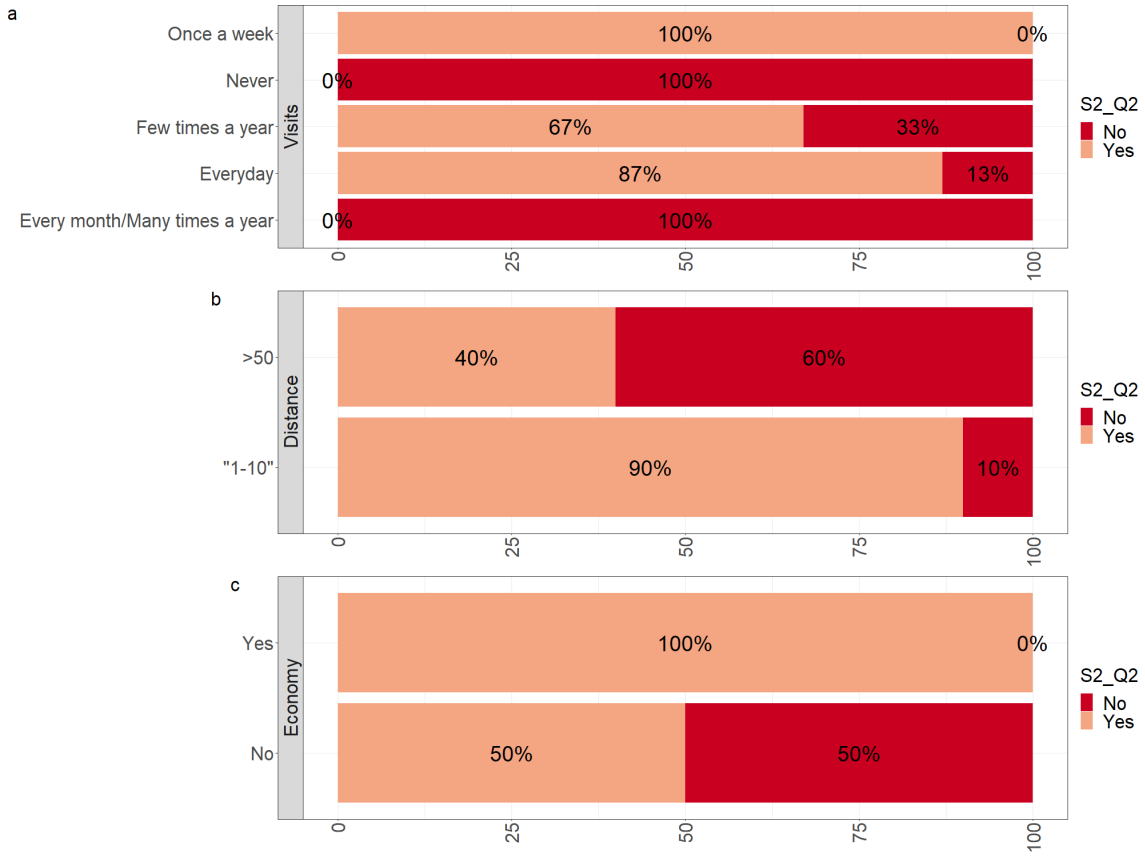

Figure 7. Awareness of the effects of climate change in Cala Millor by public administrations (in percentage, %) considering their relationship with Cala Millor in three different groups: a) Visits, contains the categories "Once a week", "Never", "Few times a year", "Every day", "Every month/many times a year"; b) Distance, contains the categories "1-10 km" and ">50 km"; c) Economy related to Cala Millor, contains the categories "Yes" and "No".

Again, generalised models did not indicate any significant relationship between knowledge of the effects of climate change and respondents' relationship with Cala Millor. The results made it possible to intuit the fulfilment of the raised conclusions although it cannot be demonstrated with significance. The 60% of the total number of people who were interviewed lived at a distance of 50 km or more from Cala Millor were not aware of climate change effects at Cala Millor. However, 90% of representatives from municipalities surrounding Cala Millor, knew about the climate change effects at Cala Millor. In the economy related to Cala Millor group, all people interviewed with an economic relation with Cala Millor were aware of the effects of climate change. People who visited Cala Millor at least once a week also obtained the highest percentage of representatives being aware of the effets.

The multi-response questions in section 2 of the survey allowed us to find out how they think climate change will affect the ecosystems and ecosystem services of Cala Millor. Responses were developed regarding the ecosystems (S2_Q3) (Consorcio de Turismo Son Servera y Sant Llorenç des Cardassar, nd.), ecosystem services (S2_Q4) (Haines-Young and Potschin, 2018), impacts in marine environment (S2_Q5) (MITECO, 2021)(IPCC, 2022) and socioeconomic system (S2_Q5) (IPCC, 2022).

Table 10 shows a summary of the questions, the possible answers and the acronym used to represent results in the follwoing figures.

Table 10. Symbology attributed to the answers of Perception of climate change impacts at Cala Millor (Survey Section 2).

Question	Answer	Acronym
S2_Q3 Impacted natural ecosystems	Coastal Forest	CF
	Dune System	DS
	Beach	BE
	Leafs Affluence	LA
	Posidonia Meadow	PM
S2_Q4 Impacted ecosystems services	Production Services	PS
	Regulation and Maintenance Services	RS
	Cultural Services	CS
S2_Q5 Impacts in marine environment	Impacts on the functioning of streams and production of organisms	C
	Impacts species distribution	D
	Impacts on the number of individuals	I
	Impacts on biodiversity	B
	Impacts on reproduction	R
	Episodes of mass mortality	M
S2_Q6 Impacts on the socioeconomic system	Impacts on water and food production (water scarcity, agriculture/agricultural production, animal health and livestock productivity)	PI
	Impacts on health and well-being (infectious diseases, heat, malnutrition, mental health, displacement of people)	HI
	Impacts on cities, settlements and infrastructure (inland flooding and associated damage, flood and storm induced damage, damage to infrastructure, damage to key economic sectors).	II

As explained above, the ecosystem most affected by the effects of climate change in Cala Millor will be mainly the dunes (which no longer exist) and the beach. Since 1956, the embryonic dune ecosystem has been reduced up to 70% and urban land use has increased by 64% by 2021

(Nolla, 2023). On the other hand, from 2005 to 2018, Posidonia has decreased its ecological status from very good to moderate (Vaquer-Sunyer, 2023). However, there is no evidence the impact on Posidonia has been only caused due to climate change. Considering the changes in land use and the increase in hotels in the area, the decreasing Posidonia ecological status could be more related to nautical activities in the area (Montefalcone, 2006; Abadie, 2012). Also related to tourist demand, in Cala Millor the Posidonia deposit is often removed from the shore, an issue that should be regulated, since the shore Posidonia leaves ecosystem contains many living organisms and is one of the main sediment replenishers, regulating the contribution of sediment in deficit areas (INAP, 2023). There is also no evidence that coastal vegetation has been altered by climate change, although it may have been affected by human use.

Figure 8 represents the percentage of perceptions of representatives of the administration on which of the natural ecosystems, their elements and their ecosystem services, as well as the urban system of Cala Millor, will be most susceptible to being impacted by the effects of climate change.

The results of the representatives' perception of the impacts of the natural ecosystems of Cala Millor (S2_Q3) show that 40% of the people indicated that the natural ecosystem that will be most affected by climate change is the dune system (DS) and the beach (BE), with a 10% less representatives than the other. Half of these people, with 50%, considered that the ecosystem services likely to suffer the greatest impact (S2_Q4) were the regulation and maintenance services (RS) and production services, by the 43% of representatives. As for the marine ecosystem (S2_Q5), according to the perception of the representatives of the administrations, the greatest impacts will be on biodiversity (B), by the 30% of representatives, and currents and the dynamics (e.g. hydrodynamic and morphodynamic) of the bay (C) and episodes of mass mortality (M), by 27% of representatives. Finally, considering only the urban system of Cala Millor (S2_Q6), 43% perceive that the greatest impacts of the effects of climate change in Cala Millor will be on people's health and wellbeing (HI) and really close to that percentage, with a 43%, production processes carried by human at the area.

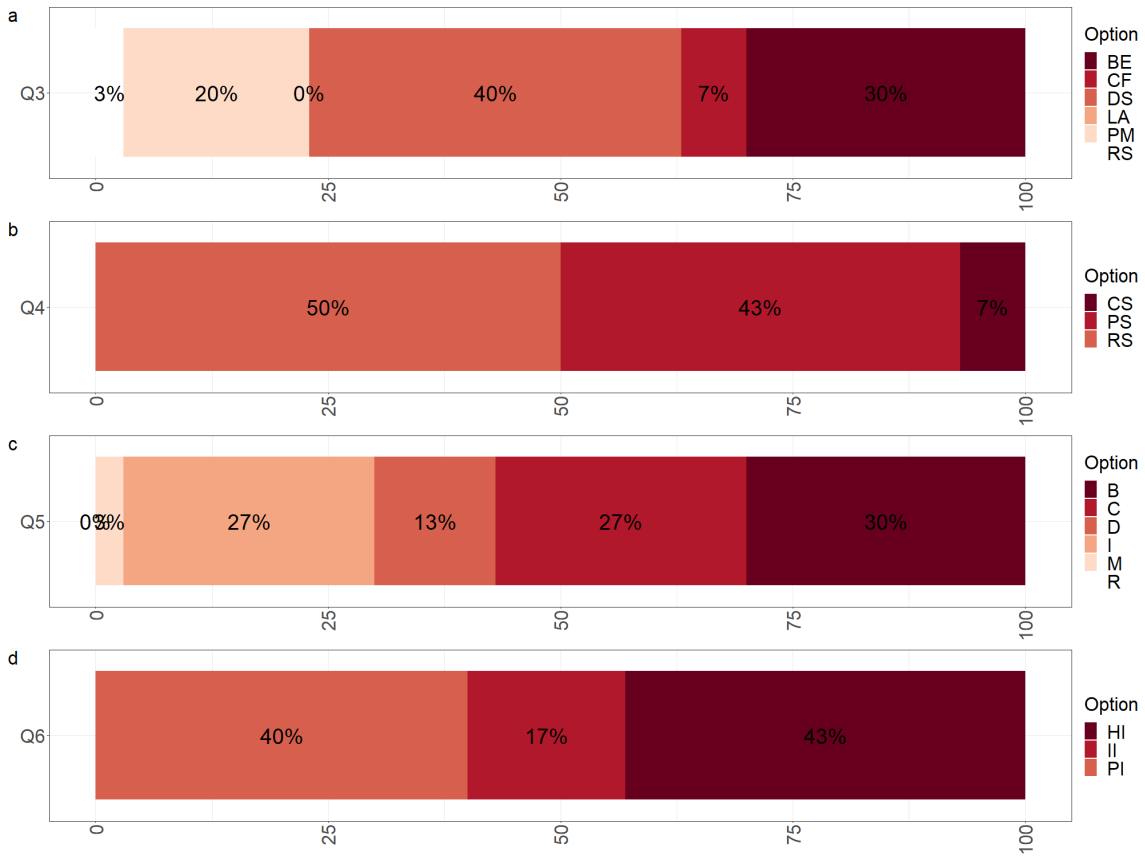

Figure 8. Percentage of perceptions (%) of public administration regarding the ecosystem, ecosystem services, marine system and urban system. The possible responses are the following: a) ecosystems of Cala Millor (S2_Q3) include coastal forest (CF), dune system(DS), beach (BE), Posidonia leafs affluence (LA); Posidonia meadow (PM); b) ecosystem services (S2_Q4) include production services (PS), regulation and maintenance services (RS) and cultural services (CS); c) marine environment impacts (S2_Q5) includes: Impacts on the functioning of streams and production of organisms (C), impacts species distribution (D), impacts on the number of individuals (I), impacts on biodiversity (B), impacts on reproduction (R), Episodes of mass mortality (M); d) socioeconomic system (S2_Q6) includes Impacts on water and food production (water scarcity, agriculture/agricultural production, animal health and livestock productivity) (PI), impacts on health and well-being (infectious diseases, heat, malnutrition, mental health, displacement of people (HI), impacts on cities, settlements and infrastructure (inland flooding and associated damage, flood and storm induced damage, damage to infrastructure, damage to key economic sectors (II).

5.2.2. Behaviour and attitudes towards the effects of climate change

This section presents the results of the survey in relation to the behaviour and attitudes of the public administration representatives that can have a positive or negative impact on the evolution of ecosystems at Cala Millor. In general, at all scopes surveys, everyday behaviours with a low behavioural cost and which can be valued, as well as being pro-environmental, because they represent significant economic savings and behaviours that are the subject of

relatively intense institutional campaigns (European Union, 2021; Bustelo, 2021; Correa *et al*., 2023).

In this case, questions related to attitudes and behaviours were adapted for coastal environments. In questions S3_Q1 and S3_Q4, the interviewees had to postulate their preferences and, in questions S3_Q2 and S3_Q3, they had to respond with regard to their behaviour related to climate change action in coastal areas or beach use. As mentioned in the previous section (see 5.2.1.), the beach and the dune system are the ecosystems of the Cala Millor coastline that are disappearing at a faster rate than other ecosystems in the area. For this reason, the questions referring to attitudes and behaviours make greater reference to these ecosystems.

Attitudes

Question S3_Q1 (Figure 9.a), considered the possibility of seafront site setbacks, a measure developed in several climate change adaptation projects to regenerate dune systems, while Question S3_Q4 (Figure 9.b), referred to the maintenance of Posidonia leaf deposits by the shore, a measure used to support sediment accumulation in the beach ecosystem.

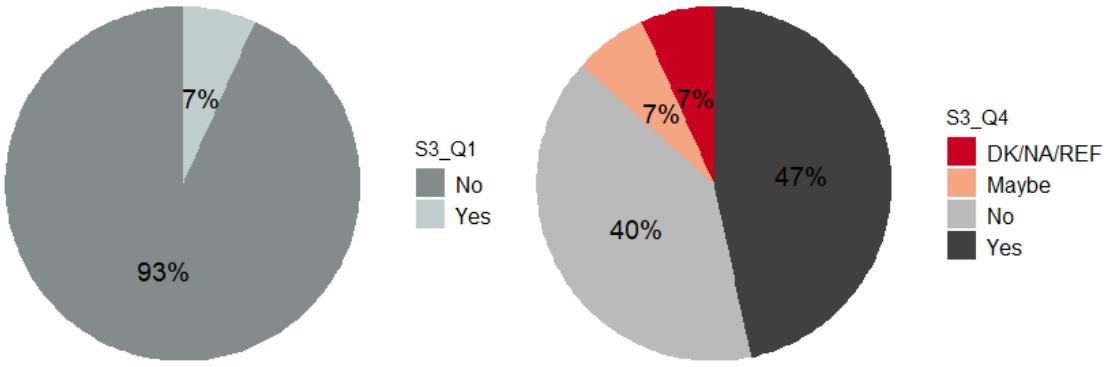

Figure 9. Climate action attitude answers of public administration representatives in percentage (%): a) S3_Q1: *On the seafront of Cala Millor there are many locations that facilitate the purchase of products or other services (e.g. bars, restaurants, car rental or water activities) for beach users. If you were to visit the beach, would you mind having to go further to buy these products or access these services?* ; b) S3_Q4: *When you go to the beach, do you prefer the accumulation of leaves of marine plants (Posidonia oceanica) to have been removed from the shore?*

In Figure 9.a, it can be seen that 93% of the representatives of the public administration showed a positive attitude towards the possibility of having to move beyond the seafront to obtain products or site services. Likewise, in Figure 9.b, they showed a negative attitude towards the appearance of *Posidonia oceanica* leaves deposited on the shore, resulting in 47% of people who would prefer them to be removed.

Behaviour

Table 11 shows a summary of the frequencies obtained for differnet behaviours. Results of question S3_Q2 aimed to identify those representatives who are more active and participatory

in acting against ecosystem degradation. Question S3_Q3, aimed to identify the social awareness of taking natural materials from the beach. For those questions and in order to facilitate the analysis, the response alternatives have been grouped into two basic categories. The first one sums the response alternatives "always", "frequently" and "sometimes" and the second adds the categories "seldom" and "never".

Table 11. Likert scale of responses on the behaviours of public administration representatives with regard to individual action on climate change and use of beaches

Behaviour	Always	Frequently	Sometimes	Total (Always, frequently and sometimes)	Seldom	Never	Total (Seldom, never)
Volunteer in coastal ecosystem conservation/protection/ restoration programmes (S3_Q2)	0.0%	13.3%	20.0%	**33.3%**	33.3%	33.3%	**66.6%**
Collect natural materials (shells, sponges, etc.) (S3_Q3)	0.0%	6.7%	0.0%	**6.7%**	6.7%	86.7%	**93.4%**

The 67% of the respondents had a negative attitude towards participation in volunteer programmes dedicated to maintaining, protecting or restoring coastal ecosystems. On the other hand, 93% of respondents had a positive attitude, showing awareness of the effects of taking natural materials from the natural beach ecosystem.

Positive attitudes and behaviours

In the dermoscopy of these variables, the aim is to determine the people who have the most positive attitudes and behaviours. Figure 10 represents the percentage of positive attitudes and behaviours for each question according to category and socio-demographic group.

In terms of gender, males stood out as having the best attitudes and behaviour, with an 83%±33.5% of representativity in positive attitudes and behaviours. Considering the position, both the mayor category and the island executive councillors category, all the people interviewed showed positive attitudes in all the questions. In terms of the scope group, the regional represent 100% in all behaviours and attitudes. Finally, People aged between 25 and 39 years are the ones with the most positive attitudes and behaviour, also with a 100% of representatives.

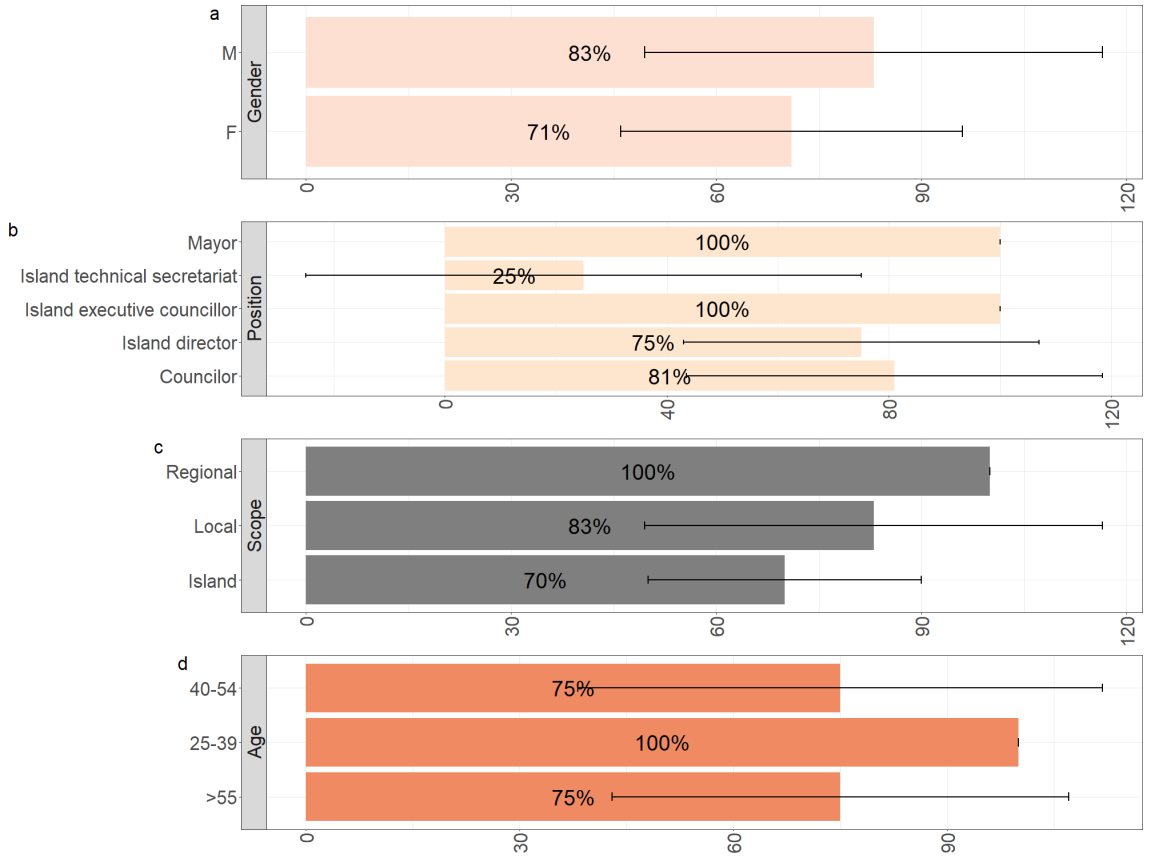

Figure 10. Demoscopy of the positive attitudes and behaviour means and standard deviation (in percentage, %) by groups: a) Gender, includes the categories female (F) and male (M); b) Position, contains the categories regional director, mayor, island technical secretariat, island executive councillor, island director, councillor; c) Scope contains the categories regional, island, local; d) Age, contains the categories "40-54", "25-39" and ">55".

In the same way, Figure 11 presents the study of the variables showing the relation with Cala Millor.

Regarding the distance, representatives living in municipalities 1 to 10 km from Cala Millor, showed better behaviour and attitudes with a 72%±42.7% percentage of representatives with positive behaviour and attitudes. Considering the economy, people with an economy related to Cala Millor showed better attitudes towards individual climate change action and beach use in all questions, with 75±41.8% . Finally, people that visited Cala Millor once a week had 3% more representatives having positive attitudes and behaviours, with a 75±42.1%, than the ones that visited Cala Millor everyday.

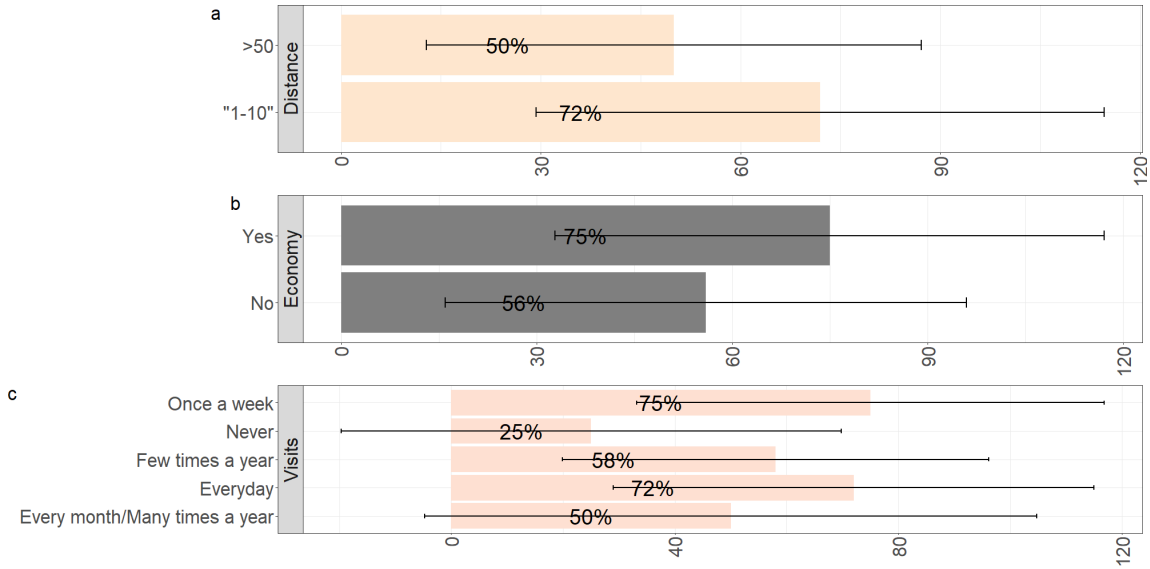

Figure 11. Positive attitudes and behaviours means and standard deviation (in percentage, %) by the relation to Cala Millor groups: a) Distance, contains the categories "1-10" and ">50"; b) Economy, contains the categories "Yes" and "No"; Visits, contains the categories "Once a week", "Never", "Few times a year", "Every day", "Every month/many times a year"; and c) Visits, contains the categories "Once a week", "Never", "Few times a year", "Every day", "Every month/many times a year".

5.2.3. Management perception for climate change adaptation

The "ecotasa" as a tool

According to Law 2/2016 the "ecotasa" is a soft tax on tourist accommodation in the Balearic Islands to promote sustainable tourism and the Commission for the Promotion of Sustainable Tourism (BOE-A-2016-4175). In section 3, questions regarding the "ecotasa" of the Balearic island as a management tool to fund projects for adaptation, conservation and ecosystem improvement were developed. Table 12 shows results of which public administration representatives would agree in paying the tax (S4_Q1).

Table 12. Willingness of public administrations interviewed to pay the "ecotasa" with the aim of funding

Willingness to pay the "ecotasa"	%
Yes	87.0
No	13.0

In this study, 87% representatives of public administration agree on paying the "ecotasa", while 13% disagree.

Question S4_Q2 asked the representatives whether the amount paid (e.g. the amount ranges from 1.1 and 4.4 € to date) is adequate, if it should be higher or less. In commerce studies of sustainability, it has been found that consumers view sustainability and the associated generational differences in willingness to pay for sustainable products and services

(Simon-Kucher and Partners, 2021). According to the assumption of this study, an adapted sociodemographic and relation with Cala Millor analisis was made on representatives who would pay a higher rate or who would pay a higher amount in eco-tax to fund projects to address climate change (Figure 12).

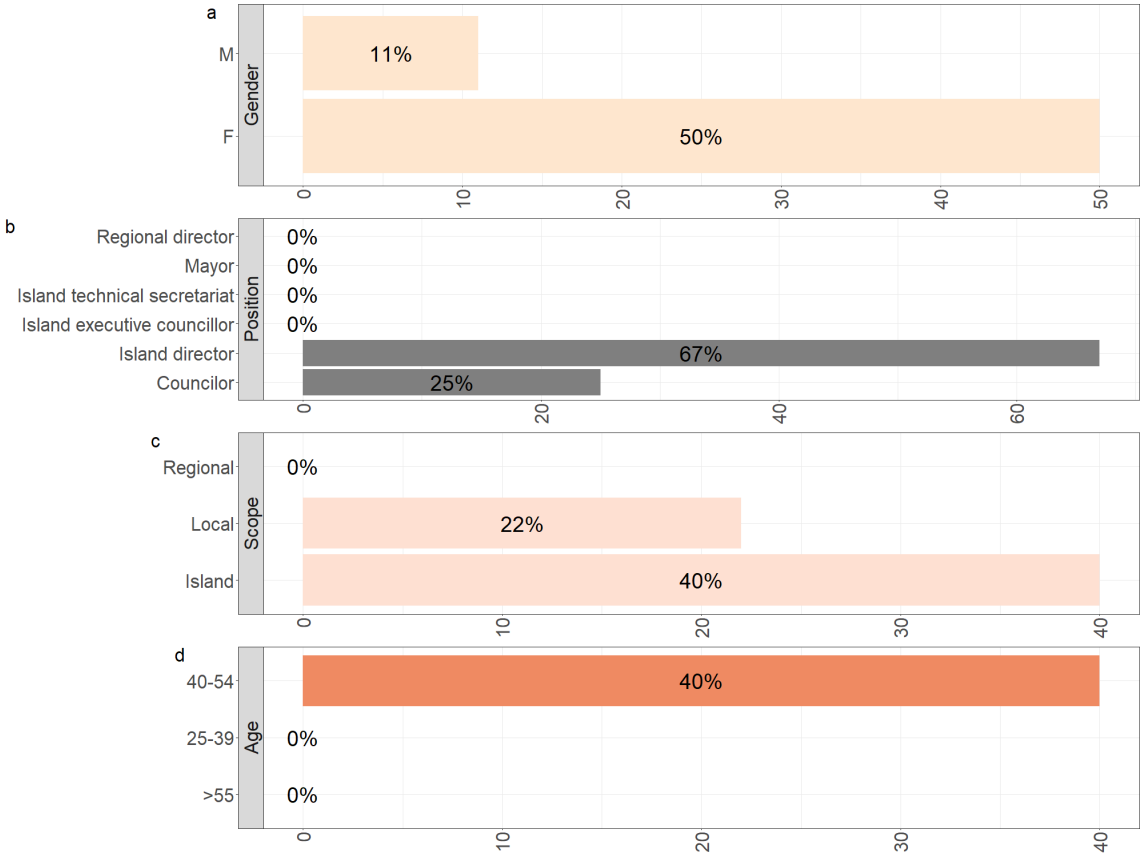

Figure 12. Demoscopy of representatives who would pay a higher amount of eco-tax (in percentage, %) by groups: a) Gender, includes the categories female (F) and male (M); b) Position, contains the categories regional director, mayor, island technical secretariat, island executive councillor, island director, councillor; c) Scope contains the categories regional, island, local; d) Age, contains the categories "40-54", "25-39" and ">55".

The results do not fit the premise of young people's relationship with the dissipation of paying more to finance adaptation projects, but it is the aged range 40 to 54 who represent the willingness to pay more. Of this age category, 40% responded that the "eco-tax" should be higher. Attending the position group, only island directors and councillors agreed on paying more, being the island directors a higher percentage with 67% of representatives. As might be expected, considering the result of the previous group, the most represented scope was the island scope.

Management in climate change adaptation

Regarding the latest surveys at different scopes, the European expressed that the European Union, together with national governments, are the most responsible for tackling climate

change (European Union, 2023). The inclusion of people in the processes of studying and developing responses to environmental issues has been an issue regularly addressed in research, laws, and international conventions (United Nations, 1992; IPCC, 2022), which consider that an informed society integrated in climate action facilitates both mitigation and adaptation to climate change. This increase of citizen participation in governance processes was reflected in 2021 national surveys, where results showed that for citizens the best tool to address climate change would be policy planning at national scope (Engie, 2021). However, today's gambling policies were rated negatively at different levels of public administration (Bustelo, 2020; Correa *et al*., 2023), with almost the sole exception, as mentioned above, of the European Union, to which a high percentage of those surveyed gave a less negative assessment than the national administrations (European Union, 2023).

In the survey proposed in this master thesis, a modification of the questions regarding management is proposed, referring to climate change adaptation Figure 13 shows the results obtained in reference to the weight that entities, bodies or citizens should have in climate change adaptation (S4_Q3).

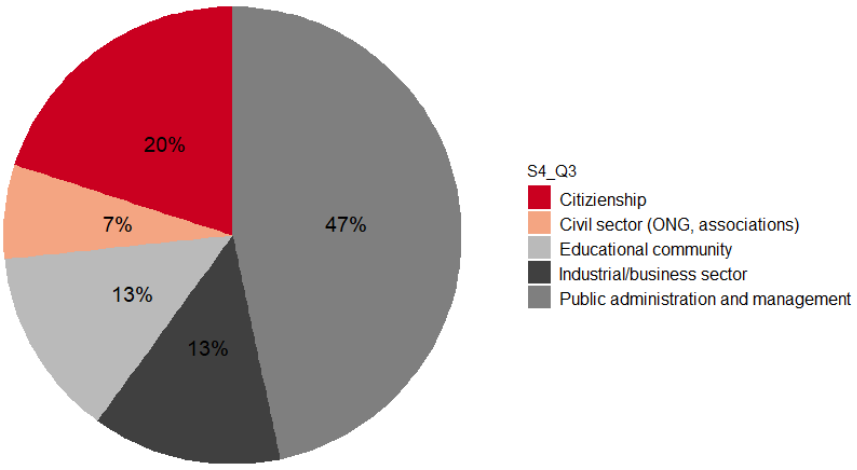

Figure 13. Percentage of representative administration responses of which scale of public administration has the most weight in the process of adaptation to climate change in Cala Millor (S4_Q3).

Coinciding surveys to citizens at European and island scope (European Union, 2023;), it can be seen how the representatives of the administrations consider that the greatest weight should be given to public administrations, with 46%.

A recent survey conducted by the European Investment Bank reveals that 83% of the Spanish population considers itself more concerned about the climate emergency than its own government, which is more than eight points above the European average (European Investment Bank, 2022). In particular, the majority believe that the measures that have been adopted so far are too flexible, leading 58% of Spaniards to believe that their country will not meet its greenhouse gas emission commitments. At this point, it would be interesting to know whether public administrations consider that theirs is the one that should have the most weight for climate change adaptation. Figure 14 represents the percentages voted by the public administrations according to the scope.

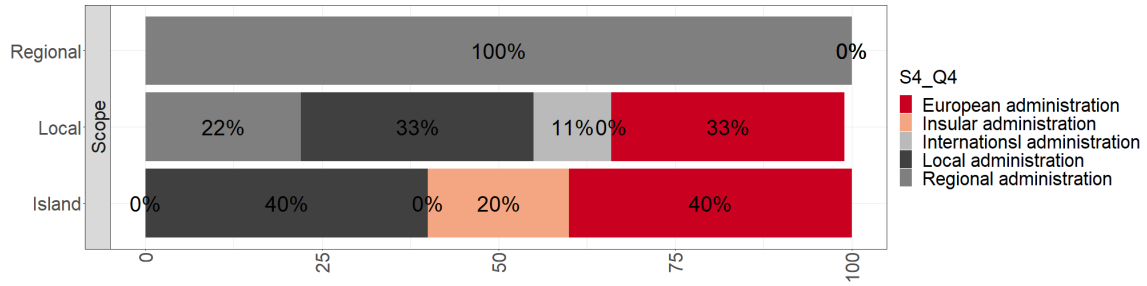

Figure 14. Percentage of representative administration responses of which scale of public administration (European, island, international, reginal, local) has the most weight in the process of adaptation to climate change in Cala Millor grouped by scope and its categories: regional, island, local.

In general, results show that unlike the publication of the European Investment Bank (2022), the administrations in charge of managing Cala Millor, assume their responsibilities and are willing to develop policies for adaptation to climate change, but mostly alongside with European policies. Results indicated that 100% of the regional representation thought that their entity had the most weight in the management of climate change adaptation. At the local level, the majority of representatives, with 33%, stated that their level also had the most weight in climate change adaptation management, with another 33% indicating that it should be the European level. Finally, at the island level, only 20% stated that their administration should have the most weight for climate change adaptation, the remaining 80% selected local and European administration.

5.3. Perception of changes in coastal ecosystems, attitudes and knowledge of climate change among scholars of Cala Millor, that will be potentially affected by the adaptation plan

Normally the school and student society group is the last to be taken into account in participatory governance processes. In fact, studies on children's perception of climate action are relatively limited yet and they have not been considered yet in global climate action surveys. In general, primary school surveys are related to global climate change and scopes of study are usually local or regional (Lee *et al*., 2020; Morote *et al.*, 2021; Sjöblom *et al*., 2022; Ramos *et al.,* 2023). This section aims to understand not only children's global perception of climate change, but also their perception of its effects at the local level, in order to design campaigns adapted to their knowledge that will allow them to be involved in the governance process.

In this section, only the results of the global climate change section (5.3.3) have been discussed with other studies, as, there were no primary school surveys specifically developed on the perception of climate change effects at local coasts and questions in sections 5.2.1 and 5.2.2 were developed expressly developed for urban coastal environments such as Cala Millor.

In total, 137 children from 4 summer schools were surveyed at Cala Millor. In Table 13, all surveyed children are classified by their sociodemographic characteristics and relation with Cala Millor.

Table 13. Sociodemographic characteristics of the public administration representatives interviewed.

Sociodemographic Characteristics	n=137	Percentage (%)
Age (Mean 8.19±1.24 years)		
6		8.0
7		21.9
8		31.4
9		25.6
10		8.0
11		5.1
Summer school		
Sant Llorenç des Cardassar		23.4
Son Servera		24.1
Sa Coma		14.6
Cala Millor		38.0
Parents position		
Senior professional		0.7
Local shop owner		5.8
Average worker		13.9
Administrative staff		14.6
Sales staff		8.8
Skilled worker		17.5
Security worker		1.5
Unskilled worker		35.8
DK/NA/REF		1.50
Gender		
Female		50.4
Male		49.6

Relation with Cala Millor	n=137	Percentage (%)
Distance from Cala Millor		
<1		24.8
1-10		73.7
10-50		1.5
Economy related		
Yes		54.7
No		28.5
DK/NA/REF		16.8

Starting with the age group, the mean of scholars surveyed was 8.19±1.24. The summer school where there were more participants was at Cala Millor, representing 38% of answers, while Sa Coma was where the least number of children participated, being 15%. Regarding the group of parents' position, the most frequent category, with 36%, was unskilled occupations and the least were senior professionals with 1%. Around half of respondents were males and the other half females. Taking into account the variables that relate the participants with the study area, the 73% lived in the municipalities of Cala Millor (e.g. 1-10Km category), 25% lived in the town of Cala Millor, and finally just the 2% lived in municipalities close to this area (e.g. 10-50 Km category).

5.3.1. Perception of climate change effects at Cala Millor regarding ecosystems

This section analysed whether children are able to perceive the effects of climate change that affect the ecosystems of the Cala Millor area. As explained in section 5.2.2., the main effects are visible on the beach and the dune system, being mainly affected by the rise in sea level and extreme weather events (Morales-Márquez *et al*., 2018; Luque *et al*., 2021). The question S2_Q1 *Do you know if there is more sand on the beach of Cala Millor than before?* covers both

the beach and the dunes, as it refers to sand in general, and the question S2_Q4 *Do you know if there are more or less storms than before in Cala Millor?* alludes to extreme storm event effects inquiring about its recurrence. The other coastal ecosystems of Cala Millor (e.g. Coastal forest, *Posidonia oceanica* meadow, *Posidonia oceanica* leafs affluence by the shore, rocky shore) are included in the other questions of the section, where the rising temperatures in the marine ecosystem (S2_Q2) and the decrease in the abundance of individuals and loss of biodiversity both marine and terrestrial (S2_Q3) are questioned.

Table 14 shows results of children's perception regarding effects of climate change on Cala Millor ecosystems.

Table 14. Children's perception of climate change effects at Cala Millor on a Likert scale.

Ecosystem topic	More	Same	Less	DK/NA/REF
Regarding sand (S2_Q1)	18.2	12.4	32.9	36.5
Sea temperature (S2_Q2)	30.7	21.2	21.9	26.3
Animals and plants (S2_Q3)	17.5	16.1	42.3	24.1
Storms (S2_Q4)	*12.4*	*12.4*	38.0	37.2

The results show that 37% of the children who participated in the survey could not answer whether the amount of sand in Cala Millor had been reduced. Of those who were able to answer, the majority, 33%, considered that the beach had less sand than before. The increase in sea temperature was perceived by 31% of the children, representing the majority who selected this option. Regarding the amount of animals and plants, the majority perceived that there were more than before. Finally, only 12% of the children perceived an increase in storms, with a decrease in storms, at 38%, being the highest perception of the children.

So the map for a great perception of the effects of climate change in Cala Millor would be that the children perceive less sand, more temperature in the sea, more animal and plant species, both marine and terrestrial, and more storms in recent years. In Figure 15, the averages of schoolchildren who perceived the effects of climate change are represented regarding socio-demographic groups, and greater perception regarding relation to Cala Millor groups is displayed in Figure 16. As an initial conclusion, higher socio-demographic status and children closely related to Cala Millor will have a greater perception of the effects of climate change in the area.

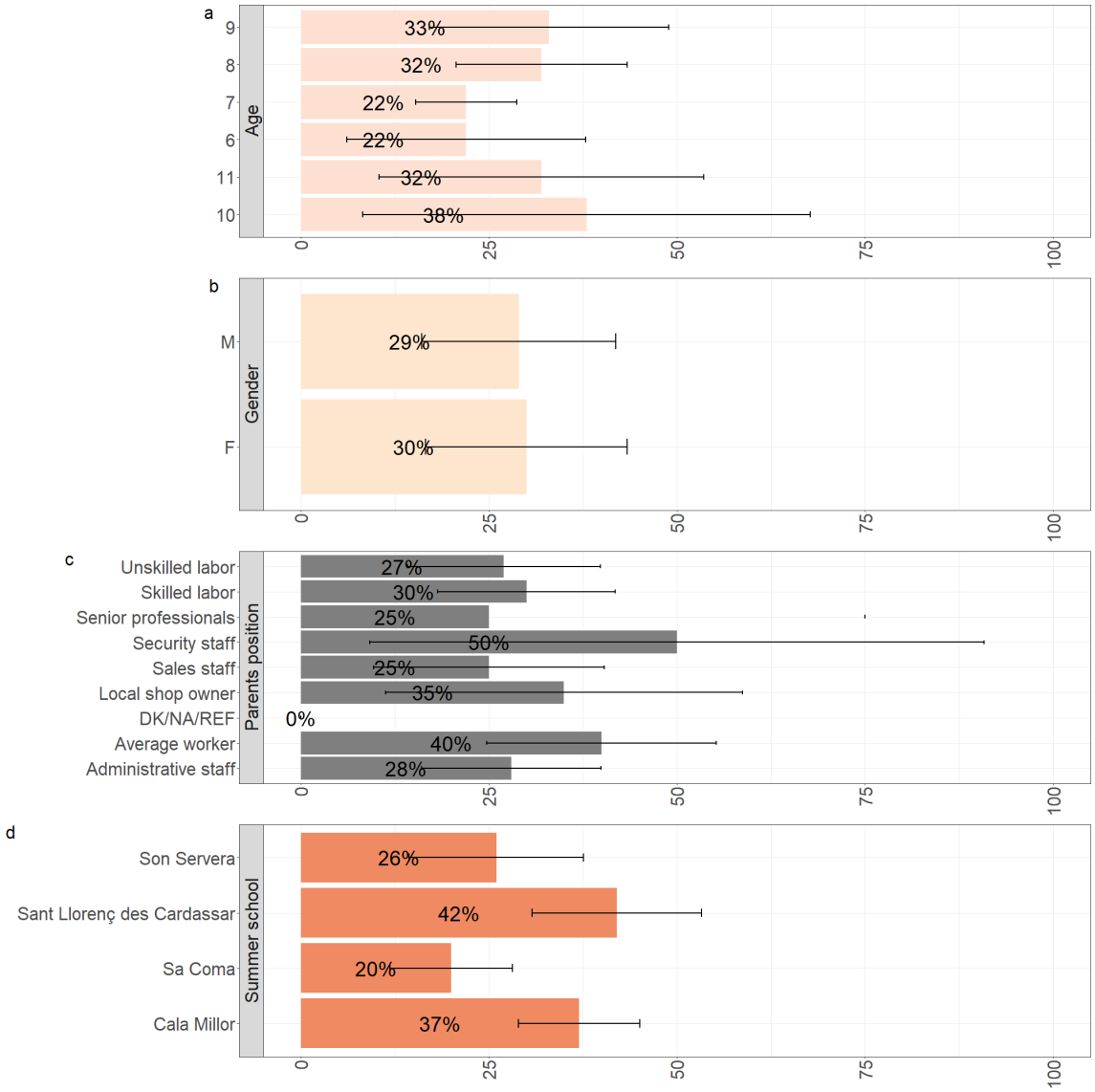

Figure 15. Mean and standard deviation of children's great perception of climate change effects at Cala Millor regarding socio-demografphic groups (in percentage, %): a) Age, includes categories 8-years-old (8), 9-years-old (9), 10-years-old(10) and 11-years-old(11); b) Gender, includes the categories female (F) and male (M); c) Parents position, includes categories unskilled labour (e.g. labourers, cleaning staff, delivery staff, etc.), skilled labour (e.g. drivers, taxists, mechanic, bricklayer, carpenter, etc.), senior professionals (e.g. lawyers, psychologists, doctors, judges, colonels, etc.), security staff (e.g. police, security guards, firefighters, etc.), sales staff (e.g. shop assistants, sales representatives, commercial staff, etc.), local shop owners (e.g. parents who own a shop in the area) and average workers (e.g. nurses, teachers, etc.) and administrative staff (e.g. clerks, bankers, secretaries, etc.); d) Summer School, includes: Son Servera, Sant Llorenç des Cadassar and Cala Millor.

Statistical analysis using generalised linear models with binomial regression showed significant differences of the climate change perception variables with the parents' occupation/position group (χ^2=8.9877, p-value<0.01) and with the summer school group (χ^2=8.9877, p-value<0.01).

In this regard, children whose parents position is related to security were more aware of the climate change effects at Cala Millor, by half percent of children having a greater perception, while children with parents who work in customer-facing jobs selling goods and services and senior professionals had less perception of the effects, with a 25±15.3 (of sales staff) and 25±50.0 (senior professionals). Regarding the centres, children from Sant Llorenç des Cardassar summer school had a better perception of climate change effects, with a mean of 42±11.3%, while on the opposite side at Sa Coma summer school, 20±8.2% of participants knew about the effects.

On the other hand, although statistical significance could not be assured, there appeared to be a generation gap between 6 and 7 year olds and older children. According to the results, 8 to 11 year olds have a better perception of the effects of climate change, with 10 year olds having the best perception of these effects (38% of children). Gender does not seem to influence the perception, as only 30% of both sexes seem to have a great perception of the effects.

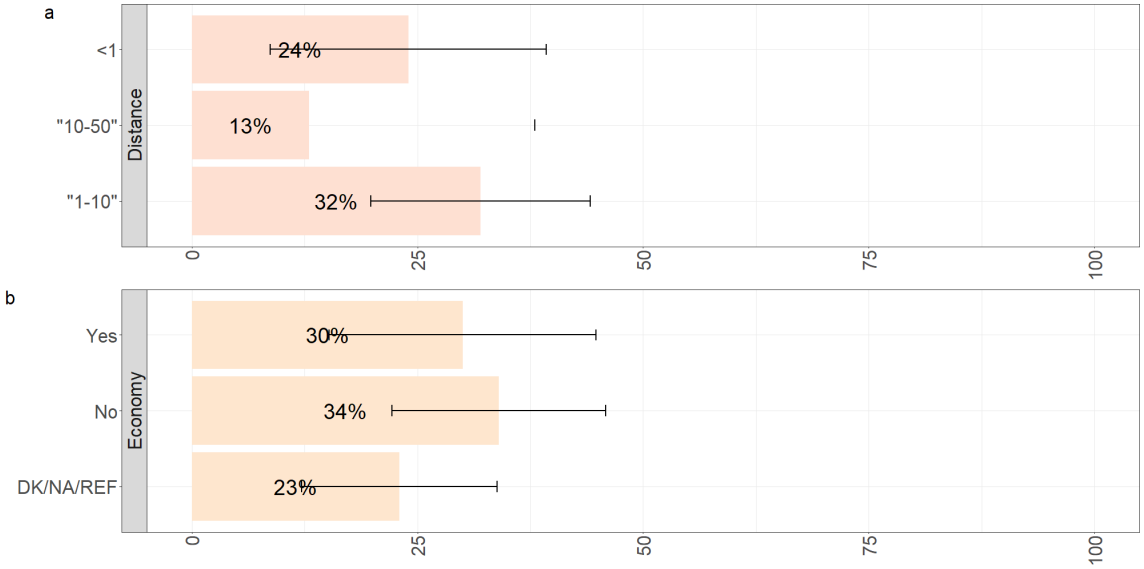

Figure 16. Greater perceptions means and standard deviation (in percentage, %) by the relation to Cala Millor groups: a) Distance, contains the categories <1, "1-10" and "10-50"; b) Economy, contains the categories "Yes" and "No"; Visits, contains the categories "Once a week", "Never", "Few times a year", "Every day", "Every month/many times a year".

Statistical analysis also showed significant differences of the climate change perception effects with the economy-related-to Cala Millor group (χ^2=6.7232, p-value<0.01) (Figure 16). Thus, children who had relatives with economy related to Cala Millor, had 4% less greater perception than children that did not have relatives with economy related to Cala Millor, which showed an average perception of 30±14.8%.

The distance variable did not show any significant relations with the perception but according to the results, children living in close areas to Cala Millor, had a greater perception of climate change effects in the area. However, 24±15.3% children who live at Cala Milllor (<1Km) had a greater perception, while 32±12.1% of children living in surrounding areas showed a greater perception.

As an initial conclusion, higher socio-demographic status and children closely related to Cala Millor will have a greater perception of the effects of climate change in the area.

Results deviate substantially from the initial assumptions. People with higher positions are those with children who perceive less the effects of climate change in Cala Millor. Likewise, it was to be expected that the older they are, the more aware of the existence of these effects and the more they pay attention to their environment. There are no studies providing results of at what age children begin to perceive the effects of climate change. However, it has been proven that from age 5 to 9 years there is rapid development in all measures, but that sustained attention in the environment improves to age 10 years (Betts *et. al*, 2006).

5.2.2. Behaviour and attitudes towards the effects of climate change

Questionnaires analysing children's perception of specific coastal ecosystems has not been developed yet. However, among the learning methods associated with children, the most commonly used are instructional dynamics. In this way, children's attention is drawn to relevant topics such as climate action (Gibb, 2016; Newsome *et al.*, 2023). This is the same methodology that was used for the data collection success of this section where a dynamic and adapted activity was developed. Taking this assumption when the questionnaire was developed, the S3_Q1 (*What do you like to do when you go to Cala Millor beach?*) question arised, where children were asked about the activities they liked the most to do when they go to the beach.

In Figure 17, results of preference activities of children when going to the beach are shown.

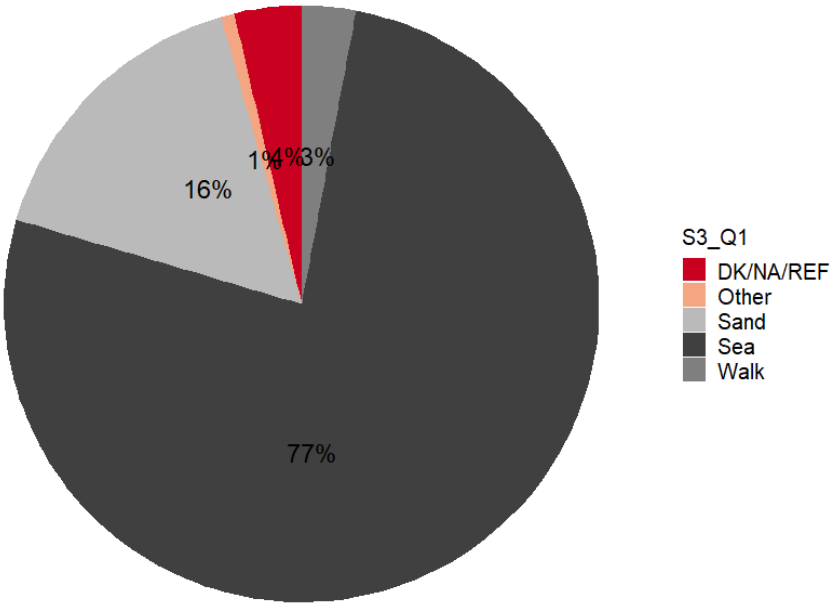

Figure 17. What do children prefer to do when they go to the beach in percentage (%).

Statistical analysis did not show meaningful relationships between the independent variables and the answers given by childrens. The results show that 77% of children prefer to take part in activities related to the marine environment, rather than on the beach (16%) or in the coastal forest (1%).

Behaviour

With reference to behaviour, children were asked the same question as people from the public administration, on the same basis as in section 5.2.2 above. Also in this section, results of question S3_Q3, aimed to identify the social awareness of taking natural materials from the beach. Table 15 shows a summary of the frequencies obtained for these behaviours using the Likert scale.

Table 15. Likert scale of responses on the behaviours of children with regard to individual action on climate change and use of beaches.

Behaviour	Always	Frequently	Sometimes	Total (Always, frequently and sometimes)	Seldom	Never	Total (Seldom, never)	DK/NA/REF
Collect natural materials (shells, sponges, etc.) (S3_Q3)	31.0%	8.0%	17.5%	**56.6%**	9.5%	17.5%	**27.0%**	**2.9%**

In general, children can be said to have a negative attitude towards the conservation of the beach environment. More than 56% said that they took natural materials from the beach, while a total of 27% said that they never or hardly ever took these materials.

Attitude

Question S3_Q4 *When you go to the beach, do you prefer the accumulation of leaves of marine plants (Posidonia oceanica) to have been removed from the shore?* (Figure 18), referred to the maintenance of *Posidonia oceanica* leaf deposits by the shore, a measure used to support sediment accumulation in the beach ecosystem.

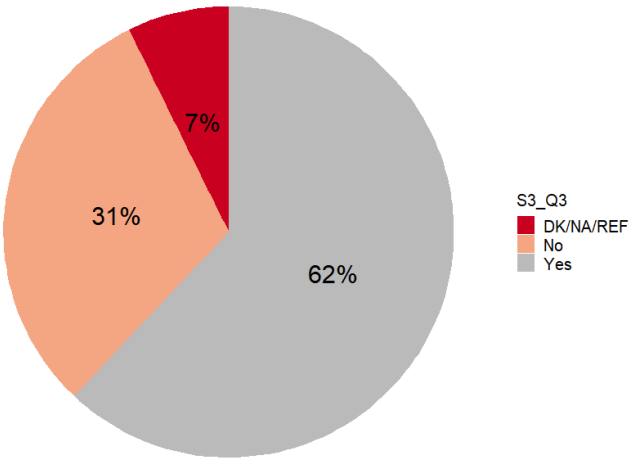

Figure 18. Answers of children to the question S3_Q4 *When you go to the beach, do you prefer the accumulation of leaves of marine plants (Posidonia oceanica) to have been removed from the shore?*, in percentage(%).

In the results, it can be seen that children had a negative attitude towards the appearance of *Posidonia oceanica* leaves deposited on the shore, resulting in 62% of respondents who would prefer them to be removed. The 31% of surveyed children had a positive attitude.

Positive attitudes and behaviours

For the dermoscopy of these variables, the mean of positive attitudes and behaviour of the two previous questions was calculated. The aim was to determine the scholars who have the most positive attitudes and behaviours of all socio-demographic and related-to-Calla Millor groups.

Figure 19 represents the percentage of positive attitudes and behaviours for each question according to category and socio-demographic group, and Figure 20 according to the relation with Cala Millor variables.

Statistical analysis did not show meaningful relationships between the independent variables and the answers given by childrens.

In this case, there were two very noticeable gaps in the results of the means of positive attitudes and behaviour in the age group. The generational gap that was found in Figure 15 (e.g. section 5.3.1) seemed to appear again, and also there was another meaningful difference between 9 and 1 years of age, with the oldest children (11 years-old) having the most positive attitudes and behaviour (64±30.3%). The positive attitudes and behaviours with the lowest number of representatives were the youngest children, with an average of 27% (of 6-years-old children) and 25±7.1% (of 7-years-old children). Children in the middle age range represented 34±11.5% (of 8-years-old-children). Regarding the gender group, boys seemed to have a more positive attitude than girls, with 39±10.2% and 32±4.2%, respectively. Again, the occupation of parents as security personnel was noteworthy, as their children represented the group with the highest number of representatives, with 75±35.4%. And also, as in the section 5.3.1 graph, the sales staff category was the category with the lowest children representation of positive attitudes and behaviours, with 21±4.3%. In this case, children from Cala Millor Summer School were the ones having a higher mean, with 44±8.2%, and children from Son Servera the lowest, with 21±21%.

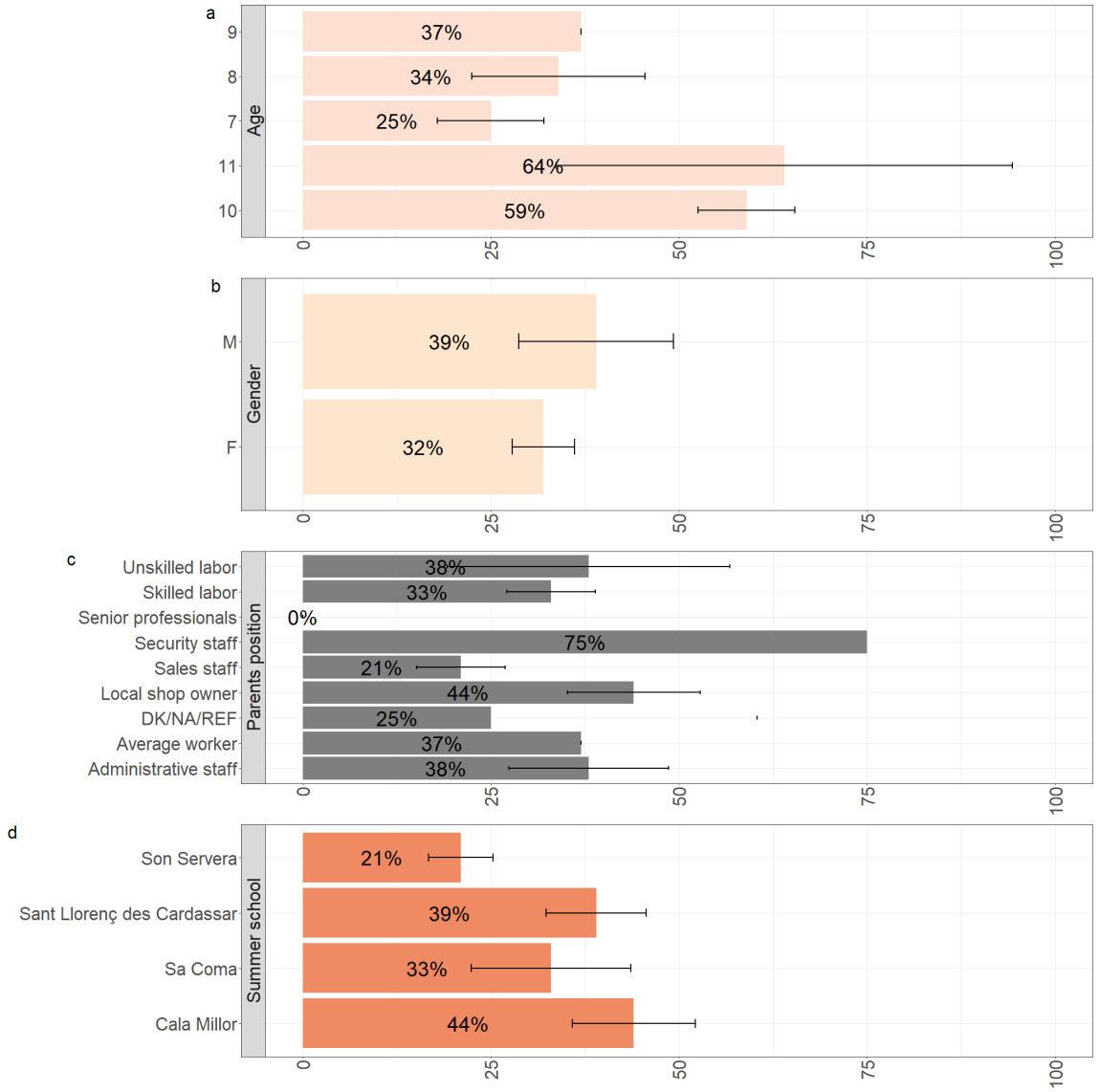

Figure 19. Demoscopy of the positive attitudes and behaviour means and standard deviation of children (in percentage, %) by groups: a) Age, includes categories 7-years-old (7), 8-years-old (8), 9-years-old (9), 10-years-old(10) and 11-years-old(11); Gender, includes the categories female (F) and male (M); c) Parents position, includes categories unskilled labour (e.g. labourers, cleaning staff, delivery staff, etc.), skilled labour (e.g. drivers, taxists, mechanic, bricklayer, carpenter, etc.), senior professionals (e.g. lawyers, psychologists, doctors, judges, colonels, etc.), security staff (e.g. police, security guards, firefighters, etc.), sales staff (e.g. shop assistants, sales representatives, commercial staff, etc.), local shop owners (e.g. parents who own a shop in the area) and average workers (e.g. nurses, teachers, etc.) and administrative staff (e.g. clerks, bankers, secretaries, etc.); d) Summer School, includes: Son Servera, Sant Llorenç des Cadassar and Cala Millor.

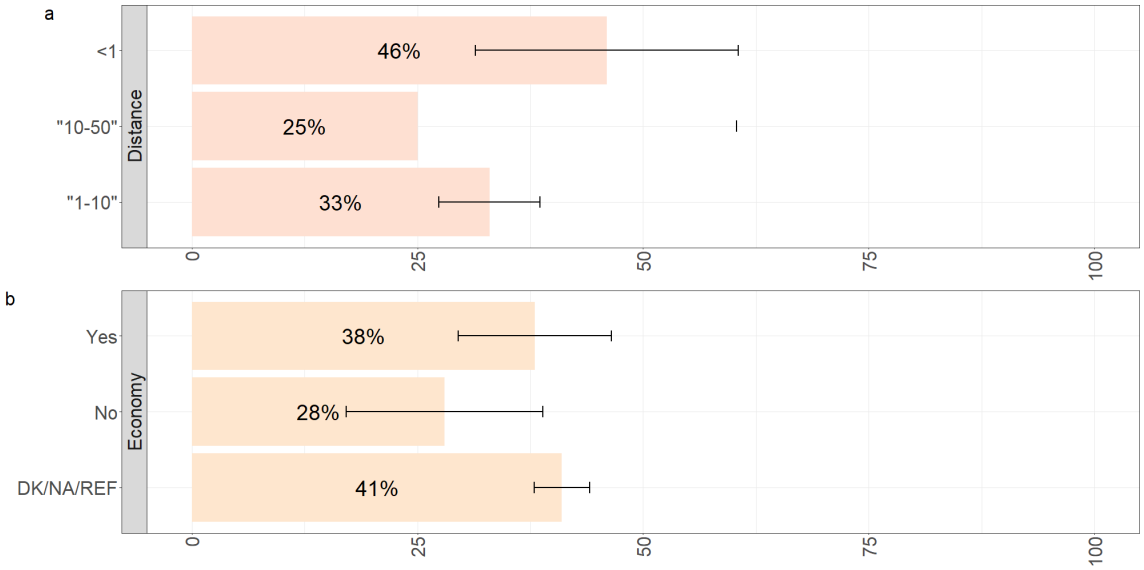

Figure 20. Greater behaviours and attitudes means and standard deviation of children (in percentage, %) by the relation to Cala Millor groups: a) Distance, contains the categories <1, "1-10" and "10-50"; b) Economy, contains the categories "Yes" and "No" or "DK/NA/REF".

Statistical analysis results showed significant relationships with the distance variable (χ^2=7.83, p-value<0.01). Children living in Cala Millor had a higher average in positive attitudes and behaviours, with 46±14.6%. On the other hand, children living in further municipalities had a mean of 25±35.4% (Figure 20).

For the other group, although not with significance, children who did not know whether they had or not relatives with economical activities at Cala Millor were represented the highest mean, being 41±3.1%. Regarding the two other categories, children with relatives whose economical activities were related to Cala Millor, had a higher mean than the others, with 38±8.5% and 28±10.9%, respectively.

5.2.3. Global climate change

In this section, results of the perception of global climate change will be discussed with the most recent studies of climate action at primary schools. Before entering in more complex questions about the understanding of climate change, children were asked whether they knew what climate change concept is or if they ever had heard about it. If the participants responded that they had heard about the concept the rest of the questions of the section were asked. Otherwise the survey would end in this question. The results are shown in Figure 21.

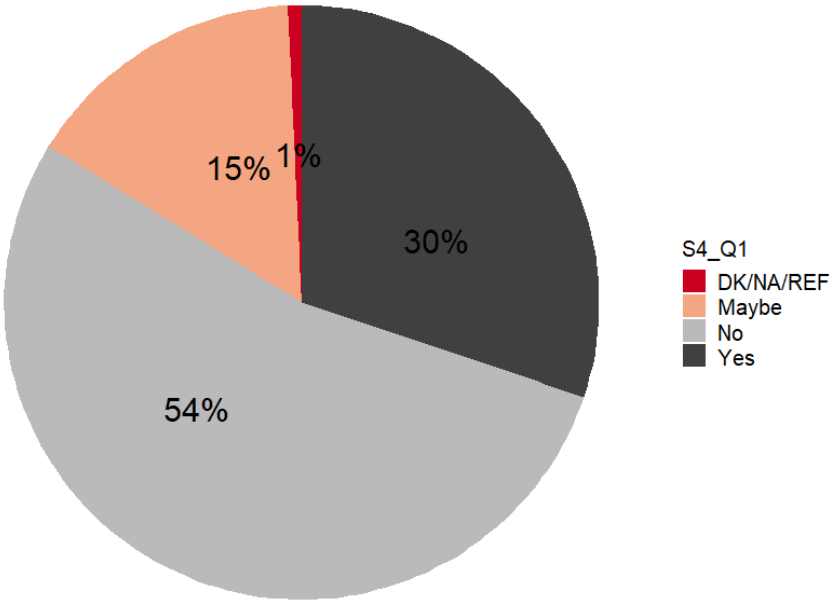

Figure 21. Children's awareness and knowledge of the concept of climate change results in percentage (%).

In the results, 54% of children did not hear of the climate change concept. Only 45% were aware of it or may have heard about it.

In the statistical analysis significant relationships were found between the awareness about the concept of climate change and age group (χ^2=6.988, p-value<0.001) and the summer school (χ^2=8.98, p-value<0.01).

Climate change's severity

From this section, only children who had responded "yes" or "maybe " to the previous question kept being surveyed (n=62; percentage =45%).

Taking into account the most recent studies, children believed and were concerned about climate change (Lee *et al*. 2020; Sjöblom *et al*., 2022). On this basis, the present study questioned the degree of severity of climate change to children from summer schools under study. Table 16 shows the percentage of the perception of children that responded to climate change being a severe issue (S4_Q2).

Table 16. Answers on the severity of climate change by children.

S4_Q2. Is climate change a severe issue?	%
Yes	52.6
No	11.2
Maybe	27.4
DK/NA/REF	9.7

Most of the respondents seemed concerned about climate change, responding that climate change is a severe concern. Those were the 53%. Followed by 27% children who noted that climate change may be a severe concern. Next, 11% of children did not consider climate changes a severe concern. And finally, the 10% did not know what to answer.

In Figure 22, results of the dermoscopy of severity of climate change perception by children are shown.

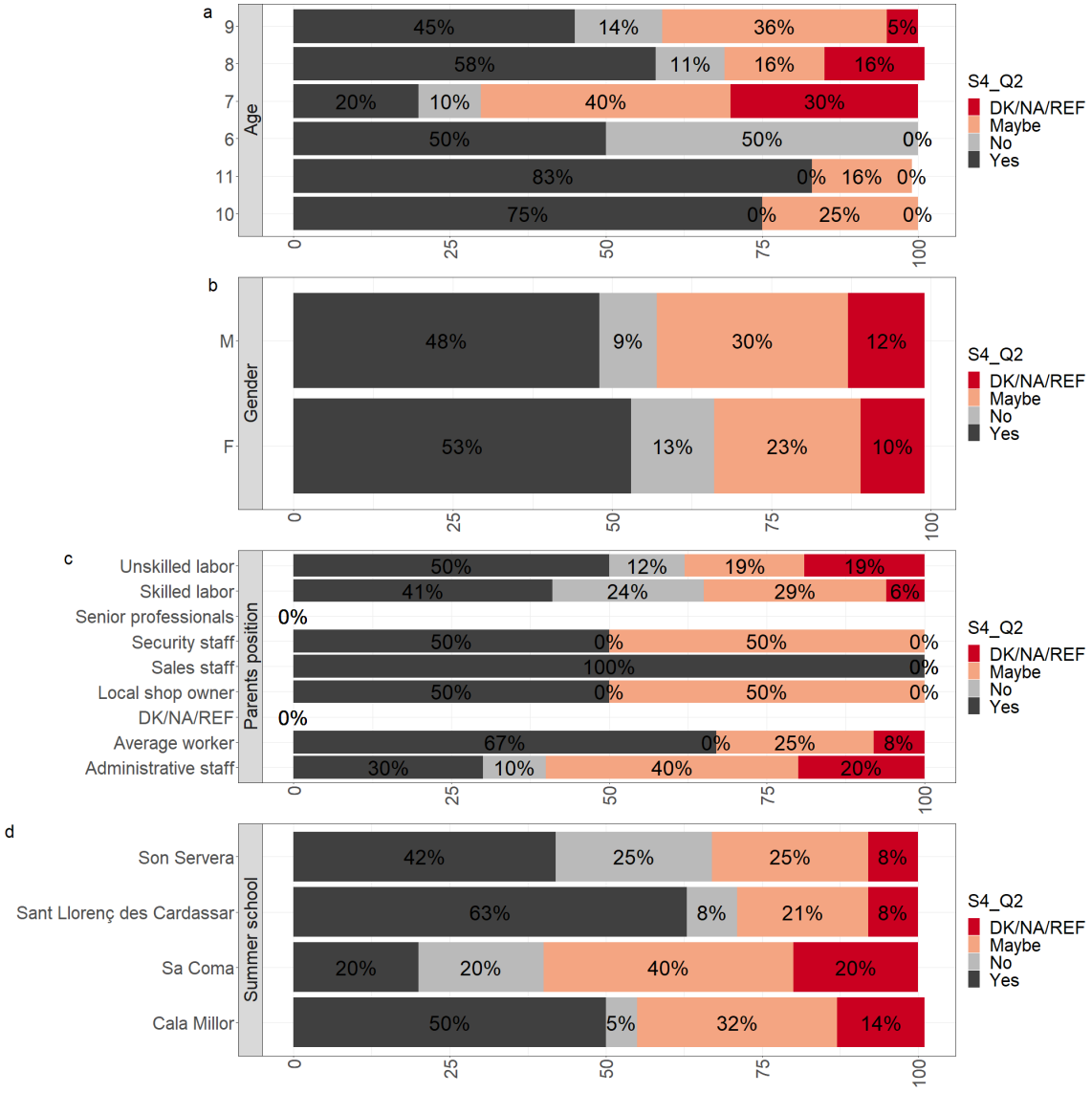

Figure 22. Demoscopy of perception of climate change as a severe issue of children (in percentage, %) by groups: a) Age, includes categories 6-years-old (6), 7-years-old (7), 8-years-old (8), 9-years-old (9), 10-years-old (10) and 11-years-old (11); Gender, includes the categories female (F) and male (M); c) Parents position, includes categories unskilled labour (e.g. labourers, cleaning staff, delivery staff, etc.), skilled labour (e.g. drivers, taxists, mechanic, bricklayer, carpenter, etc.), senior professionals (e.g.

lawyers, psychologists, doctors, judges, colonels, etc.), security staff (e.g. police, security guards, firefighters, etc.), sales staff (e.g. shop assistants, sales representatives, commercial staff, etc.), local shop owners (e.g. parents who own a shop in the area) and average workers (e.g. nurses, teachers, etc.) and administrative staff (e.g. clerks, bankers, secretaries, etc.); d) Summer School, includes: Son Servera, Sant Llorenç des Cadassar and Cala Millor.

The generalised models applied showed meaningful relationships of the answers about severity and age socio-demographic variable (χ^2=3.32, p-value<0.05). Thus, older children perceived climate change as a severe concern (83% of 11-years-old children and 73% of 10-years-old children). In the youngest range of ages, less 7-years-old children and 8-years-old children than the aged 6 children responded that climate change was a severe issue. In the gender group, the two categories were very evenly matched, with 50% of the children in both cases perceiving climate change as severe. Children with parents working in sales had the highest proportion of children who felt that climate change is severe, with 100% of responses. However, children whose parents were in management occupations (e.g. office work) had the lowest percentage, at 30%. Finally, the summer school where the severity of climate change was most perceived was in Sant Llorenç des Cardassar. In Sa Coma, only 20% claimed that climate change was a severe concern, the lowest percentage.

In Figure 23, responses of children regarding the severity of climate change are shown by related-to-CalaMillor variables.

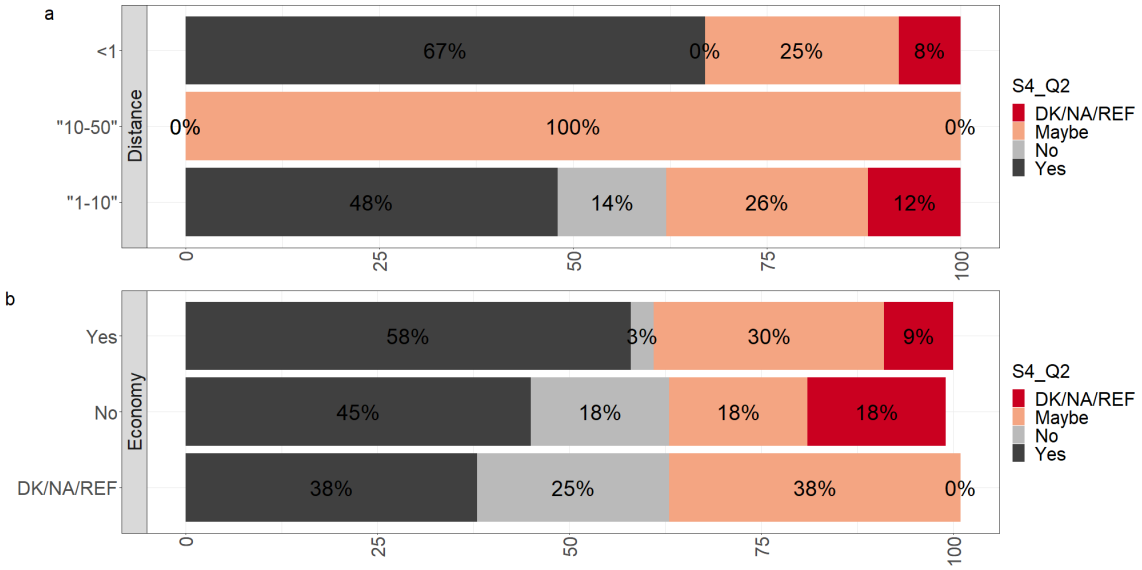

Figure 23. Children's perception of severity of climate change by the relation to Cala Millor groups: a) Distance, contains the categories <1, "1-10" and "10-50" km; b) Economy, contains the categories "Yes" and "No".

Although it cannot be stated with significance, the perception of climate change as a severe issue seemed to be linked to Cala Millor in the results. In the distance group, 67% of the children living in Cala Millor stated climate change as severe, as well as those living in surrounding municipalities in the area where 48% agreed with the severity of climate change. However, all children living between 10 and 50km responded that climate change could be somewhat severe. In terms of the economy, a certain correlation is also perceived, as 58% of

the children with an economy linked to Cala Millor considered climate change a severe problem. Likewise, 45% of the children who did not have an economy linked to Cala Millor also perceived it as a serious problem.

Causes and effects of global climate change

Before considering the specific activities that cause the climate change (e.g. causes) and impacts that are causing on the environment (e.g. consequences), children were asked whether the climate change is caused by human activities, by natural processes or both. Table 17 shows the percentage of children answers for each option.

Table 17. Answers of degree of climate change severity by public administrations.

S4_Q3. Do you think climate change is something that happens naturally, or is it caused by people, or both?	%
Human activity	30.0
Natural processes	55.0
DK/NA/REF	15.0

Results showed that most children believe that climate change is caused by natural processes (55%). Thirty percent thought it was due to human activities and the remaining 15% noted that it is caused by both.

The next two questions asked what are those climate change actions that humans do to accelerate climate change (S4_Q5) and what are the consequences of the process (S4_Q4). Highlight that questions in this section were developed in order to be able to perceive misunderstandings in comprehension of the causes and consequences of climate change. Children were asked to select 4 options in the case of the question on causes (S4_Q5) and 3 options in the case of the question on consequences (S4_Q4), where some of the answers were not related to climate change related processes. Table 18 shows a summary of the possible responses and their acronym symbols. Figure 24 shows the results of both causes and consequences questions.

Table 18. Symbology attributed to the answers of perception of global climate change causes and consequences.

Question	**Answer**	**Acronym**
S2_Q4 Causes	Going by car every day to school or work	C
	Not recycling	R
	Having all the lights in the house on at the same time	L
	Pollute the sea with wastewater	P
	Littering the street or in the sea	G
	Leaving the door open	S
	Pulling up plants (both marine and terrestrial) and trees	PL
	Using gas-filled sprays	SP
S2_Q5 Consequen-ces	More plastics in nature	MP
	Temperature is hotter and the sea water is warmer	MW
	More poverty	MP
	More storms	MS
	More diseases	MD
	Sea water is more acidic	MA
	More endangered species	ME

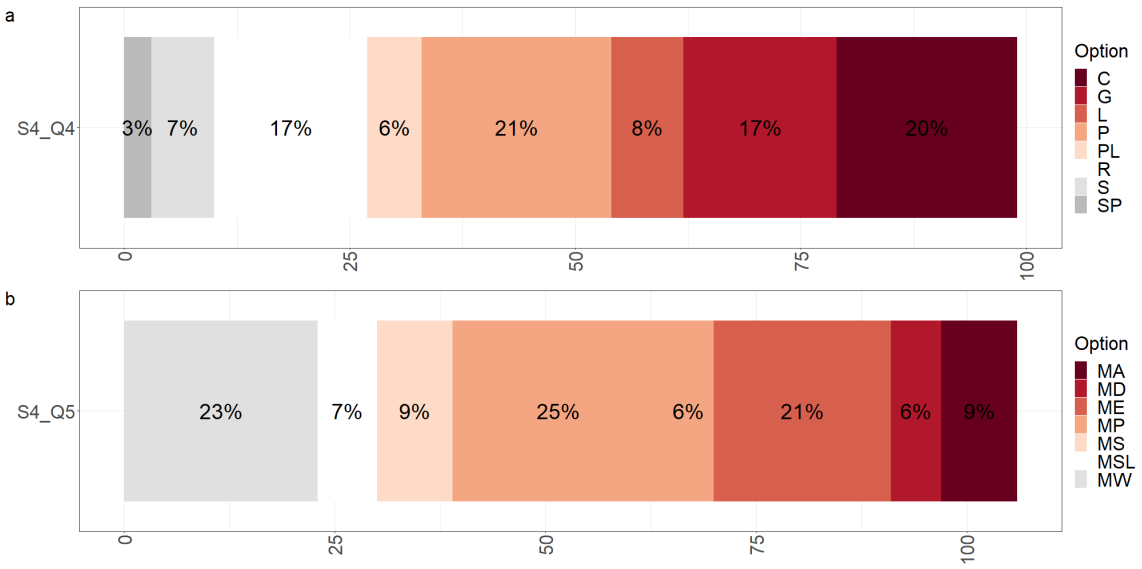

Figure 24. a) Survey results of causes of climate children perceived by children. b) Survey results of consequences of climate children perceived by children.

In relation to the first question, the children considered that climate change was caused by polluting the sea with wastewater (P) with a percentage of 21%, by going by car every day to school or work (C), with 20%, and finally littering the street or the sea (G) and not recycling (R) both by 17%.

In relation to the consequences, the most frequently selected option was "more plastics in nature" (MP), by 25%, secondly, children associated the consequences of climate change with the increasing temperature (MW), by 23%, and thirdly, with having more endangered species (ME), by 21%.

Finally, it was considered suitable to ask about climate change regarding sea level rise. The children were asked to give a reasonable explanation about why the sea level is rising (S4_Q6). The results of this question are shown in Table 19.

Table 19. Results of children's reasonable explanation of sea level rising in percentage (%).

S4_Q6. Do you know why sea level is rising?	%
Gives a reasonable explanation	21.0%
DK/NA/REF	79.0%

Statistical significance did not show meaningful relations between the answers and socio-demographic data. As shown in the results, 79% of children could not give an answer to sea level rise, and only 21% could explain it in a reasonable way.

Discussion of perception of global change by children

Children should be an indispensable group when initiating climate action or climate change adaptation processes. Many authors have and they have proved to highlight the potential of engaging children to tackle climate change impacts (Tanner *et al.*, 2009; Kazi *et al.*, 2013; UNICEF, 2021). We adults will only see the beginning of the consequences of climate change

and as long as climate change continues to accelerate, future generations will be the ones to be in need of developing more and effective measures.

Most of the children surveyed in this study had never heard of climate change. These are strange results given the increasing participative climate change awareness campaigns and the rise of climate change divulgation through technologies. According to the study conducted by Morote *et al.* (2021), in Valencia, digital media are the main sources of information on climate change for children and are available to the vast majority. Perhaps, in future studies, it would be interesting to add other questions to identify this absence in children's knowledge about climate change. Age is not a reason why children are unfamiliar with the term, as in other studies, children of similar ages have been surveyed and shown to have a wealth of knowledge on the subject, being able to explain even more complex meteorological processes (Sjöblom *et al*., 2022; Ramos *et al.*, 2023). In addition to the lack of awareness of the concept, it is worrying that only half percent of children perceive climate change as a severe concern. However, it is also true that this is not the first time this has happened, sometimes the level of concern among children is not as high as it should be (Ramos *et al.*, 2023). Some studies have shown that the consequences selected by children and their concern of climate change are connected with the country's higher climate change vulnerability (University of Notre Dame, 2021). For example, Sjöblom et *al.* (2022) compared climate change perception of children from Finland and Tanzania. Tanzania children were really concerned about soil erosion, disease spread, and food availability, consequences that are already tangible in the country, while Finnish students were specifically worried about animals in other countries, so they saw climate change as a threat, but not for themselves. Also, results show that children living closer to the coast consider climate change a severe concern. These statements become solid with the findings of Prudente *et al.* (2015) where there was evidence of local differences, with children living in coastal areas more worried than those living in rural areas of the Philippines.

On the other hand, results on the perception of causes and consequences are another concerning matter in this study. Children have a misperception of the activities that cause climate change as well as the impacts they cause. Firstly, mMost people believe that this is a natural process, which is relatively true, since, as stated in the introduction to this Master Thesis, it has been demonstrated on countless occasions that human activities are accelerating the processes of climate change (IPCC, 2023). Among the causes of climate change that received the highest percentage of responses, litter and plastics are the ones most associated with climate change, and as is well known, this is a sustainability issue, completely different from the issue raised in the question. Therefore, in this section, awareness of this issue can be perceived due to the intense awareness-raising campaigns of recent years (Espino and Koot, 2020; ONU, 2021; European Union, 2023). Secondly, it is reassuring to note that they also associate climate change with vehicle use (e.g. increased greenhouse gas emissions) as a cause and rising temperatures as a consequence. Furthermore, the misunderstanding between environmental concepts is relatively frequent among children and is a somewhat complicated subject to deal with due to the complexity of the explanations of the processes and the consequences they have on ecosystems (Chang *et al*., 2018; Ratinen *et al*., 2013; Chang and Pascua, 2016; Truelove and Parks, 2012). Alexander (2000) noted that it is essential to understand each school system when making comparisons. The study provided results about students' thoughts that helped the researchers to understand the knowledge production

without over-generalising all students. Anyway, it is true that in schools is important and can make a difference, but family and friends are also meaningful factors in predicting climate change concerns (Stevenson *et al.*, 2019).

6. Conclusions

With reasonable caution, this Master thesis is a first approximation of establishing a participatory and geographically scaled governance framework for climate change adaptation of an urban beach.

The phrase 'think globally, act locally' becomes ever more important when discussing climate adaptation strategies and plans. Governance and climate change are concepts that have relatively recently been integrated into the same umbrella. This is why it is a varied and complex concept that involves many representatives, both from the administration and society, each taking an important role in the adaptation process. Getting all these areas to work in harmony and strive for a common goal is no easy task and requires a rigorous and clear basis to identify the connection nodes between all the players involved. This complexity becomes even more challenging in the area of Cala Millor, as it is located between two municipalities (Son Servera and Sant Llorenç des Cardassar), by the coast of an island, and it is managed by 5 governmental bodies at 4 different scopes. Governance thus becomes an essential mechanism for the adaptation process of Cala Millor, and all decisions must be approved, not only by the decision-makers, but also by the citizens.

6.1. A working group as a participatory mechanism for public administration

In the first objective of the Master thesis, a mechanism has been developed to involve public administrations from the beginning of the process. Public administrations have the legal competences to develop the policies to adapt the coast of Cala Millor to climate change. Local governments play a key role in fostering public engagement and local action, by sharing knowledge with society of the benefits and necessities of climate adaptation. Furthermore, local governments possess a lot of vital information on the potential areas where climate adaptation is urgently needed. They have a direct perspective of which measures are viable in their area. At island level, the replicability of the climate change adaptation process is essential, as other tourist stations from Mallorca have very similar hydrodynamical, ecological and socioeconomic characteristics to the study area. This argument extends to the other islands of the Balearic Islands or coastal municipalities of the Spanish since 1660 Km the Mediterranean coast will be affected by climate change (IGN, n.d.).

At the state level, they represent the broader framework, which must be taken up at all other levels of administration. In this sense, the ladder analogy introduced at the beginning of the thesis can be applied in an adaptation governance plan. In each rung there are new policies and each representative is well aware of what it means to execute these policies. Being on a higher rung does not mean being more important for the process of adapting to climate change, but it means having another perspective to bring to others. This is why the interdepartmental and

multilevel adaptation Working Group should therefore ensure meaningful exchanges with national and sub-national authorities to include their expertise in adaptation policymaking and to support activities in line with the national adaptation policy.

Specific consideration should be given on how to involve the regional and local level of governance. Obviously not all representatives of the administration with competencies can be part of the Working Group, but make sure they are represented when identifying members. Therefore, a screening of those with the most direct competences should be carried out, always alongside at least one direct representative (obviously with climate change expertise) at the local level and at higher levels of administration that can give the inside perspective of the administration and ask their co-workers from the administration if they have any doubts when performing this stage.

Beyond the perspective of all, the Working Group's foundations need to be strongly consolidated in a general protocol. In this case, the national, regional, island and local election process put the process of creating the group at risk, considerably delaying some of the established steps. Until relatively recently, the governments had not been formed, let alone consolidated, so that the draft contact directory was not available until months after the originally planned agenda. Fortunately, this setback in the process has also been a learning experience. The operating regulations are adapted in case of an electoral situation, where the representatives who will initially be involved in the adaptation process are not known. This flexibility allows new members to be included at any stage of the process. Ensuring future representativeness in the event that new parties need to be integrated.

Once the members have been identified and established a sound operating regime, other representatives with indirect competencies should not be forgotten, as they might become important in some part of the process. It is therefore necessary to interview each and every one of them in order to find out the degree of interest and influence they have for the climate change adaptation plan. Any information that is a potential contribution to the project should be always welcome. Having this assessment and analysis of entities with competencies for climate change adaptation in a summary as the Interest-Influence Mendelow matrix, can be really useful at later stages of the project and will help to build a map of public administration representatives and their interrelations with each other. For example, it has been identified that many of those with indirect competencies at the local level have a strong interest in climate change adaptation, possibly because their departments will be directly affected in any of its areas. However, at the island level, representatives show less interest but, in their interview responses, explicitly note their ability to influence other agencies. These people, who will not be members of the Working Group, can help in future to reach out to a wider audience for the dissemination of the adaptation process or to involve more people.

6.2. Public administration perception, attitudes and opinions

The interview with public administration representatives is also related to the second objective of this Master Thesis. Besides finding out the relationship of interest-influence that representatives have, it served to analyse their perception regarding climate change adaptation. The Spanish elections also affected this part of the thesis, as only 15 people could be interviewed, resulting in very little representation of the regional public administration in the

analysis. The sample size is not sufficient to determine whether there is a significant relationship between the perception of climate change and the different socio-demographic variables studied. However, despite not having been able to obtain significant relationships in the models developed between the issues and the socio-demographic variables and the relationship with Cala Millor, some generalised perceptions and behaviours are evident in the public administrations representatives community.

In the first section, the generalised opinion at European and Spanish level of the importance of climate change can be observed, as the majority of socio-demographic groups considered climate change to be a severe problem, except the island director representatives and representatives aged more than 55 years, who considered it a moderate concern. It is also evident in results that people who are more related with Cala Millor are more aware of climate change effects in the area. Regarding the multi answers questions in this section, it can be concluded that in general, people perceive the effects happening in Cala Millor ecosystems. As discussed above, it is indeed a fact that all natural ecosystems will be affected somehow in Cala Millor. Nevertheless, it has been argued in the results and discussion that the most noticeable effects, which have even led to the complete degradation of the ecosystem following extreme weather events, are the beach and embryonic dunes. These arguments coincide with the survey results, being the beach and embryonic dunes being the most perceived ecosystems affected by climate change. Considering the perception of the affection of climate change in the Cala Millor ecosystems of the previous question, the majority of people perceive that climate change will mostly endanger the production and maintenance and regulation services provided by these ecosystems, rather than cultural ones. In the marine system, biodiversity, mass mortality, and changes on currents are the impacts most perceived by the people surveyed. The socio-economic system of Cala Millor is built on a tourism-based economy. The general concern for health due to the effects of climate change is also highlighted in the perception.

Apart from administration representatives' perception of the climate change effects at Cala Millor, the adoption of certain positive attitudes and behaviours is another relevant issue on which to make comparisons with empirical reality. In responses to the second section, social consolidation of certain attitudes and behaviours can be seen, which are appropriate and naturalised by large segments of the population. For example, in Balearic Islands some campaigns have arised in recent years recommending maintaining the natural materials of the beaches in the ecosystem. The means of attitudes and behaviours show that mayors and island executive councillors, regional and 25 to 34 aged had a 100% of representatives performing positive attitudes and behaviours. Also, representatives more related with Cala Millor, were the ones with higher positive attitudes and behaviours, but not raising the 100% in any case.

Finally, more than half of the representatives would be willing to pay if the "eco-tax" were invested in adaptation, protection, and environmental protection programmes as a management tool to fund projects for adaptation, conservation and ecosystem improvement appearing to be associated with higher economic status and older age, in contrast to previous citizen surveys conducted by other organisations and authors, where young people resulted the category willing the most to pay higher amounts for sustainable products and services. Regarding management, the opinion of public representatives on the weight of climate change adaptation management coincide with results of previous citizens surveys conducted by other organisations and authors at higher geographic scales, with public administration being the

most answered option. On the other hand, the representatives' acceptance of this weight in their own administration differs in the different scopes of public administration. At regional level, the representatives agree that they have the most weight in the adaptation process of Cala Millor. At the local level, representatives also declared that their administration scope should take main responsibility but sharing the weight with the European public administration. At island scope, representatives agreed with the ones before, answering that local and European administration should have more weight in the adaptation process of Cala Milor.

6.3. Scholars perception, attitudes and opinions

The results found depart substantially from the initial assumptions. Neither the higher socio-demographic position nor the greater relationship with Cala Millor lead children to have a better perception of the effects of climate change at Cala Millor. In the perception section, it is concluded with statistical significance that people in occupations with higher economic status are the ones with children who perceive the effects of climate change in Cala Millor the least, together with sales staff. On the opposite side, security personnel have children with a higher perception of the effects. Also, the children of the Sant Llorenç des Cardassar school have the best average perception of these effects. Finally, although not statistically significant, age plays a very important role in perception, as there seems to be a gap between 6-8 and 9-11 years-old children.

Similar conclusions are reflected in the demoscopic study in the following section, although it cannot be significantly affirmed. Children whose parents have sales staff occupations are the most represented in terms of positive attitudes and behaviours, and the children of XXX have the lowest percentages. However, in this case, children related to Cala Millor, both because they were surveyed at the summer school of Cala Millor or they live in Cala Millor, have a higher average of positive attitudes and behaviours than the other categories of each group. Playing with the sea is what children like to do most. This information helps to understand more about the importance that children attribute to the different ecosystems of Cala Millor, and this knowledge could be integrated into future designs of awareness-raising campaigns adapted to children and within the framework of the adaptation project.

With regard to global climate change, firstly, it can be said with significance that there is an association of knowledge or lack of knowledge of climate change with age that it is recommended to conduct a depth study in future lines. Most of the children surveyed for this work were not aware of the concept of climate change, and half of those who were aware or had heard of the concept could not say whether it was a serious problem or they did not consider it concerning. Furthermore, their responses indicated that it is a process that happens only naturally, so they also had no knowledge of the origin of climate change. In the multi-response questions on causes and consequences, the children presented misconceptions in their knowledge and behaviours that are the subject of relatively intense institutional campaigns (e.g. the increase of plastics and litter, separating waste and recycling, etc.), as most of them associated both causes and consequences with sustainability problems, such as plastics pollution or garbage. In addition, among the most represented answers, the use of vehicles was also among the causes, and rising temperatures and endangered species were also among the consequences. When designing future awareness campaigns for children in the framework of

the climate change adaptation process, it would be advisable to start from the basics of the concepts of climate change and its origins, with special emphasis on the differences between climate change and sustainability.

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Annex I. Summer School Activity: Perception of the effects of climate change in Cala Millor by summer school students

ACTIVITY: PERCEPTION OF THE EFFECTS OF CLIMATE CHANGE IN CALA MILLOR BY SUMMER SCHOOL STUDENTS	
Description of the activity	The activity is part of the European project LIFE AdaptCalaMillor. The language in which the activity is conducted is Catalan or Spanish depending on the vehicular language of the group and the child. The activity is structured in four blocks: **1. Welcome** (5 min): All people introduce themselves through a game. It explains how the workshop will work. **2. Survey + SOCIB games** (35 min): The survey aims to collect the perception of children about climate change, as well as the effects of climate change in Cala Millor. The format is a multi-response survey. Three SOCIB representatives interview/survey 3 boys or girls simultaneously. The rest of the group carries out another activity related to the activities of the ICTS SOCIB (large multi-platform puzzle, stories, colouring, Lego construction of the observation platforms depending on age). **3. Dynamics + explanatory talk** (15 min): Do you know what climate change is? Basic explanations are offered about climate change and its effects on urban beaches, such as Cala Millor. The explanatory talk is adapted for each age group and their prior knowledge. Finally, a question-and-answer session begins and the children's ideas are debated. In addition, a game is proposed related to the changes that Cala Millor has undergone over time and the effects of an extreme event (storm). It is a participatory, dynamic and collaborative game. **4. Satisfaction survey** (5 min): through the satisfaction survey, children can provide their opinion on the activity by selecting images that represent different types of emotions. The survey is provided in two languages: Spanish and Catalan .
Target audiences	The activity takes place in the summer schools of Son Servera, Cala Millor, Sant Llorenç des Cardassar and Sa Coma. The activity is designed so that groups of between 15-30 boys and girls between 6 and 11 years old can participate. The number of groups will depend on the total number of summer school students.
Tentative dates and times	Visit to the Sant Llorenç des Cardassar Summer School ● Day: Thursday, July 27, 2023. ● Time: Group 1 from 9:30 to 10:30. Group 2 from 11:00 to 12:00. Visit to the Son Servera summer school ● Day: Wednesday, August 2, 2023. ● Time: Group 1 from 9:30 to 10:45. Group 2 from 11:15 a.m. to 12:00 p.m. Visit to the Sa Coma Summer School ● Day: Friday, August 4, 2023. ● Time: Group 1 from 9:30 to 10:30. Group 2 from 11:00 to 12:00. Visit to the Cala Millor Summer School ● Day: Tuesday, August 22, 2023. ● Time: Group 1 from 9:30 to 10:30. Group 2 from 10:30 to 11:30. Group 3 from 11:30 to 12:30. Group 4 from 12:30 to 1:30 p.m.

ACTIVITY: PERCEPTION OF THE EFFECTS OF CLIMATE CHANGE IN CALA MILLOR BY SUMMER SCHOOL STUDENTS	
Goals	1. Know and analyze the perception of climate change. 2. Promote knowledge of the LIFE AdaptCalaMillor project. 3. Introduce and publicize the impacts and effects of climate change on urban beaches.
Key competencies of the curriculum related to the activity[1]	- Competence in linguistic communication. - Mathematical competence and competence in science, technology and engineering. - Personal, social and learning-to-learn competence. - Citizen competition. - Entrepreneurial competition. - Competence in cultural awareness and expression.
Objectives of the curricular contents related to the activity[2]	*Natural Sciences:* - Start scientific activity, using different sources of information (direct, texts...), using new technologies to select information, simulate processes, as instruments to learn and share knowledge and present conclusions. - Analyse human intervention in the environment by making a critical assessment and promoting attitudes of protection and conservation of the environment. *Social Sciences:* - Actively participate in group activities, developing social skills that lead to adopting responsible, constructive, supportive and dialogic behaviour, respecting the basic principles of democratic functioning. - Be critical of human intervention in the environment, learn how human life affects the environment and acquire habits and attitudes of defence and recovery of the environment, as well as the cultural heritage of our community and the Spanish State. *Civic and social values:* - Become aware of the environmental situation and develop attitudes of responsibility in protecting the immediate environment.
Family involvement	- They are provided with information about the project and the activity. - They are requested to obtain participation authorization and informed consent.
Material delivered for summer school	- 2 stories The ocean is my home - 2 posters Why are oceans important?
Material delivered to summer school	- 1 SOCIB backpack - 1 toy glider - 1 SOCIB photography exhibition brochure - 1 SOCIB brochure

[1] As indicated in Royal Decree 157/2022, of March 1, which establishes the organization and minimum teachings of Primary Education (State Agency, 2022).
[2] According to LOMCE: Primary Education curriculum regulations (CAIB, 2023)

ACTIVITY: PERCEPTION OF THE EFFECTS OF CLIMATE CHANGE IN CALA MILLOR BY SUMMER SCHOOL STUDENTS	
directors	
Material necessary for the activity	- Printed surveys - Printed satisfaction surveys - Laminated photographs of Cala Millor - Laminated question cards - SOCIB puzzle - Colorable - Plastidecor - Pens

Annex II. General Protocol Working Group (in Spanish)

PROTOCOLO GENERAL DE ACTUACIÓN DEL GRUPO DE TRABAJO ADAPT CALA MILLOR

En Cala Millor, a 20 de septiembre de 2023

CLÁUSULAS

Primera – Objeto

El presente Protocolo tiene por objeto establecer el marco de colaboración entre las partes firmantes para potenciar la comunicación e interrelación entre las administraciones públicas estatales, autonómicas, insulares y locales con competencias e intereses en la gestión y planificación de la playa urbana de Cala Millor. A tal fin y en el marco del proyecto LIFE21 GIC/ES/101074227 AdaptCalaMilor[3], se constituye el Grupo de Trabajo Adapt Cala Millor para promover una planificación y gestión administrativa efectiva en las medidas de adaptación frente al cambio climático en la playa urbana de Cala Millor.

Segunda – Compromisos de las entidades firmantes

Las entidades firmantes se comprometen a:

- Participar, a través de personal técnico, en el Grupo de Trabajo Adapt Cala Millor.
- Poner a disposición de las partes firmantes la información que obre en su poder, o en poder de los organismos dependientes del mismo (siempre que no esté sometida a algún tipo de protección intelectual), que pueda resultar de interés para el logro de los objetivos del presente Protocolo.
- Colaborar con el conjunto de entidades firmantes para generar el conocimiento y experiencia que permita definir los mecanismos para favorecer una planificación a largo plazo de las inversiones necesarias para la adaptación frente al cambio climático en la playa urbana de Cala Millor.
- Participar, activamente, en la búsqueda de financiación para el desarrollo de las actuaciones y medidas específicas que permitan la adaptación frente al cambio climático en la playa urbana de Cala Millor.
- Facilitar la adhesión de otras administraciones públicas competentes y con interés sobre la adaptación frente al cambio climático en la playa urbana de Cala Millor al presente Protocolo.
- Posibilitar la retirada o exclusión voluntaria de alguna de las partes.

Antes del acto formal de constitución del Grupo de Trabajo Adapt Cala Millor, que se celebrará en Cala Millor del 20 de septiembre de 2023, cada entidad habrá firmado su adhesión al

[3] "Proceso de gobernanza participativa y multinivel para diseñar un proyecto transformador de adaptación al cambio climático en la playa de Cala Millor desde un enfoque integrado y multidisciplinar basado en la ciencia - LIFE AdaptCalaMillor" (LIFE21 GIC/ES/101074227): https://www.caib.es/sites/adaptcalamillor/

presente protocolo y designado a sus representantes técnicos del Grupo de Trabajo Adapt Cala Millor mediante la firma de la resolución que figura en el Anexo 1.

Tercera – Defínción

El Grupo de Trabajo Adapt Cala Millor es el órgano encargado de promover una planificación y gestión administrativa efectiva en relación a las medidas relacionadas con la adaptación frente al cambio climático en la playa urbana de Cala Millor.

Cuarta - Funciones

Son funciones del Grupo de Trabajo Adapt Cala Millor:

- Facilitar y potenciar la comunicación e interrelación entre las entidades firmantes del protocolo.
- Identificar y priorizar las actuaciones a realizar en la playa urbana de Cala Millor en el marco de la adaptación al cambio climático.
- Promover la gestión administrativa efectiva de las medidas priorizadas en Cala Millor.
- Elevar la documentación y los acuerdos alcanzados por el Grupo de Trabajo Adapt Cala Millor al Comité Directivo del LIFE AdaptCalaMillor.

Quinta - Composición

El Grupo de Trabajo Adapt Cala Millor estará integrado por el personal técnico, nombrado por las entidades firmantes del Protocolo General de Actuación (ver Anexo 1).

Las personas representantes del personal técnico de las entidades firmantes del Protocolo podrán delegar, puntualmente, sus funciones.

El Grupo de Trabajo Adapt Cala Millor podrá incorporar nuevas personas integrantes a lo largo del desarrollo del proyecto, en el caso de que sea requerido a propuesta de cualquier miembro. Asimismo, se podrá invitar, puntualmente, a participar y colaborar en las reuniones del Grupo de Trabajo Adapt Cala Millor, a otras personas con conocimiento técnico o experiencia en la materia.

El Grupo de Trabajo Adapt Cala Millor estará constituido por la coordinación, la secretaría y las personas representantes del personal técnico de las entidades firmantes del Protocolo.

Sexta - Coordinación

La titularidad de la coordinación del Grupo de Trabajo Adapt Cala Millor se designará durante la constitución del Grupo de Trabajo Adapt Cala Millor.

Son funciones de la coordinación del Grupo de Trabajo Adapt Cala Millor:

- Representar y ejercer las acciones que correspondan al Grupo de Trabajo Adapt Cala Millor.
- Acordar la convocatoria de las sesiones ordinarias y extraordinarias del pleno del Grupo de Trabajo Adapt Cala Millor, así como la fijación del orden del día de las sesiones, teniendo en cuenta las propuestas y peticiones de sus integrantes.
- Presidir las sesiones del pleno y moderar el desarrollo de los debates y suspenderlos por causas justificadas.
- Velar por el cumplimiento de las decisiones adoptadas.
- Cualesquiera otras que le sean inherentes a su condición de coordinación.

Séptima - Integrantes

Les corresponde a las personas integrantes del Grupo de Trabajo Adapt Cala Millor:

- Compartir experiencias y conocimientos en el ámbito de la temática de las sesiones.
- Participar en los debates y decisiones de las sesiones.
- Formular ruegos y preguntas.
- Obtener la información precisa que les permita cumplir con sus funciones.
- Cuantas otras funciones le sean inherentes a su condición.

Octava - Secretaría

Actuará como secretaría del Grupo de Trabajo Adapt Cala Millor una persona integrante externa, designada por la coordinación de esta, y le corresponderá las siguientes funciones:

- Asistir a las reuniones.
- Efectuar la convocatoria de las sesiones, así como de las citaciones de las personas integrantes, por orden de la coordinación.
- Recibir los actos de comunicación de las personas integrantes del grupo de trabajo y, en consecuencia, las notificaciones, peticiones de datos, rectificaciones o cualquier otra clase de escritos de la que deba tener conocimiento.
- Redactar y autorizar las actas de las sesiones.
- Cuantas funciones le sean inherentes a su condición de secretaría.

Novena - Convocatoria de sesiones

El Grupo de Trabajo Adapt Cala Millor será convocado por la secretaría de éste, por decisión de la coordinación o por petición de la mayoría simple de sus integrantes.

Las sesiones podrán ser ordinarias o extraordinarias. Las convocatorias de ambos tipos de sesiones serán notificadas a las personas integrantes del Grupo de Trabajo Adapt Cala Millor con una antelación mínima de siete días hábiles, para las sesiones ordinarias, y de tres días hábiles para las sesiones extraordinarias.

Las notificaciones de las convocatorias deberán contener el orden del día, el lugar, la fecha y la hora señalados para la realización de la sesión. A dicha notificación se adjuntará, si fuera posible, la documentación necesaria para el desarrollo de la sesión. La información sobre los temas que figuren en el orden del día estará, en cualquier caso, en poder de la coordinación y a disposición de las personas integrantes con la referida antelación.

El Grupo de Trabajo Adapt Cala Millor celebrará una sesión ordinaria aproximadamente cada cuatro meses, según el calendario tentativo según sigue, y sesiones extraordinarias cuantas veces lo considere pertinente su coordinación o la mayoría simple de sus integrantes.

- 1ª Reunión ordinaria, septiembre de 2023. Presencial, Cala Millor.
- 2º Reunión ordinaria, diciembre de 2023. Virtual.
- 3ª Reunión ordinaria, marzo de 2024. Presencial, Palma.
- 4ª Reunión ordinaria, septiembre de 2024. Presencial, Cala Millor.
- 5ª Reunión ordinaria, noviembre de 2024. Presencial, Madrid.
- 6ª Reunión ordinaria, marzo de 2025. Presencial, Palma.
- 7ª Reunión ordinaria, junio de 2025. Virtual.
- 8ª Reunión ordinaria, septiembre de 2025. Presencial, Cala Millor.
- 9ª Reunión ordinaria, diciembre de 2025. Virtual.
- 10ª Reunión ordinaria, marzo de 2026. Presencial, Palma.

Podrá utilizarse para la convocatoria cualquier medio que permita dejar constancia de su recepción por el destinatario, incluidos los mecánicos, electrónicos e informáticos.

Décima - Inicio y desarrollo de las sesiones

Para que el Grupo de Trabajo Adapt Cala Millor esté válidamente constituido, para poder celebrar las sesiones, llevar a cabo deliberaciones y adoptar decisiones, se requerirá la presencia de la coordinación y de la secretaría o, en su caso, de quien sustituya a estas personas, y de la tercera parte de las personas integrantes del Grupo de Trabajo Adapt Cala Millor.

El orden del día será establecido por la coordinación y deberán incluirse, de forma preceptiva, los puntos solicitados por cualquiera de las personas integrantes del Grupo de Trabajo Adapt Cala Millor.

No podrá ser objeto de deliberación o decisión ningún asunto que no figure incluido en el orden del día, salvo que estén presentes todos las personas integrantes del Grupo de Trabajo Adapt Cala Millor y sea declarada la urgencia del asunto por todas ellas.

Décima primera - Actas

De cada sesión que realice el Grupo de Trabajo Adapt Cala Millor, levantará acta la secretaría, que deberá recoger las personas asistentes, el orden del día de la reunión, el lugar y la hora en que se realizó, los puntos principales de las deliberaciones, así como el contenido de las decisiones adoptadas.

Cualquier integrante tendrá derecho a solicitar la transcripción íntegra de su intervención o propuesta, siempre que aporte en el acto o dentro del plazo que señale la coordinación, el texto que se corresponda fielmente con su intervención, y se hará constar así en el acta o se adjuntará copia a esta.

Las actas se aprobarán en la misma sesión o en la siguiente a la que se refieran.

Décima segunda - Confidencialidad

La forma de comunicación de las decisiones adoptadas por el Grupo de Trabajo Adapt Cala Millor en sus sesiones se decidirá de común acuerdo por parte de sus integrantes.

Décima tercera - Disposiciones finales

Durante la sesión de constitución del Grupo de Trabajo Adapt Cala Millor se ratificará su régimen de funcionamiento.

El presente Protocolo no tiene la consideración de Convenio entre administraciones, según la Ley 40/2015, de 1 de octubre, de régimen jurídico del sector público. Cualquier actuación derivada del presente Protocolo que pudiera comportar obligaciones jurídicas para las partes, será necesario para su efectividad que se establezca mediante Convenio suscrito o autorizado por los órganos competentes de las partes intervinientes.

Anexo 1. Ejemplo de firma al protocolo general de actuación del Grupo de Trabajo Adapt Cala Millor y nombramiento de las personas representantes técnicas del Grupo de Trabajo Adapt Cala Millor.

Resolución de [CARGO DE LA PERSONA REPRESENTANTE DE LA ENTIDAD] de [NOMBRE ENTIDAD] por la que se adhiere al protocolo general de actuación del Grupo de Trabajo Adapt Cala Millor, nombra la representación y suplencia del personal técnco en el Grupo de Trabajo Adapt Cala Millor del proyecto LIFE21-GIC-ES-LIFE AdaptCalaMillor.

1. Firmar por parte de [NOMBRE DE LA ENTIDAD] el protocolo general de actuación del Grupo de Trabajo Adapt Cala Millor del proyecto LIFE21-GIC-ES-LIFE AdaptCalaMillor.
2. Nombrar la representación y suplencia de [NOMBRE DE LA ENTIDAD] en el Grupo de Trabajo Adapt Cala Millor.
    - Representante técnico titular: [CARGO] de [ENTIDAD], el/la Sr. / la Sra. [NOMBRE Y APELLIDOS].
    - Suplente 1: [CARGO] de [ENTIDAD], el/la Sr. / la Sra. [NOMBRE Y APELLIDOS].
    - Suplente 2: [CARGO] de [ENTIDAD], el/la Sr. / la Sra. [NOMBRE Y APELLIDOS].
3. Notificar esta Resolución a las personas interesadas.

[LUGAR], [DIA] de [MES] de 2023

[NOMBRE Y APELLIDOS REPRESENTANTE DE LA ENTIDAD]

[CARGO]

[ENTIDAD