

The Governance of Sea Level Rise in the San Francisco Bay Area: results from a survey of stakeholders.

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1 Executive Summary

In the past few years, a large community of policy stakeholders in the San Francisco Bay Area have been debating the risks and the adaptive solutions to sea level rise. While there is emerging agreement about the risks posed by sea level rise, a major challenge is the establishment of multi-level governance arrangements to enable cooperation within and between the local and regional levels of geographic scale. As part of the UC Berkeley/UC Davis research project [Resilient Infrastructure as Seas Rise \(RISER\)](#), in 2017 we published an analysis of the governance challenges called “The Governance Gap: Climate Adaptation and Sea Level Rise in the San Francisco Bay Area”, hereinafter the “Governance Gap report”. As a follow-up to the [Governance Gap](#) report, in summer 2018 we invited stakeholders involved in the governance of sea level rise in the San Francisco Bay Area to complete an online survey. The survey was launched on June 25th and was closed on September 10th, 2018. We received 722 responses. The survey revealed the following major initial findings, which are guiding subsequent in-depth analysis:

- Most San Francisco Bay Area stakeholders address sea level rise as only part of their work, with a smaller core group having sea level rise as their major focus;
- Most San Francisco Bay Area stakeholders work at the local level, with a smaller number working across the entire region;
- Transportation, storm water, and wastewater infrastructure, along with disadvantaged communities, are perceived to be the most vulnerable to sea level rise;
- There is a relatively high level of agreement on perceived risks, but much lower level of agreement on appropriate infrastructure and governance actions;
- The largest barriers to collaboration, as perceived by respondents, are lack of an overall sea level rise adaptation plan, insufficient political leadership, funding gaps, and low levels of public support. Lack of scientific information is NOT perceived as a major barrier;
- While stakeholders desire an overall climate adaptation plan that identifies an appropriate mix of “gray” and “green” infrastructure, there is an aversion to creating any new regional authority; assigning responsibility to an existing agency receives lukewarm support;
- Most collaborative activities are at an early stages of the policy process, and comprise sharing information, joint planning, public outreach, funding applications, and research;
- There are some clear differences among some of the most popular collaborative initiatives in terms of their perceived cooperation, fairness and challenges;

- The most valuable collaboration partners are reputable organizations with financial and information resources.

2 Introduction

When a group faces a coordination problem, such as regional sea level rise adaptation, it may be possible to improve outcomes by providing individuals with a more complete overview of the preferences and choices of the other members of the group. In this spirit, this report outlines the main challenges facing stakeholders who work on addressing sea level rise in the San Francisco Bay Area, as well as their perceptions of the issue, their policy preferences and their collaborative activities.

Sea level rise is a key concern in the San Francisco Bay Area, for policy-makers, stakeholders and the public alike. In the long term (up to 2100) rising sea levels could cause chronic and disruptive inundation across the Bay Area. In the shorter term, the combination of rising sea levels and extreme weather events, such as a 100-year storm, could create immense environmental, social and economic damage.

The data contained in this report results from the survey on the governance of sea level rise in the Bay Area that we fielded to stakeholders during summer 2018. Over 700 individuals completed the survey questions presented here. Their organizational affiliations range from governmental agencies to non-governmental organizations, and from the federal to the local level of governance.

The San Francisco Bay Area is a fragmented and decentralized governance context. Tackling sea level rise is a matter of climate change adaptation; even if climate change could be halted tomorrow, some of its consequences, such as fast rising sea levels, would still occur. Adaptation requires decisions to be made with respect to infrastructure investments in specific locations. Hence, adaptation to sea level rise is a land use issue. In the Bay Area, land use authority resides primarily at local level. Hence, adaptation to sea level rise has a profoundly local character. As recent research carried out in the framework of the [RISER project](#) has shown, localities in the Bay Area are interdependent in terms of their vulnerability to sea level rise: an infrastructural measure aimed at protecting one jurisdiction could adversely or positively impact another (Wang, Stacey et al., 2018)¹, either by changing the biophysical processes of flooding and tidal inundation, or when local vulnerabilities have regional impacts on infrastructure like transportation. Furthermore, there are similarities in community exposure to flooding hazards for a suite of sea level rise and storm scenarios across the Bay Area, which may inform partner selection in collaborative processes (Hummel, Wood et al., 2018)².

¹Wang, R.-Q., M. T. Stacey, L. M. M. Herdman, P. L. Barnard and L. Erikson (2018). “The Influence of Sea Level Rise on the Regional Interdependence of Coastal Infrastructure.” *Earth’s Future* 6(5): 677-688.

²Hummel, M. A., N. J. Wood, A. Schweikert, M. T. Stacey, J. Jones, P. L. Barnard and L. Erikson (2018). “Clusters of community exposure to coastal flooding hazards based on storm and sea level rise scenarios—implications for adaptation networks in the San Francisco Bay region.” *Regional Environmental Change* 18(5): 1343-1355.

In this context, our research investigates the governance dimension of adaptation to sea level rise in the Bay Area. Specifically, our survey investigated the perceptions and collaborative activities of a wide range of stakeholders who deal with sea level rise in the Bay Area in their everyday work and/or are involved in the governance processes aimed at addressing it. Understanding their perceptions of this policy issue, their policy preferences, their collaborative activities and the challenges they face in addressing sea level rise is important in order to bridge the science of climate and the social science of coordination and collaboration processes in contexts of fragmented authority and multi-level governance.

As potential respondents, we targeted individuals who work on sea level rise in any capacity and at any governance level. We gathered contact information on potential respondents from a variety of sources, as explained in the next section. These individuals represent the vast majority of the organizations that work on sea level rise in the Bay Area. All respondents were asked to reply to the survey questions in their professional capacity, unless they declared being involved as private citizens.

Our governance survey asked respondents questions about three main topics:

- their perceptions of the issue of sea level rise and of the current state of the governance;
- their preferences concerning the actions needed to tackle sea level rise in the Bay Area;
- their collaborative activities:
 - within the framework of collaborative governance initiatives;
 - bilaterally with other organizations.

The main takeaway from our survey is that coordination is the name of the game. Lack of coordination emerges as the most important barrier to respondents' collaborative activities, and as the main priority action to undertake in order to adapt to sea level rise in the Bay Area. As is typical in public policy, policy-makers and stakeholders appear to have a high level of agreement on the nature of the problem, the risks that it poses, and the menu of available solutions, but struggle to agree on the concrete actions to implement. At the same time, however, we observe an abundance of collaboration related to sea level rise, resulting in a very dense network of bilateral collaborative relations - comprising a core group of highly connected agencies and stakeholders spanning governance levels and territorial jurisdictions - and in a myriad collaborative initiatives ranging from the local to the regional level and comprising both formal initiatives and informal networks gathering stakeholders around climate adaptation goals. The system of governance related to sea level rise in the Bay Area is rapidly emerging, and fostering the trust and reputation-building mechanisms that are key conditions for successful policy coordination.

2.1 Methodology

The survey was launched for completion on 25 June 2018, and closed on 10 September 2018. We disseminated the survey to over 3000 individuals; most of them work on sea level rise on behalf of one or more organizations, while a minority are involved in the governance of sea level rise in an individual capacity. Our list of contacts covered 400 organizations, comprising government entities from all levels of governance (from federal to local), and non-governmental organizations including consultancies, higher education institutions, community based organizations, environmental organizations, designers and architects.

We identified our target respondents through various strategies. Firstly, we compiled a dataset of collaborative and policy initiatives concerning sea level rise in the Bay Area, collected the relevant policy reports, and extracted the names of organizations listed as participants and/or sponsors of the initiative. We then searched the Internet for contact information on the individuals involved. Secondly, we complemented this extensive list with additional organizations involved in the governance of sea level rise in the Bay Area retrieved via Internet searches. Thirdly, we attended meetings and public presentations of initiatives and committees working on sea level rise across the Bay, and collected information on the organizations involved. Fourthly, in our email message inviting respondents to complete the survey, we also asked them to invite colleagues or other stakeholders that they knew worked on sea level rise to contact us, in order to be provided with an individual link to the survey. The survey was implemented and distributed using the Qualtrics platform.

We obtained 722 individual replies. The response rate, calculated using the standards of the American Association of Public Opinion Research, was 22%. Collectively, our respondents represent 385 organizations (including separate local government departments). Overlap with our original list is over 50%. Overall, our sample is broadly representative of the governance actors involved in sea level rise in the Bay Area.

The figures presented in this report are descriptive barcharts and consist of simple counts of respondents' replies divided by the total number of respondents. In other words, most of the results are presented as percentage of respondents for different response choices in the survey. The wording for each survey question is included in the figure labels. Moreover, we created network graphs to illustrate the density and scale of the governance network of sea level rise in the Bay Area, as well as the key actors in it. By 'key actors', we mean the organizations possessing the highest numbers of connections in the network. Most of the figures in this report, as well as the report itself, were produced in the R statistical environment using RMarkdown.

We also produced inundation maps that overlay flooding projections with the geographic focus of our respondents' work on sea level rise. To produce the inundation maps a few steps were required. The survey contained a question asking respondents to select all Operational Landscape Units (OLUs) (as determined by the San Francisco Estuary Institute - SFEI) where their work on sea level rise is focused. Then, a percentage

of respondents' focus per OLU was calculated by dividing the number of times each OLU was selected by the total number of respondents. Respondents were allowed to select more than one OLU, so the total sum of respondents' focus per OLU is greater than 1.

The maps were built with ArcMap. The SFEI OLU shapefile was downloaded and imported into the software. The calculation made above was joined to the attribute table of the OLU shapefile by OLU ID number. This shapefile was then plotted by binning the percentage of respondents' focus per OLU into 3 categories, each containing roughly 10, or one third, of the OLUs. The categories were 23 - 28, 29 - 33, and 34 - 39 percent. Next, the Adapting to Rising Tides (ART) Sea Level Rise and Shoreline Analysis geodatabases were downloaded by county and unzipped. All levels of inundation were extracted, combined to form Bay Area-scale inundation and clipped to the OLU boundaries.

2.2 Respondents' characteristics

To better understand how sea level rise relates to the professional activities of stakeholders, the survey asked respondents about their level of involvement in the governance of sea level rise in the Bay Area, as well as their geographic focus in terms of shoreline segments. Our respondents represent a broad diversity of types of organizations. Given that the Bay Area has 9 large counties with large administrations, along with 101 municipalities, it comes as no surprise that the largest number of respondents represent local governments (see figure 1). Non-governmental organizations are the second highest category of respondents, followed by education professionals and consultants. State, federal, and regional government respondents are fewer in aggregate, but play a crucial role because they usually have a regional focus and control substantial resources and authority.

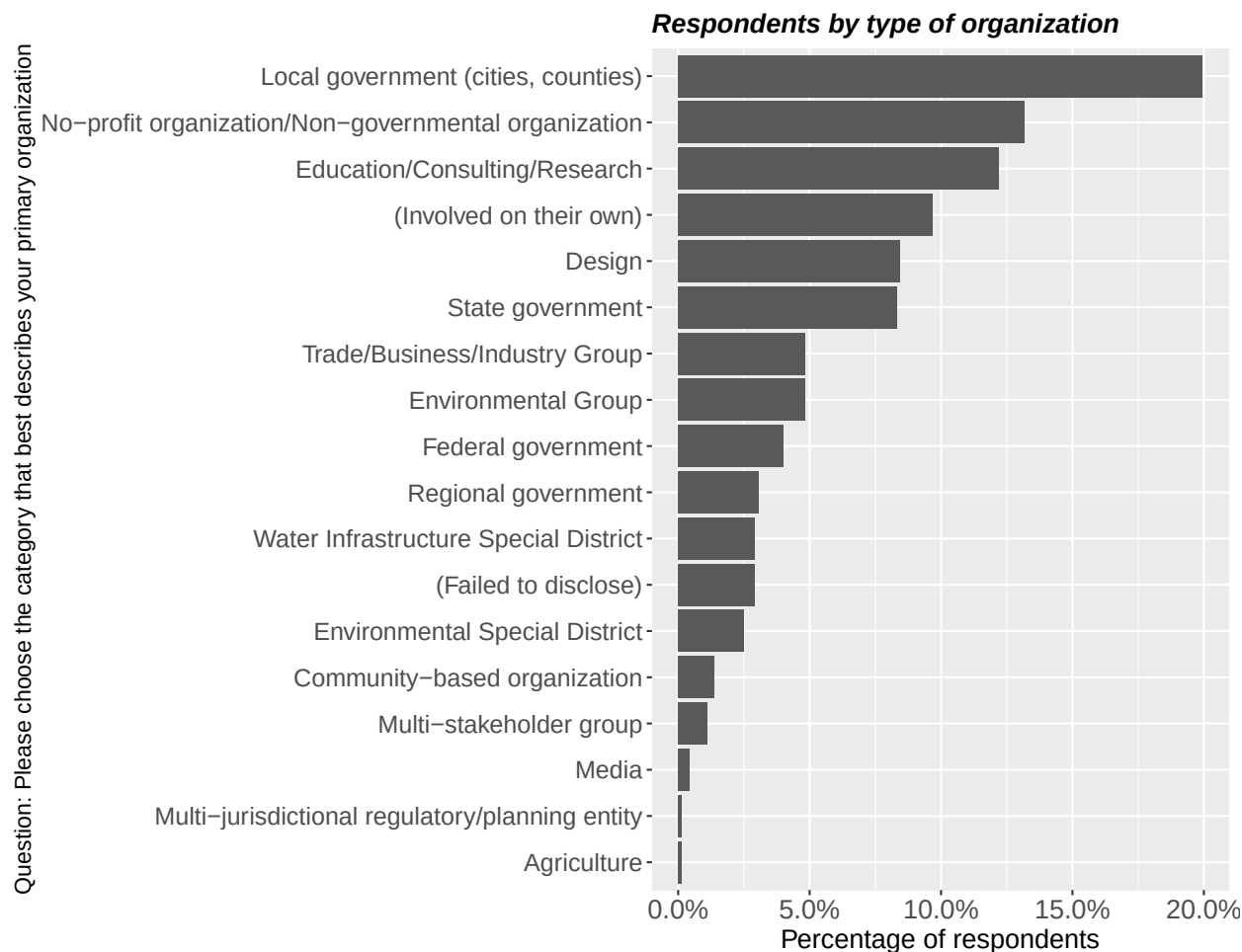


Figure 1: Respondents' organizations.

Moreover, 65 survey respondents affirmed that they are involved in the governance of sea level rise in an individual capacity, while 38 respondents declined to state their organizational affiliation. All other respondents provided information on their organizational affiliation(s). Figure 2 reports a breakdown of the count of our survey respondents by their organizational affiliation. For ease of reading, the figure only reports the count of respondents for each organization that had between 3 and 20 respondents, for a total of 52 organizations. The total number of organizations represented by only one respondent is 335. These counts include sub-entities, such as county departments.

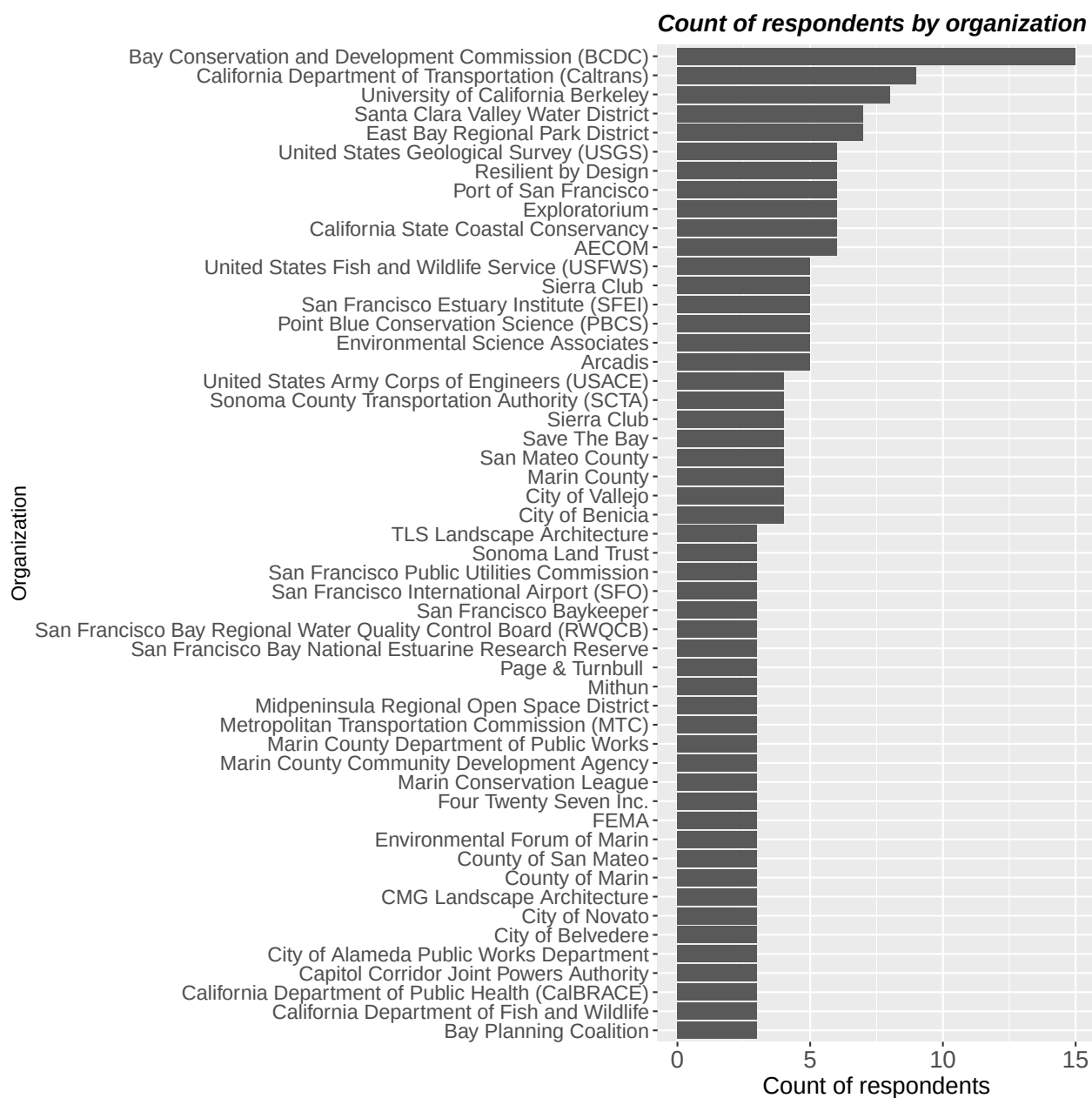


Figure 2: Breakdown of respondents' affiliations.

The majority of the respondents address sea level rise as only part of their work, mostly with occasional involvement (see figure 3). A smaller portion of respondents view sea level rise as a major portion of their work.

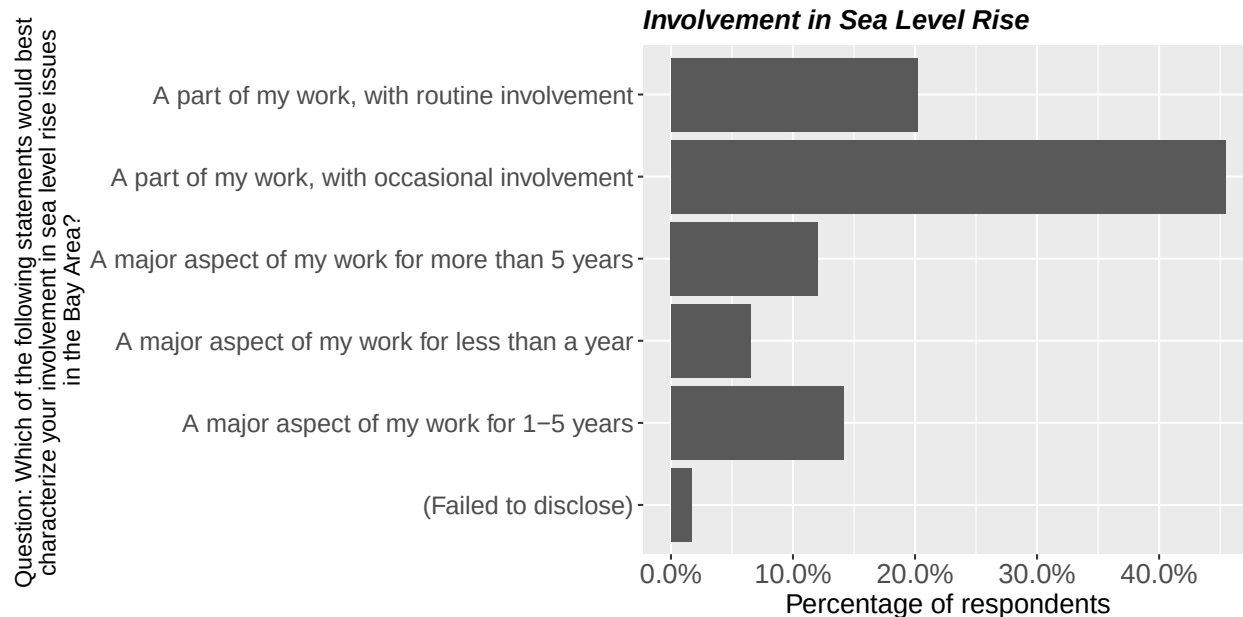


Figure 3: Respondents' involvement in sea level rise governance.

Moreover, most respondents (68%) are involved in the governance of sea level rise in the Bay Area as part of one organization, with a smaller number (22%) representing multiple organizations or participating in an individual capacity (10%).

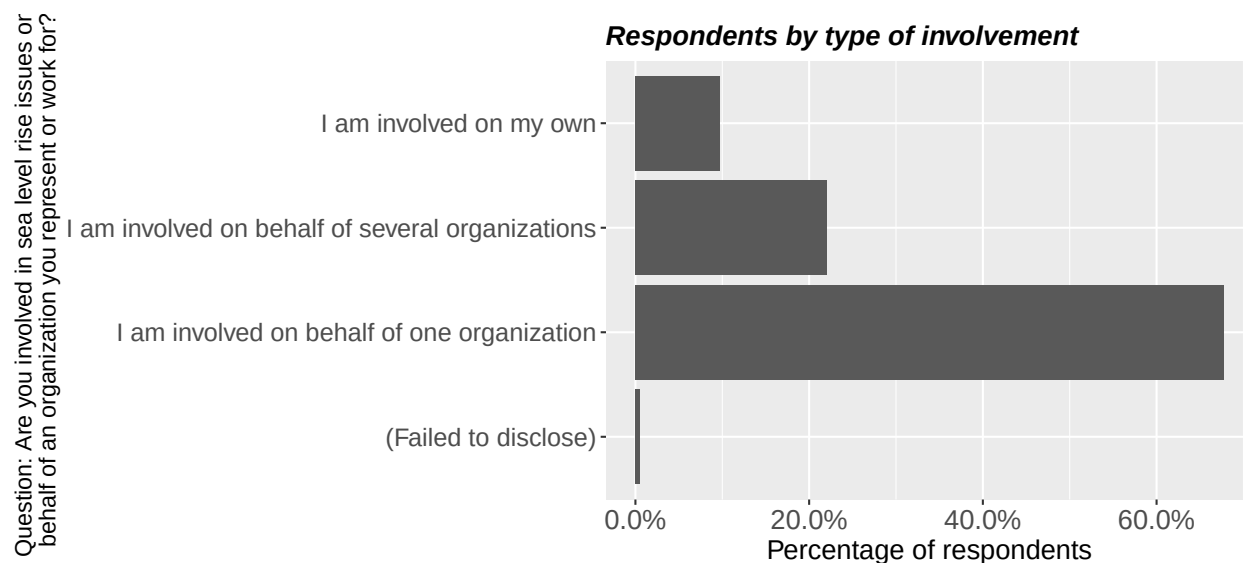


Figure 4: Type of respondents' involvement.

The majority of our respondents appear to be staff level individuals, engaged in project management, planning, outreach and communication, and policy analysis, as shown in figure 5. Combined with the results about level of involvement, this suggests that many stakeholders are working on policy and planning tasks in which sea level rise is one part of a broader environmental portfolio. However, respondents also include a substantial number of executive managers. Based on our previous research, we know that the presence of executive management within policy and planning forums can serve as a catalyst for cooperation, because executive managers provide leadership and credible resource commitment. Furthermore, the smaller number of people with a heavy level of involvement are typically the “core” of the overall sea level rise adaptation network, who will participate in many different forums.

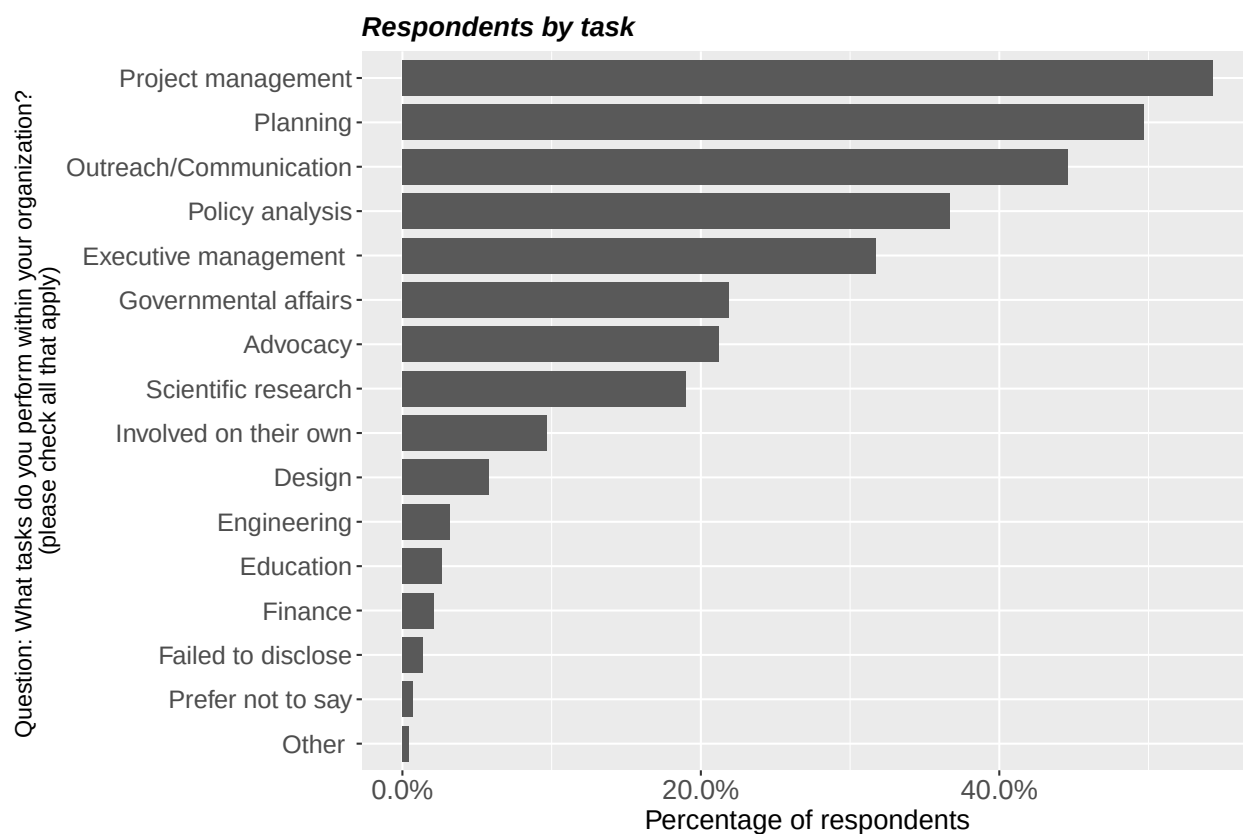


Figure 5: Respondents’ job tasks.

Each respondent was asked to identify the shoreline segments they work on, based on the shoreline segments (Operational Landscape Units, or OLUs) defined by San Francisco Estuary Institute (SFEI). The survey displayed an interactive map of OLUs, and respondents could select as many shoreline segments as they wanted or indicate that they worked on the whole region. Figure 6 shows the percentage of respondents who selected each region. Not surprisingly given the number of local government actors, most respondents

focused on one or 2-7 shoreline segments, as shown in Figure 7. Fewer respondents focus on the entire Bay Area or larger sub-regional collections of shorelines. As shown in the figure, we grouped respondents into four groups, based on the results of an algorithm that determines the best arrangement of values into classes (the Jenks natural breaks optimization calculation). The first group comprises respondents focusing on just one OLU; this class comprises 188 respondents. The second group comprises respondents that focus on 2 to 7 OLUs; this class comprises 264 respondents. The third group comprises respondents focusing on 8 to 20 OLUs; this is the smallest group, with 52 respondents. The fourth group comprises respondents focusing on over 20 OLUs; this group comprises 120 respondents. We interpret the groupings as telling of how broad an overview individual respondents have of the issue of sea level rise in the Bay Area.

Shoreline Segments Respondents Focus On

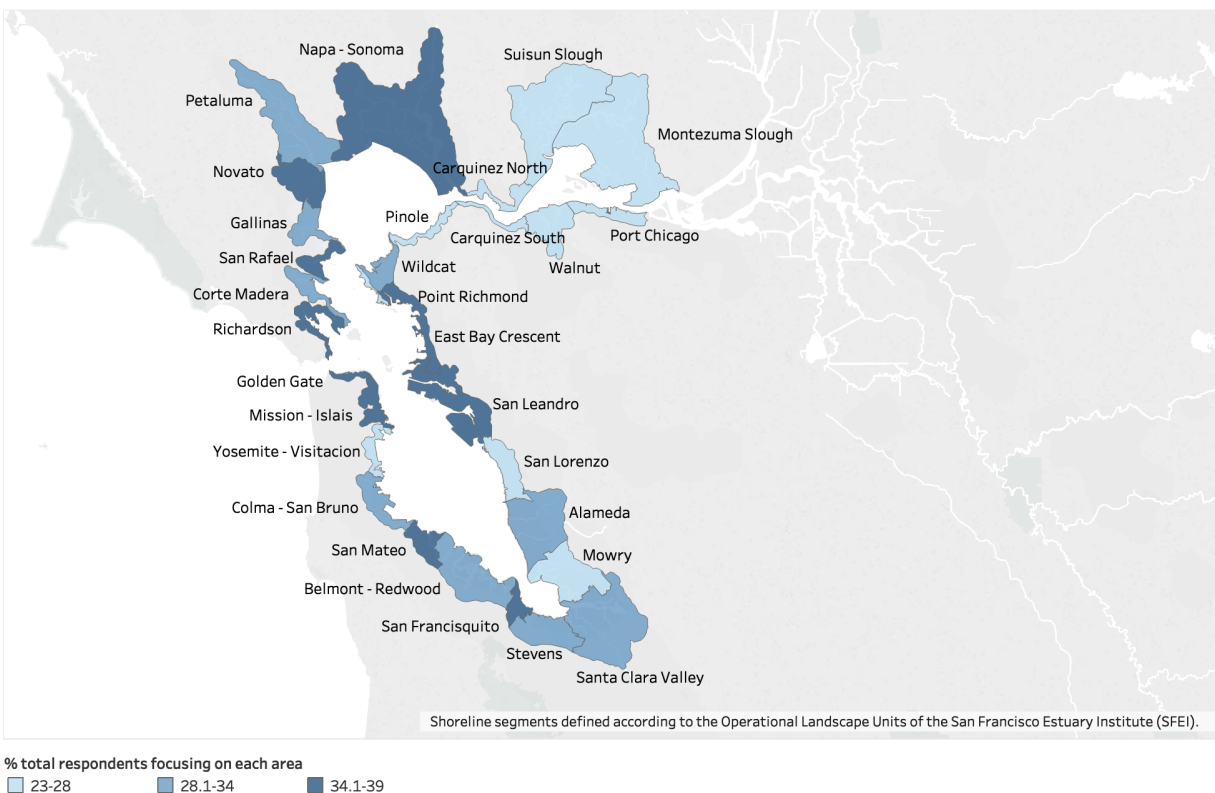


Figure 6: Overview of the shoreline segments that respondents focus on.

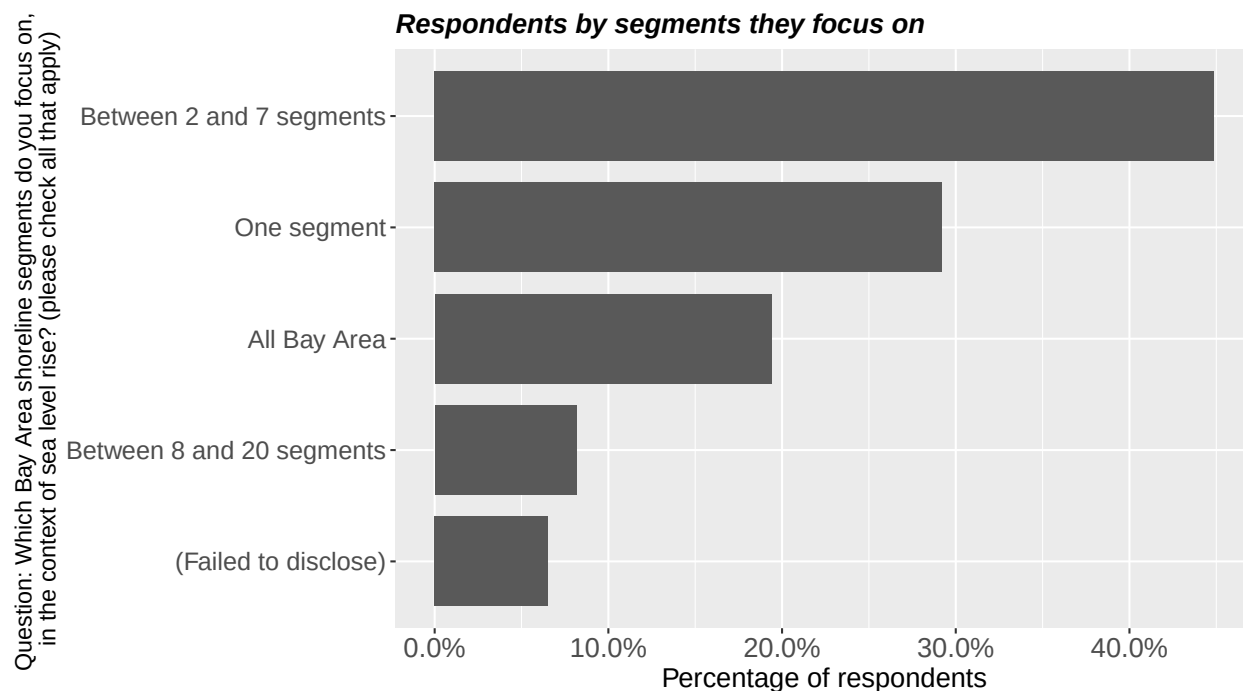


Figure 7: Breakdown of the count of shoreline segments that respondents focus on.

There is positive correlation between the segments that our respondents focus on (in aggregate) and the population figures in each segment as reported in the 2010 USA census. The Pearson's correlation coefficient is 62%, as shown in figure 8. We calculated the percentage of inundated area per OLU by intersecting the Bay Area-wide inundation map with the OLU shapefile, then calculating geometries for each entry, summing them by OLU and dividing by total OLU area. The correlation between projected area inundated with 12 inches of sea level rise and the areas that our respondents focus on is negative (-26% for 12 inches, -18% for 24 inches), as visible in figure 9. This is due to areas in the North Bay that will be heavily inundated but have lower population density, e.g. Montezuma Slough and Suisun Slough. One interpretation is that our respondents' focus seems to be directed at the most heavily populated segments, that are likely to experience the highest economic and human costs of inundation. Another interpretation is that urbanized areas have higher concentrations of professionals and organizations that become involved in environmental policy.



Figure 8: Correlation between population data and respondents' focus on shoreline segments.

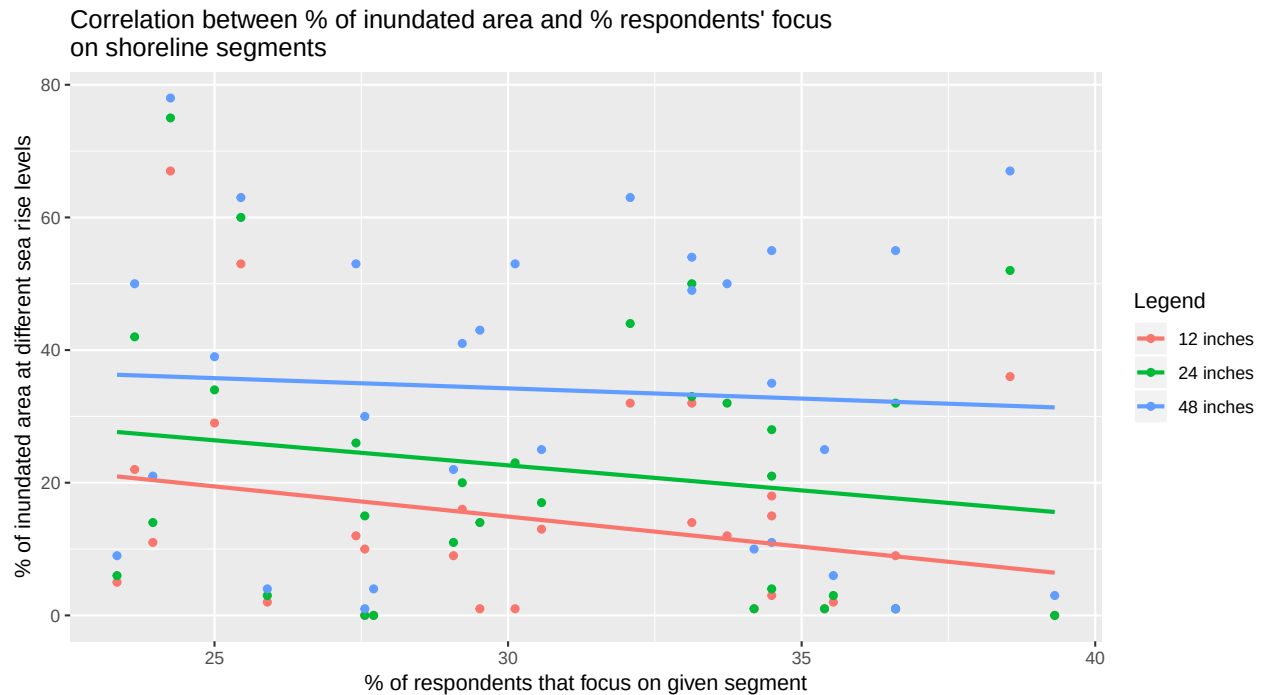


Figure 9: Correlation between % of inundated area and respondents' focus on shoreline segments.

However, the danger of inundation does not uniquely depend on sea level rise. As a number of interviewees for the [Governance Gap](#) report commented, the highest risk comes from the combination of rising sea levels and extreme weather events, such as storms surges. To outline the likely impacts of these phenomena, we produced the maps in figure 10, 11, and 12, using data available from the [Adapting to Rising Tides \(ART\) Sea Level Rise and Shoreline Analysis geodatabases](#). Three inundation levels were chosen based on their feasibility and demonstrative properties and outlined by the ART Flooding Scenarios. The scenarios are based on a “business-as-usual” prospect of high emissions up to 2050, and correspond to the “likely range” probabilistic projection of the Ocean Protection Council climate scenario (RPC 8.5) as per its most recent [sea level rise guidance for the State of California](#). The three levels are as follows:

- 2050 projected SLR (12“)
- No SLR and 5-yr Storm Surge (24“)
- 2050 projected SLR and 50-yr storm surge (48“)

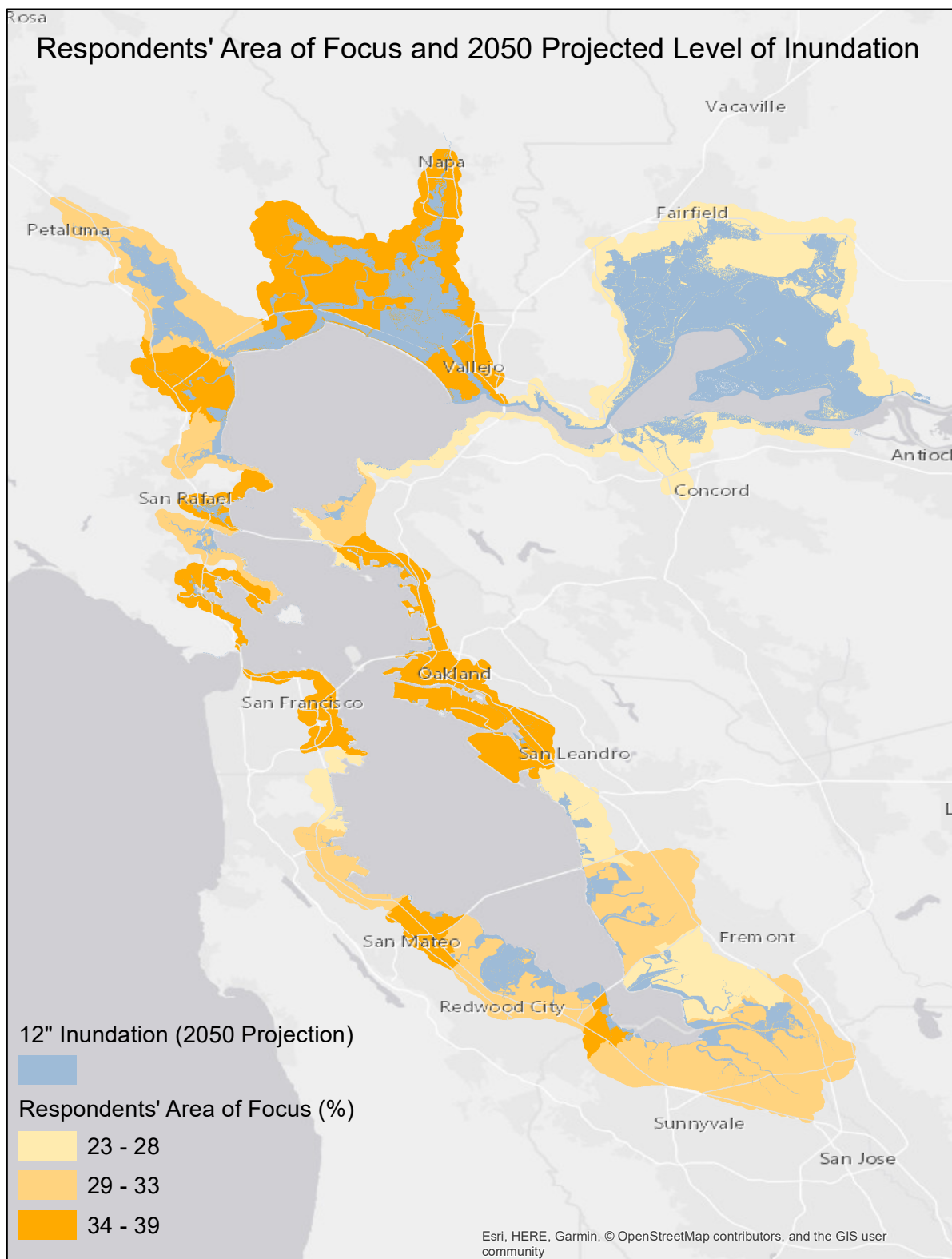


Figure 10: Respondents' areas of focus and 2050 projected level of inundation.

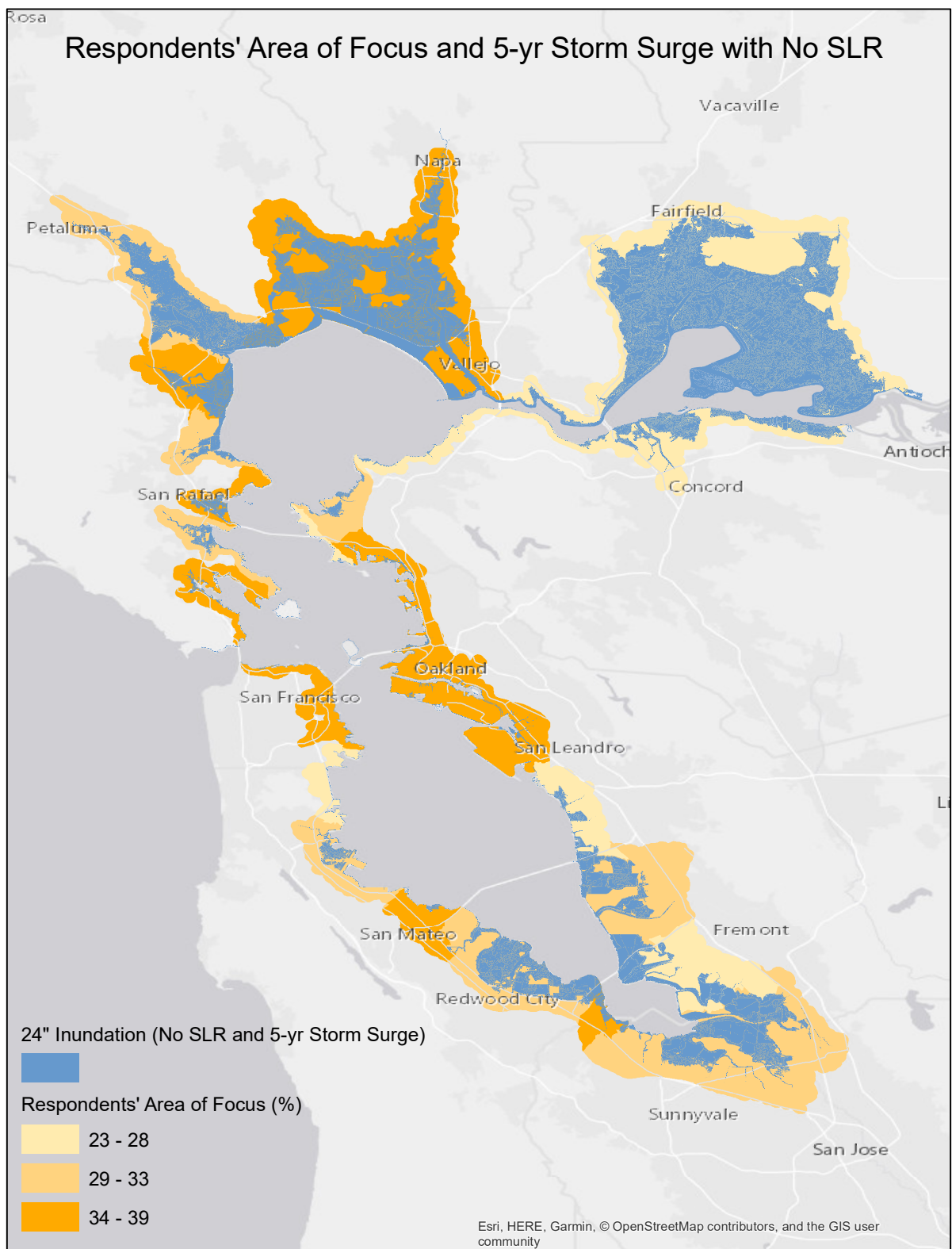


Figure 11: Respondents' areas of focus and 5-yr storm with no sea level rise.

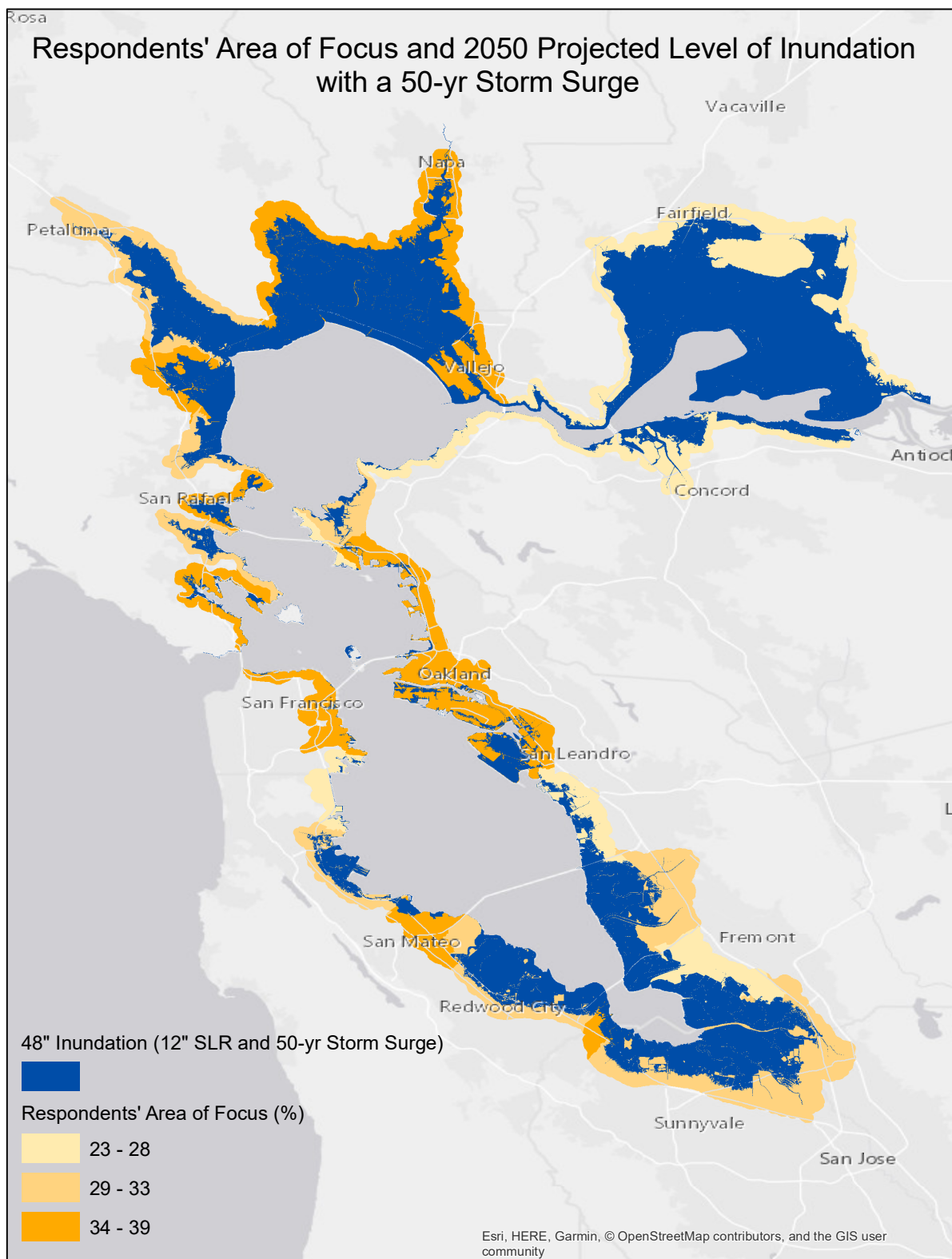


Figure 12: Respondents' areas of focus and 2050 projected levels of inundation with 50-yr storm.

Figure 10 shows that the level of sea rise projected for 2050 is projected to lead to inundation of ample portions of the North and the South Bay. The even broader extent of inundation foreseen in figure 11 is telling, however, in that it is based on a storm surge under no sea level rise. Then, figure 12 shows the projected impact of the combination of storm surges and sea level rise up to 2050: the whole Bay would be affected by flooding, particularly areas in the North, South and East Bay. Visual inspection of these figures corroborates the finding that survey respondents focus most on heavily populated segments of the Bay, rather than on those most affected in terms of inundated area.

3 Perceptions of Sea Level Rise Vulnerabilities

An interesting advantage for San Francisco Bay is that most stakeholders perceive a relatively high level of agreement in the policy arena about the risks posed by sea level rise. The majority of respondents reported a “fairly high level” or “high level” of agreement on perceived risks. Conversely, the majority of respondents reported a “not very high level”, “low level” or even “very low level” of agreement on required actions, as visible in figure 13. This is a first strong signal of the fact that respondents perceive sea level rise in the Bay Area primarily as a coordination problem: the issue is not whether the problem exists and what consequences it entails, but rather how to tackle it.

While further research is required to confirm how this pattern compares to other regions in the United States, we expect that the political attitudes in San Francisco Bay are more accepting of climate change risks than other regions such as South Florida, even in the absence of major focusing events like Superstorm Sandy, hurricanes and recurrent “sunny day” flooding. Thus, while there is certainly a need for continued analysis of risk on several fronts, the larger challenge going forward is forging agreement on the appropriate portfolio of infrastructure investments and associated governance arrangements.

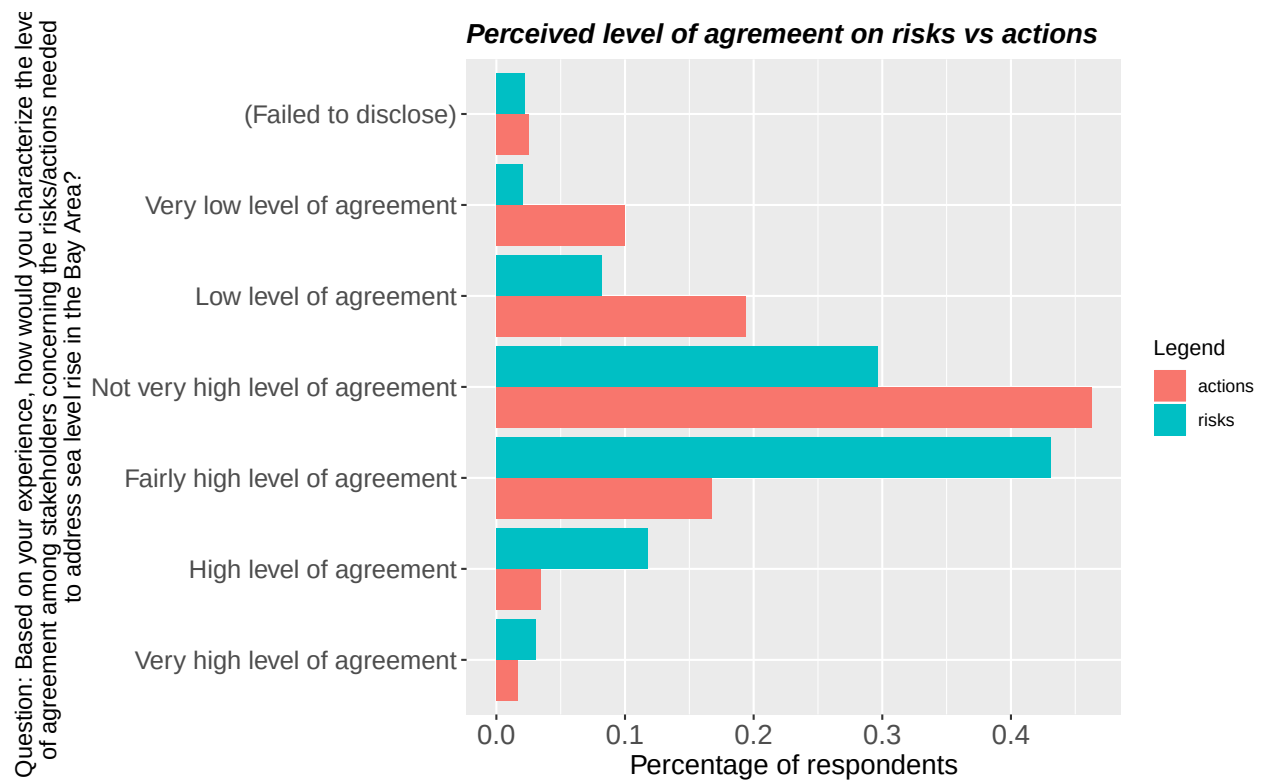


Figure 13: Respondents’ perceptions of agreement between stakeholders concerning risks posed by sea level rise and actions to address it.

Besides asking about perceived agreement in the policy arena, the survey asked respondents four questions related to their perceptions, preferences and actions concerning sea level rise in the Bay Area. Specifically, the questions concerned:

- the sectors or issues that respondents are most worried about;
- the collaborative activities they performed in relation to sea level rise in the past year;
- the barriers that they faced to engaging in collaborative activities;
- the top three policy actions that they would prioritize.

In this and the following sections, we report the responses to these questions in aggregate form. For some of the questions, we also report responses by organizational affiliation, where we think there were some interesting differences among organizations. Although the respondents’ groupings differ significantly in size (see Table 1), the breakdown of their replies is useful to gauge the differences in their perceptions, activities and preferences. For ease of reading, in the relevant barcharts we incorporated categories “media”

and “agriculture” into the “Trade/Business/Industry Group” category, and category “Multi-jurisdictional regulatory/planning entity” into the “Regional government” category.

Table 1: Count of respondents by type of organization

Type of organization	Count of respondents
Local government (cities, counties)	144
No-profit organization/Non-governmental organization	95
Education/Consulting/Research	88
(Involved on their own)	70
Design	61
State government	60
Environmental Group	35
Trade/Business/Industry Group	35
Federal government	29
Regional government	22
(Failed to disclose)	21
Water Infrastructure Special District	21
Environmental Special District	18
Community-based organization	10
Multi-stakeholder group	8
Media	3
Agriculture	1
Multi-jurisdictional regulatory/planning entity	1

As for the issues or sectors of main concern to respondents, the survey provided respondents with a list of sectors or categories that may be impacted by sea level rise, and asked them to pick the three they are most worried about. The results are in figure 14. Each question had a reply option named “Other”, linked to a text box where respondents could provide details. We re-coded those replies into new categories. In the figures, the newly created categories are preceded by the word “Other:”. Where respondents marked “Other” but did not provide any details, we reported their replies as simply “Other” in the figures.

Transportation infrastructure, wastewater and stormwater infrastructure, as well as disadvantaged communities are the top three concerns for survey respondents. The choice of the first two denotes awareness of the policy debate as informed by civil engineers, planners, and hydrological models. The intersection of sea level rise and flooding with critical infrastructure has been the topic of extensive analysis. The appearance

of disadvantaged communities among the top three concerns also denotes respondents' awareness that some individuals and communities are more exposed and vulnerable than others to sea level rise, and that adaptation measures should take environmental justice issues into account. Over the last 10 years, awareness of the heightened vulnerability of disadvantaged communities has been increasing within the entire environmental policy community in California, resulting in policy efforts such as the Integrated Regional Water Management, the Sustainable Groundwater Management Act, and others.

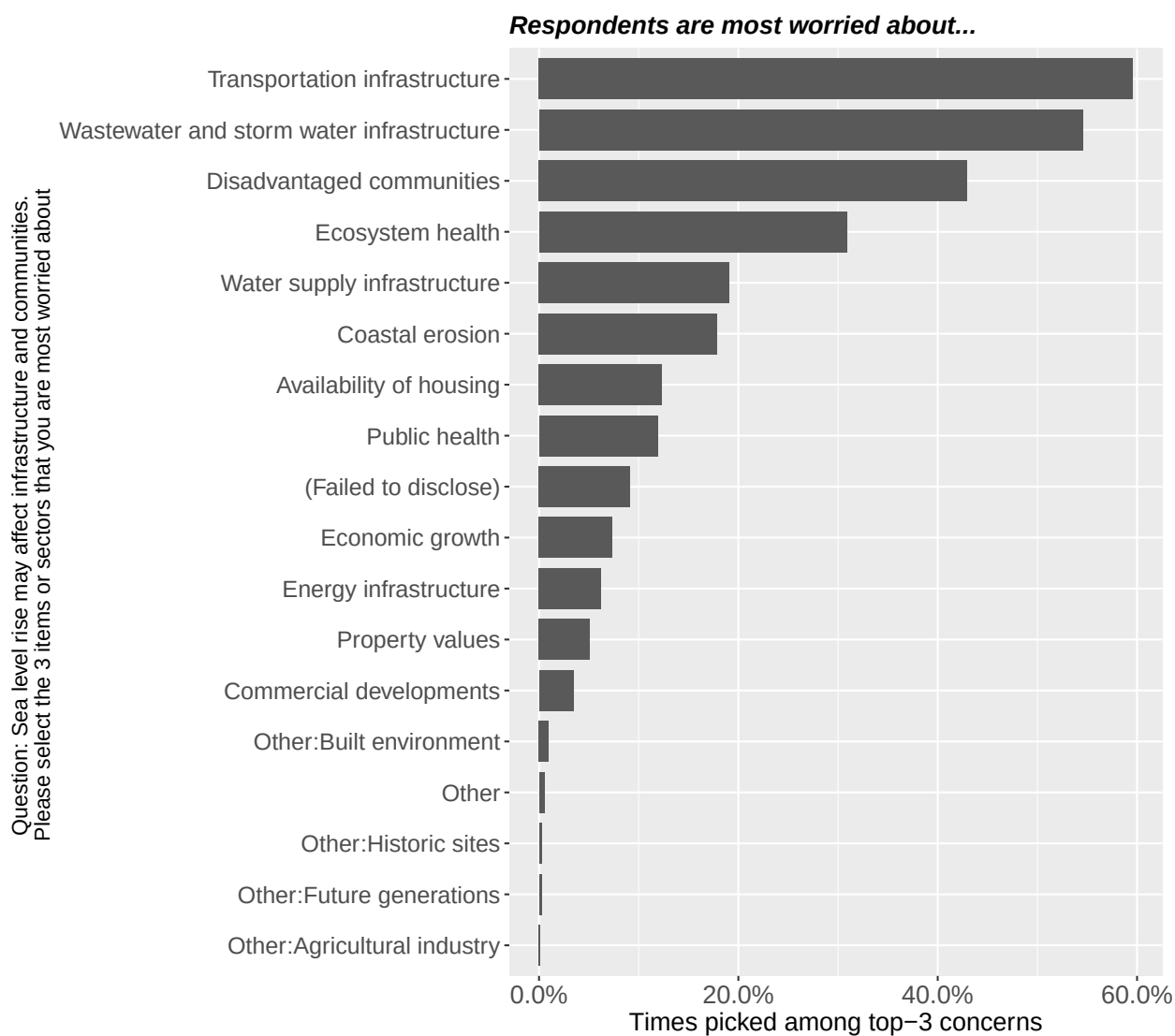


Figure 14: Respondents' top three concerns in relation to sea level rise in the Bay Area.

4 The Emergence of Collaboration

Sea level rise adaptation, including the creation and implementation of any plan, requires collaboration among stakeholders at multiple levels. The imperative for collaboration is driven by interdependence both in climate vulnerability and adaptation actions. For example, flooding in many local regions of the Bay Area creates impacts in other regions, such as through increasing traffic congestion and travel times. For adaptation, the infrastructure choices of one local area may have positive benefits for other areas by reducing the source of flood risks. Adaptation infrastructure may also have negative spillover effects, by raising water levels and flood risks in other areas. The overall point is that multiple interdependencies require actors to consider how their decisions will impact others, which necessitates cooperation at the regional level.

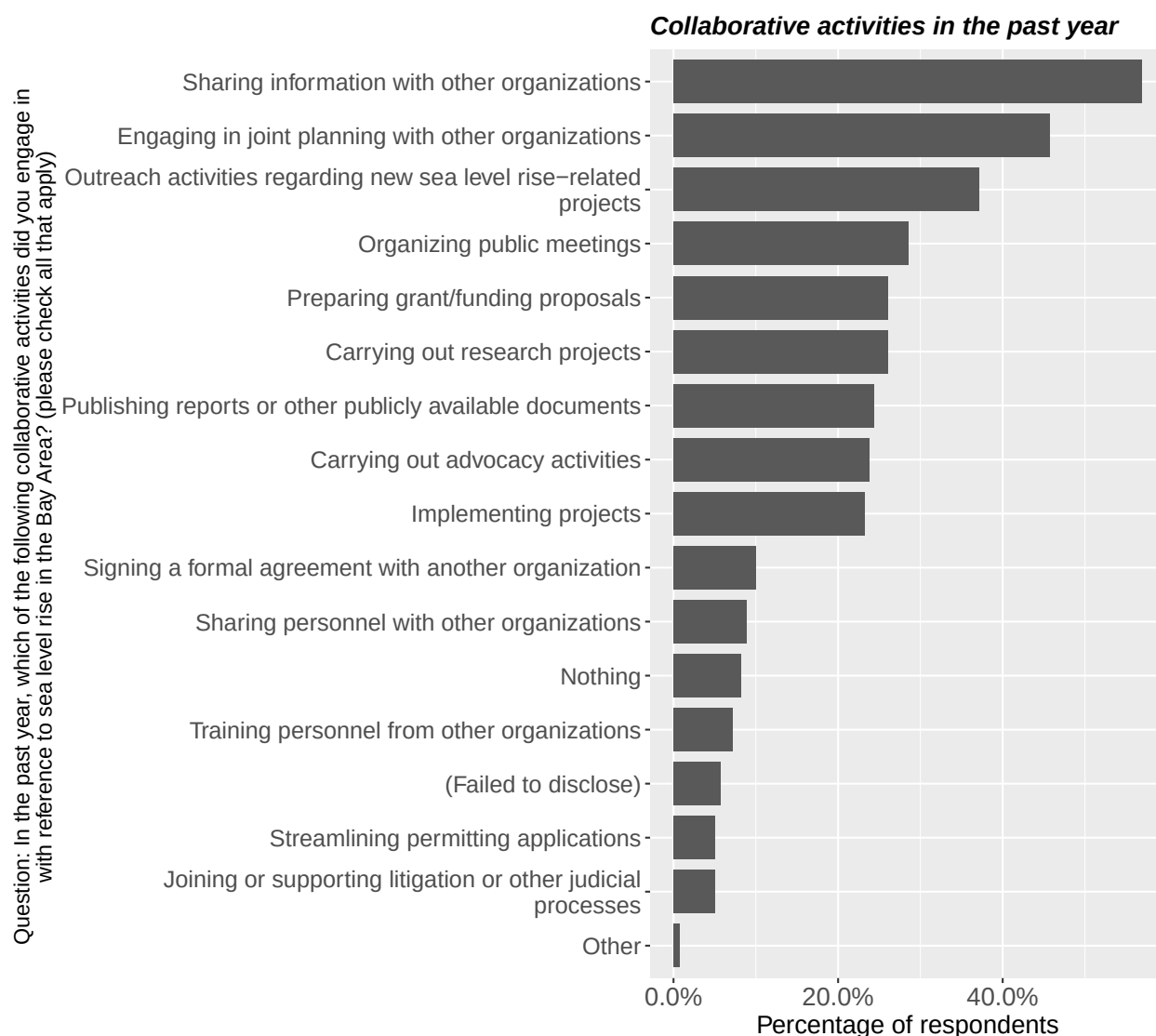


Figure 15: Collaborative activities respondents carried out in the past year.

Our results suggest that collaboration around sea level rise is at the early stages of evolution, and still emerging. Respondents were asked to report on the collaborative activities they carried out jointly with other organizations in the past year. As shown in figure 15, the most frequent responses concerned sharing information, planning, joint public engagement, research, and funding. Figure 16 reports an overview of the different engagement in select collaborative activities by type of organization. State and regional government respondents appear as the most active in terms of information sharing, followed by multi-stakeholder groups and the federal government, but also environmental groups. Respondents belonging to the state government and environmental special districts report the highest percentages of joint planning, while respondents from multi-stakeholder groups and the regional agencies report most joint implementation. Outreach activities are prominent for a third of respondents across organizations, and particularly for non-governmental entities. Respondents from environmental special districts appear most engaged in joint applications for grants and funds related to sea level rise.

Overall, respondents reported having engaged in more formal collaborative arrangements, such as sharing personnel, joint project implementation, integrated permitting, or signing formal agreements, much less frequently. To some extent this is the typical pattern of policy collaboration: rates of informal interaction usually exceed rates of more formal collaboration strategies. At the same time, addressing sea level rise in the Bay Area will require infrastructural investments with high upfront costs and long time spans. Our research experience suggests that informal collaboration is insufficient, on its own, to bring about agreement concerning investments of comparable magnitudes. As section 7 will show, this consideration is reflected in respondents' perceptions on the fairness and quality of the collaboration across different collaborative initiatives: namely, initiatives aimed at generating, gathering and diffusing information were perceived as less conflictual than initiatives aimed at making concrete decisions concerning adaptive infrastructural solutions. At the same time, informal collaborative activities create the underlying trust and mutual understanding that are pivotal to more formal arrangements, primarily in terms of shared or pooled authority across agencies and across levels of governance.

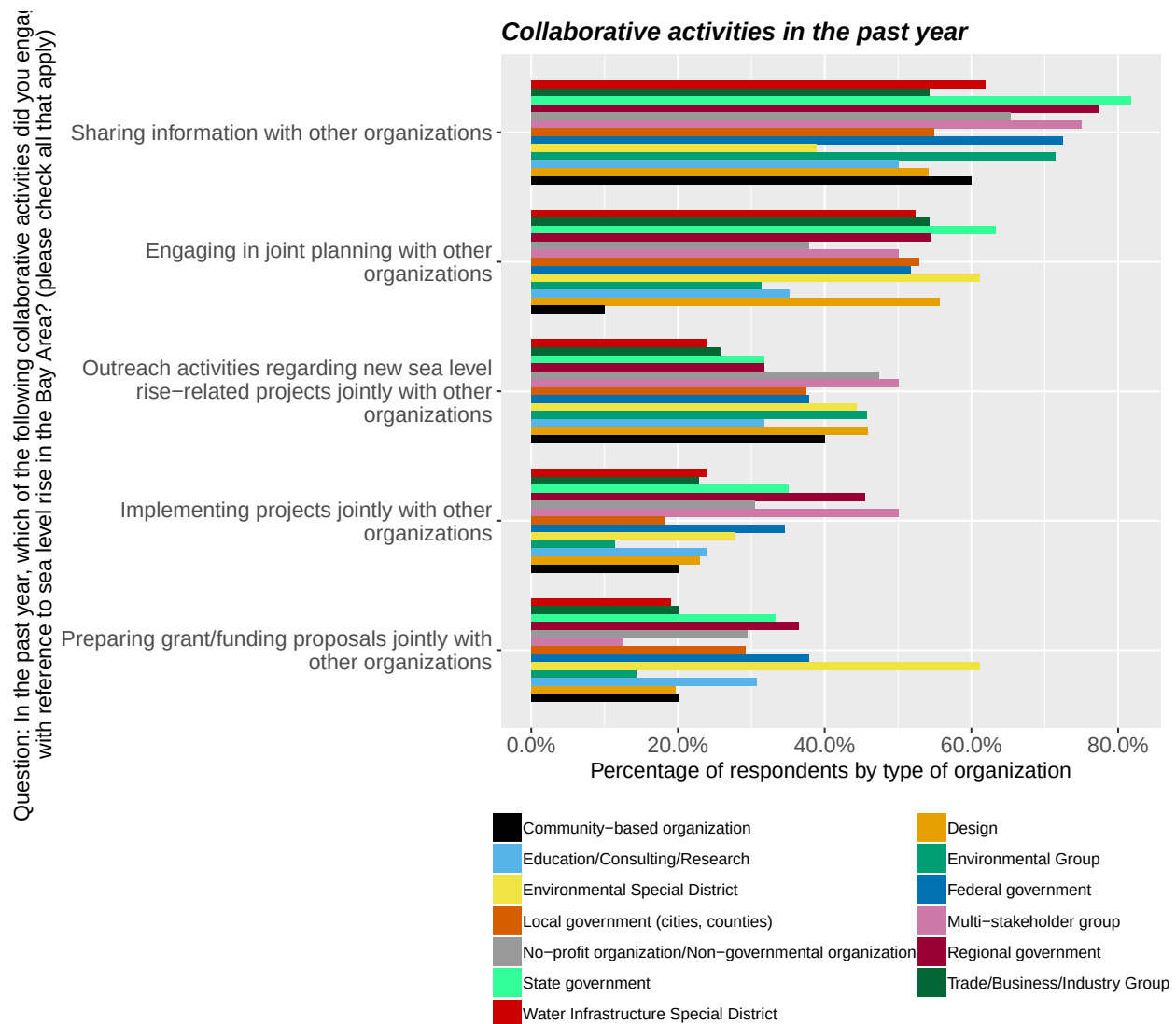


Figure 16: Respondents' collaborative activities by type of organization.

5 Governance Challenges and Solutions: A Governance Catch-22

The survey asked stakeholders to select the three most important barriers to collaboration. Their replies are in figure 17. By far the largest perceived barrier is the lack of an overarching climate adaptation plan for sea level rise to guide decisions and projects across the region. The next significant set of barriers can be conceptualized as resources needed to support an overall plan: political leadership, financial resources, public support, and human resources.

Examining figure 18, we see that the lack of an overarching plan to address sea level rise has been an obstacle to collaborative activities for most respondents, particularly those belonging to multi-stakeholder groups, and

the regional government. Lack of leadership from elected officials is particularly relevant to environmental special districts and community organizations, while local governments lament lack of a regional plan but also insufficient resources. Insufficient human resources are a significant obstacle for state government respondents. Respondents from community based organizations and environmental special districts reported lack of public support as a barrier to their collaborative activities. Overall, there is a suggestion that non-governmental organizations are more worried about civic engagement, outreach, and leadership, while local governments and special districts are concerned about policy implementation barriers like funding and permitting.

Interestingly, lack of scientific information and conflict among stakeholders were not nominated as major barriers to effective collaboration (see figure 17). This reflects the earlier finding about a relatively high level of agreement about the risks of sea level rise, which is supported by extensive analysis based on climate and hydrological models of expected sea level rise and flooding scenarios under different assumptions of climate change trajectories.

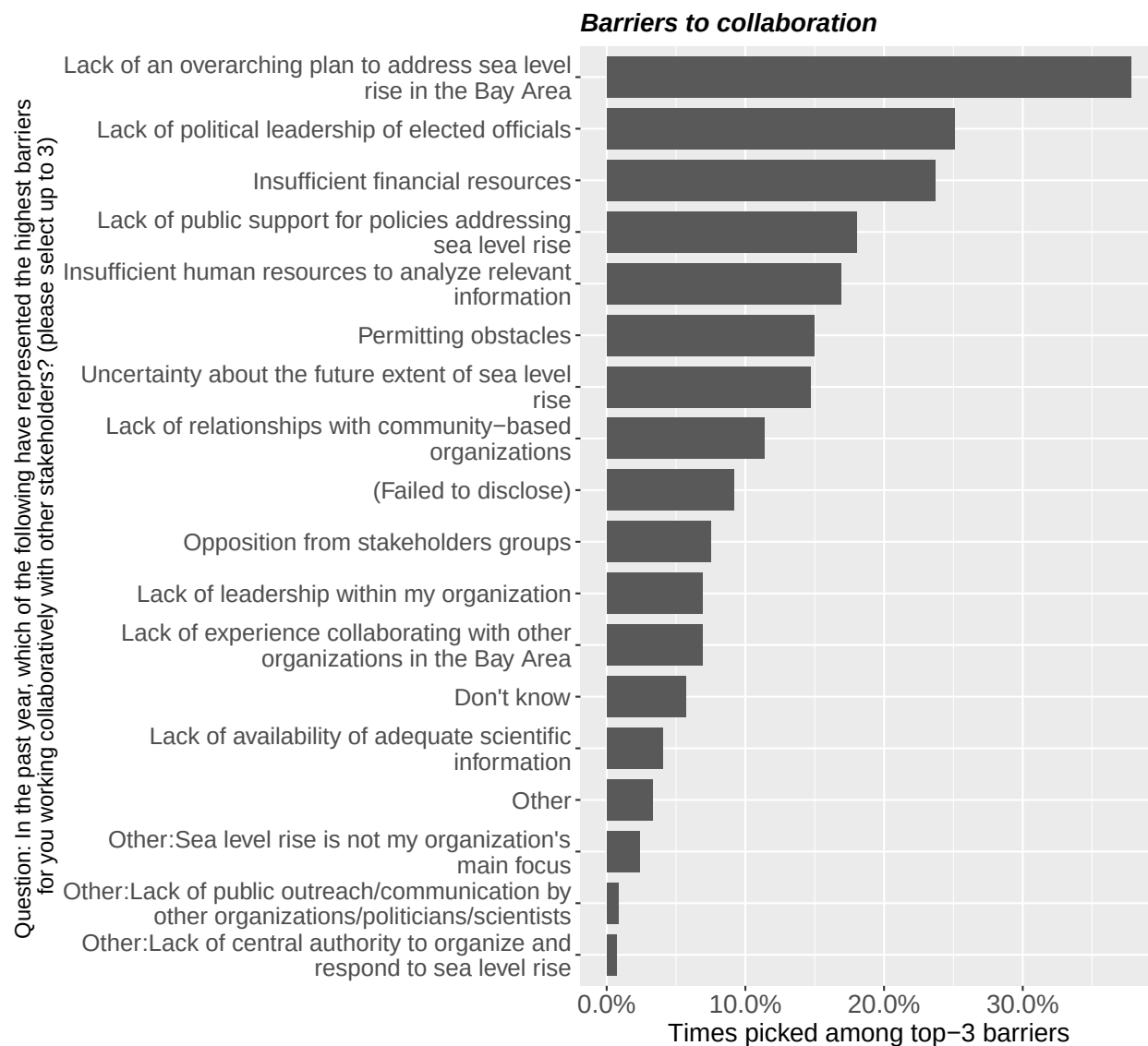


Figure 17: Barriers to respondents' engagement in collaborative activities.

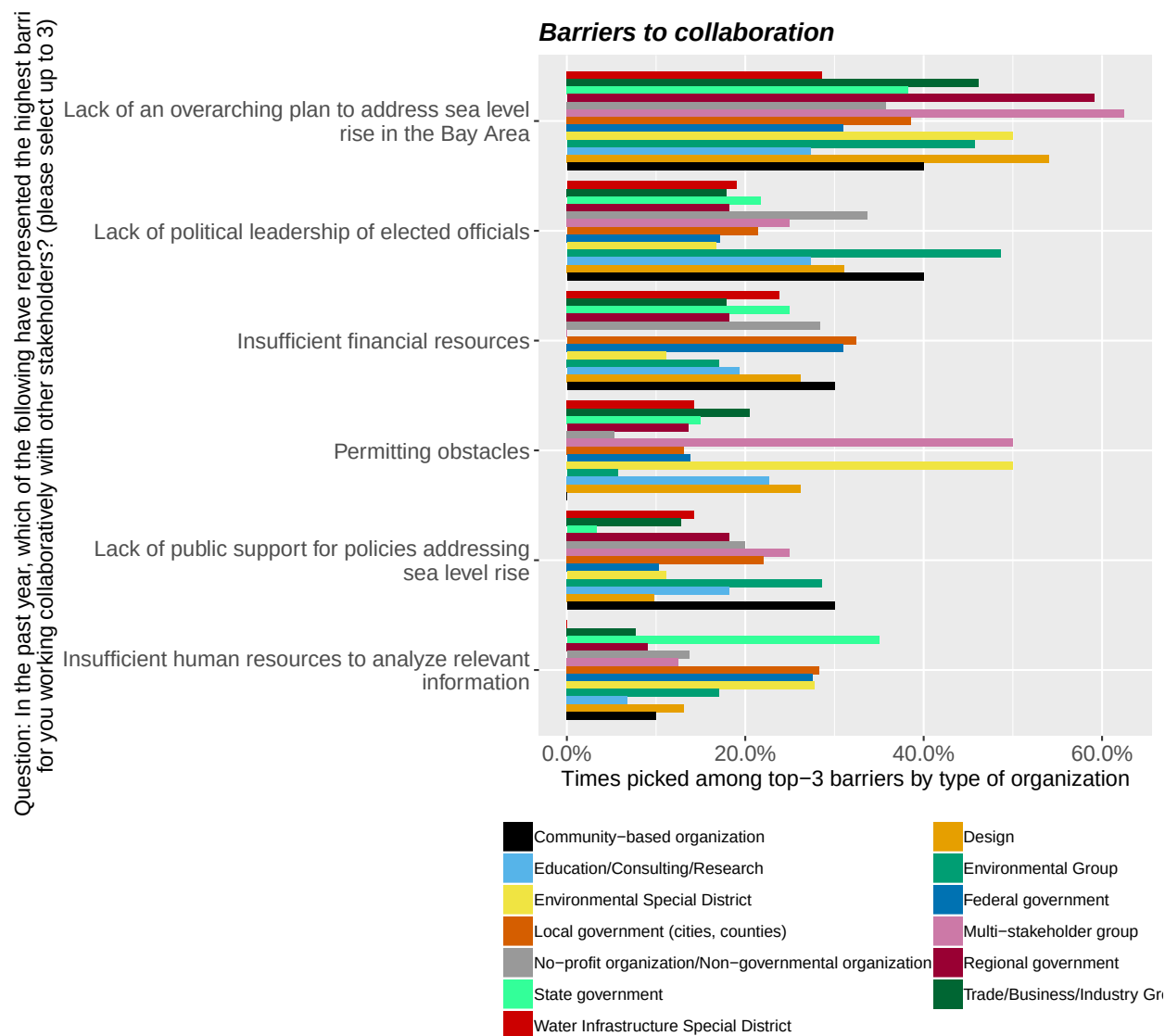


Figure 18: Main barriers to respondents' engagement in collaborative activities by type of organization.

Moreover, respondents consider the creation of a regional plan to address sea level rise and the fostering of collaborative relationships between stakeholders in the Bay Area as the top priority action to be pursued, as shown in figure 19. The figure reports the number of times each policy option was put among the top-three priority actions. The most and least selected option in the figure convey the same message: respondents put the creation of a regional plan to address sea level rise at the top of the policy agenda, and the notion that each individual jurisdiction should respond to sea level rise as they see fit at the bottom.

Figure 20 shows that the creation of a regional plan is a top priority for around a third of all respondents, and particularly for multi-stakeholder groups, state government, consultants and research professionals, and regional government. Removing permitting obstacles is a high priority for actors that are active at local

level, such as multi-stakeholder groups and environmental special districts, as well as water infrastructure special districts. Local actors are also more likely to consider lobbying the state or the federal government for funding as a top priority. Respondents who consider the establishment of a single information platform dedicated to sea level rise a priority comprise community organization, environmental special districts but also state government.

Although it has been the most selected option overall, the drafting of a regional adaptation plan is a priority for just over 30% of respondents. Completing the vulnerability assessments for all the 9 counties, fostering collaborative partnerships among stakeholders, and promoting “green infrastructure” projects are also among the most supported policy measures, often quite independently from the regional plan. In other words, the demand for coordination, although shared, comprises different elements across different respondents. This result resounds with figure 13, which showed that agreement on the actions is still lacking.

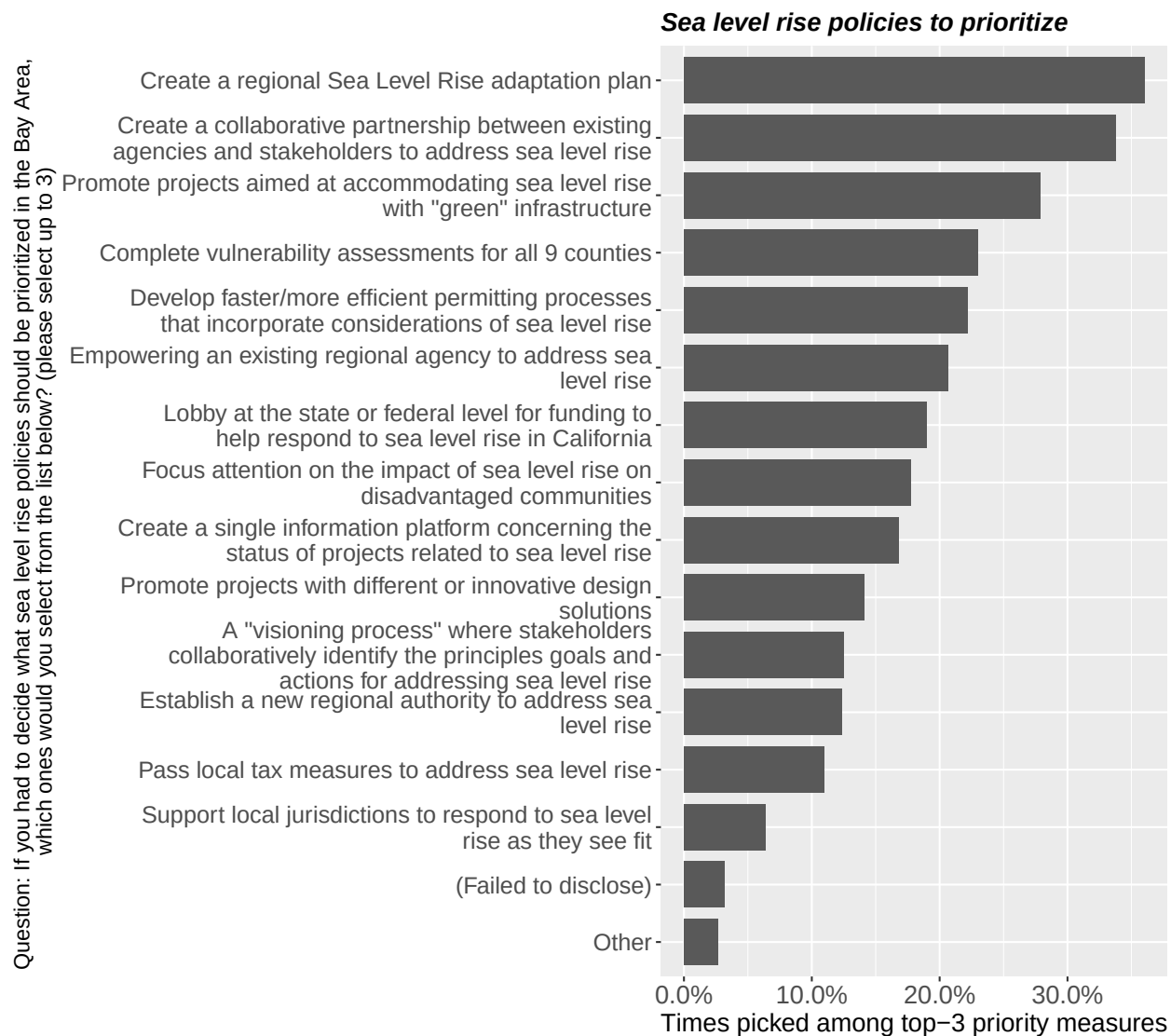


Figure 19: Respondents' policy priorities as concerns addressing sea level rise in the Bay Area.

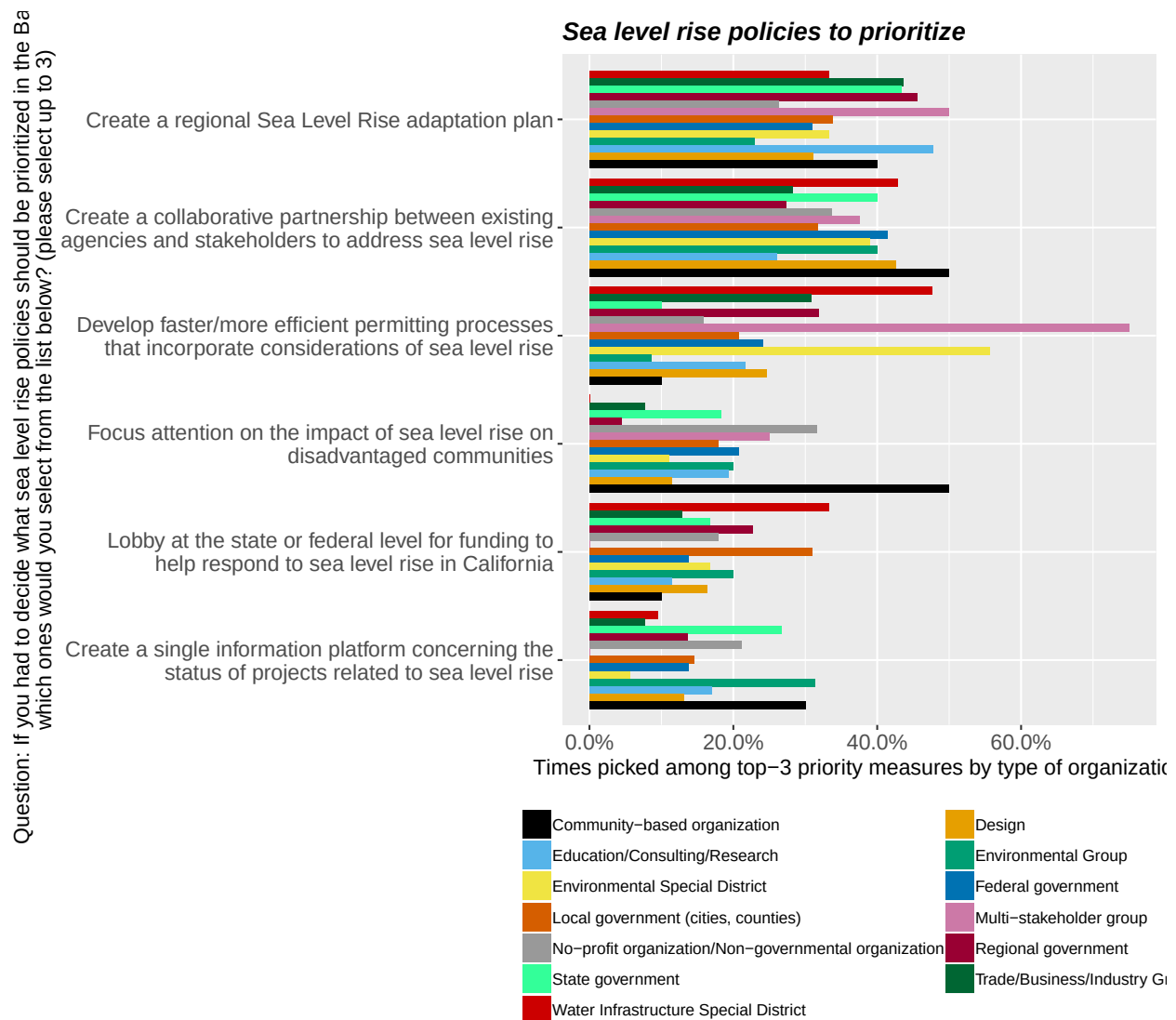


Figure 20: Respondents' policy priorities by type of organization.

6 The network of organizations working on sea level rise in the San Francisco Bay Area: an overview by level of governance.

We asked survey respondents to list the organizations that they collaborated most closely with in relation to the governance of sea level rise in the Bay Area in the past year. We invited respondents to list those organizations according to the level of governance they are placed at: federal, state, regional, and local. We also asked them to list any non-governmental organizations that they collaborated with. Of the total 722 respondents, 452 provided replies to this question. Exception made for respondents who indicated being involved in an individual capacity, and respondents who preferred not to state their organizational affiliation,

we consider each respondent as representing their primary (or only) organizational affiliation.

The figures from 21 to 25 visualize the resulting collaboration network as if sliced horizontally, by level of governance. Each figure reports the part of the overall governance network that comprises the governance actors in the title; for instance, figure 21 reports all federal actors and all actors attached to them. Each organization is represented by a single dot; organizations included in the graph comprise both the respondents' organizations and the organizations they named. In order to improve readability and provide an overview of the most central governance actors in this network, in each figure only the organizations corresponding to the governance level in the title and possessing more than 20 connections are labelled. Figure 26 visualizes the whole network emerging from survey respondents' replies. In figure 25 and figure 26, which contain denser networks than all others, only actors possessing more than, respectively, 30 and 50 total connections are labelled. To improve readability, we had to place labels away from their origin; the layout of the network graphs places the most central actors at the center, leading to label overlaps. The legend next to each figure reports the color scheme adopted for the dots.

**Sea level rise in the San Francisco Bay Area – federal agencies
(only actors with >20 connections are labelled)**

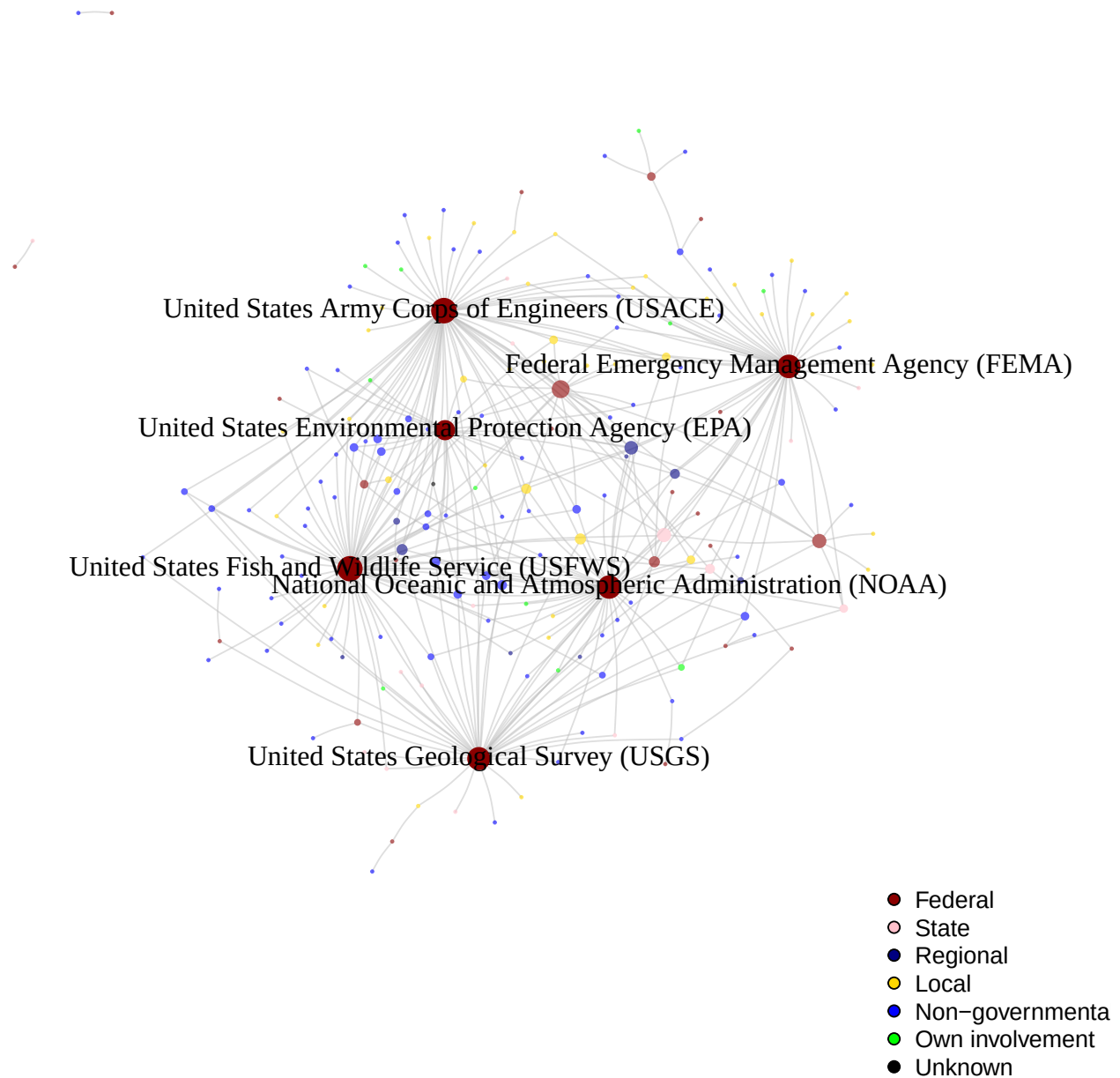


Figure 21: Sea level rise governance network - federal agencies

**Sea level rise in the San Francisco Bay Area – state agencies
(only actors with >20 connections are labelled)**

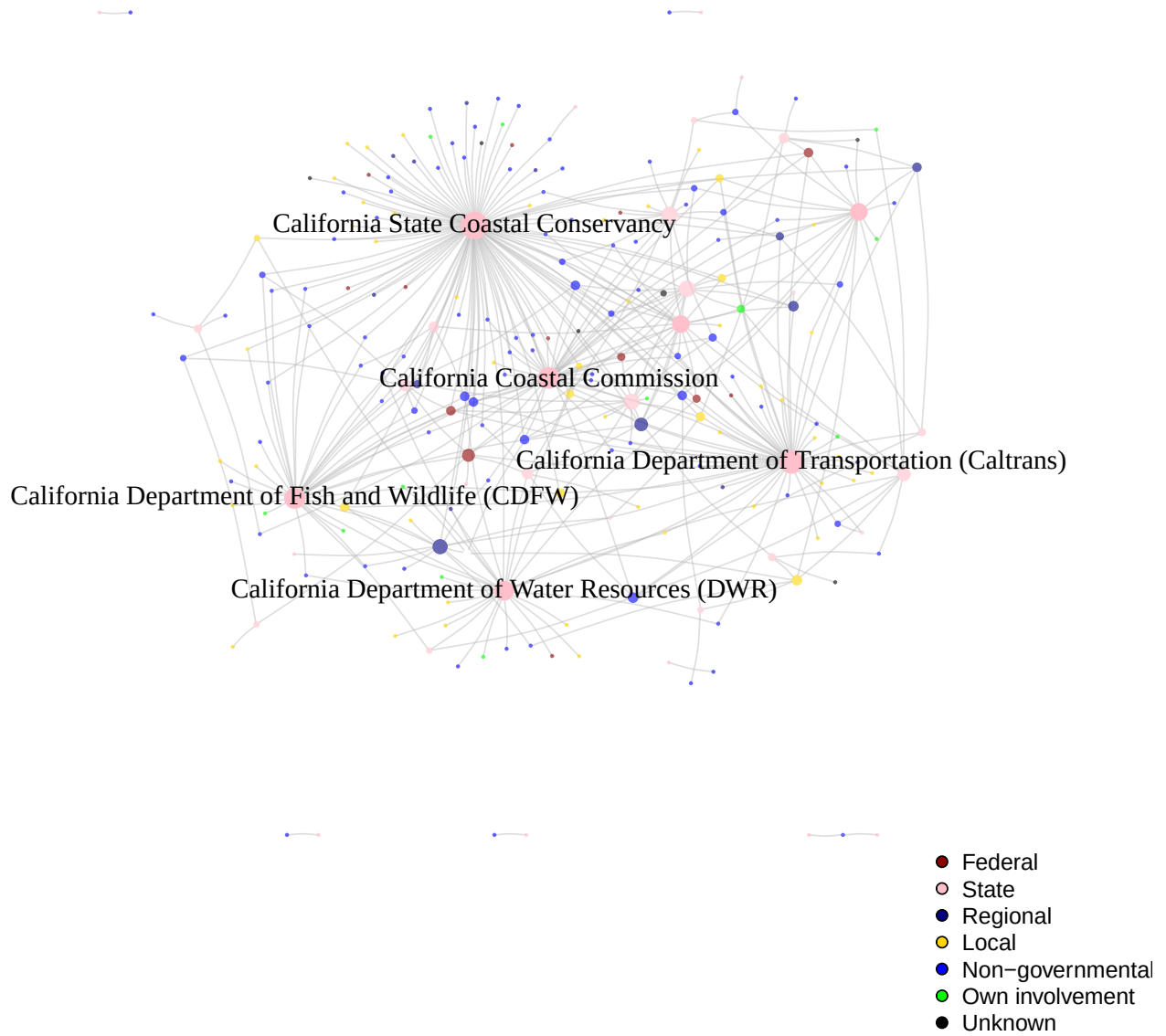


Figure 22: Sea level rise governance network - state agencies

**Sea level rise in the San Francisco Bay Area – regional agencies
(only actors with >20 connections are labelled)**

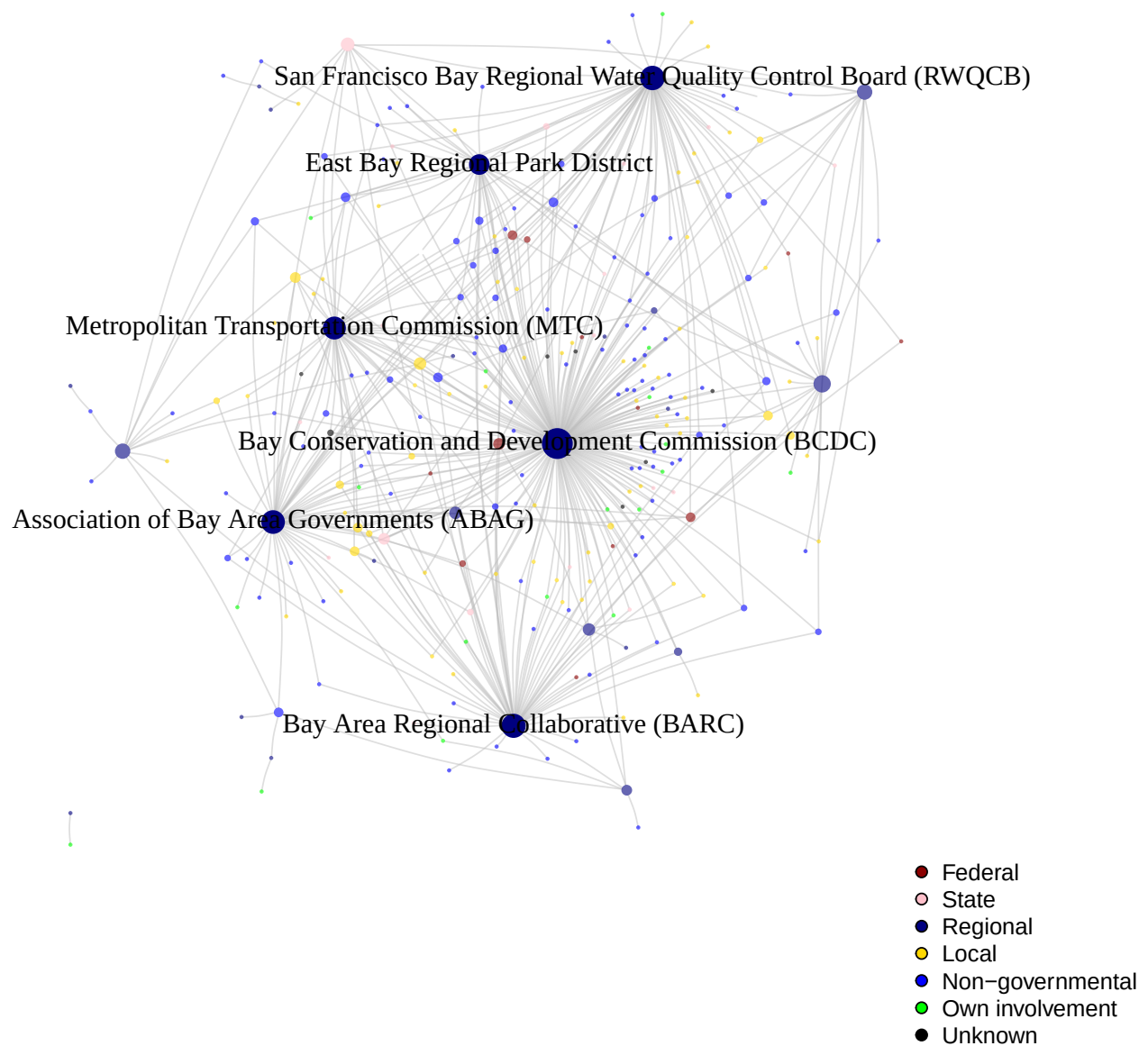


Figure 23: Sea level rise governance network - regional agencies

**Sea level rise in the San Francisco Bay Area – local agencies
(only actors with >20 connections are labelled)**

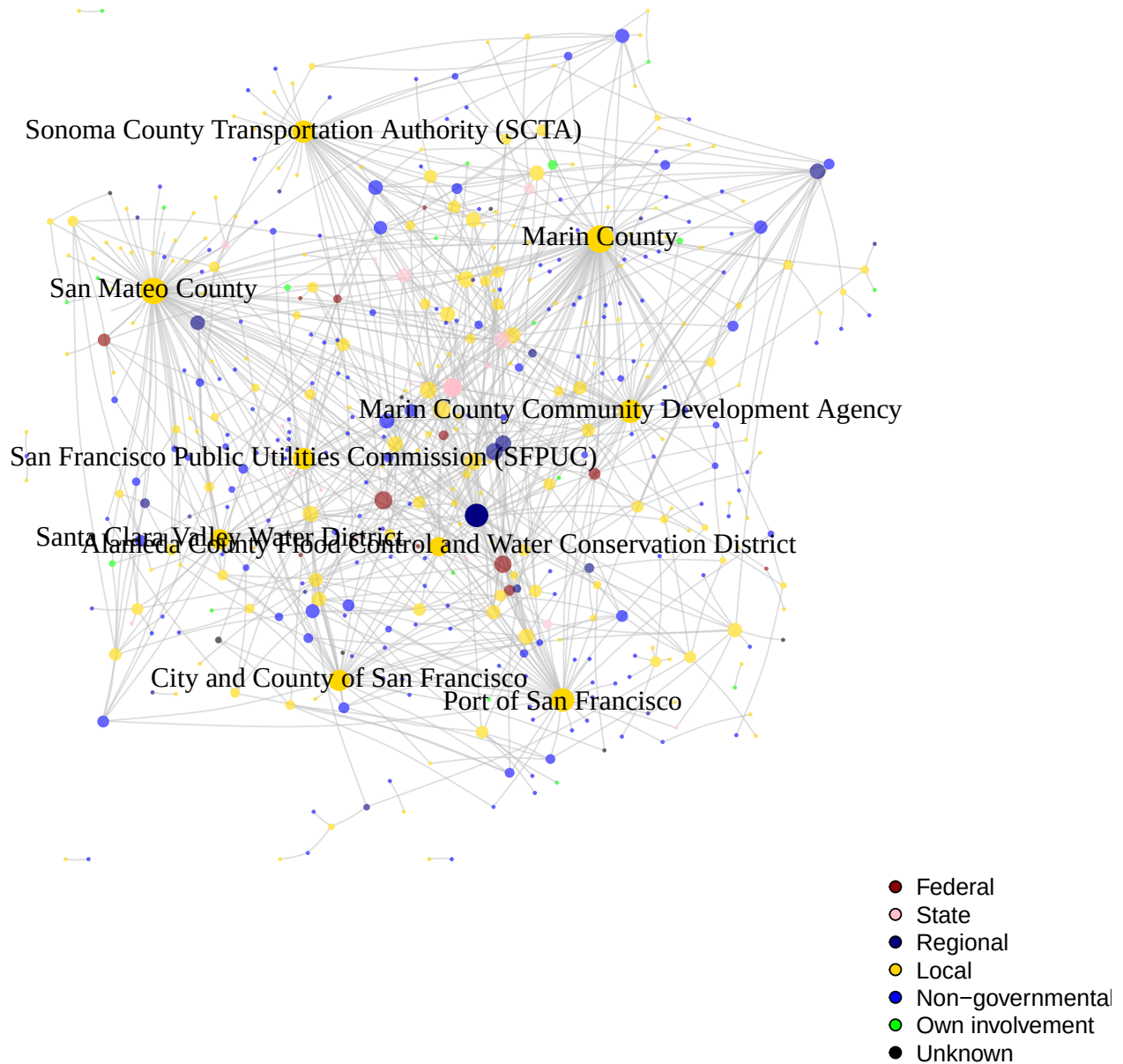


Figure 24: Sea level rise governance network - local agencies

**Sea level rise in the San Francisco Bay Area – non-governmental organizations
(only actors with >30 connections are labelled)**

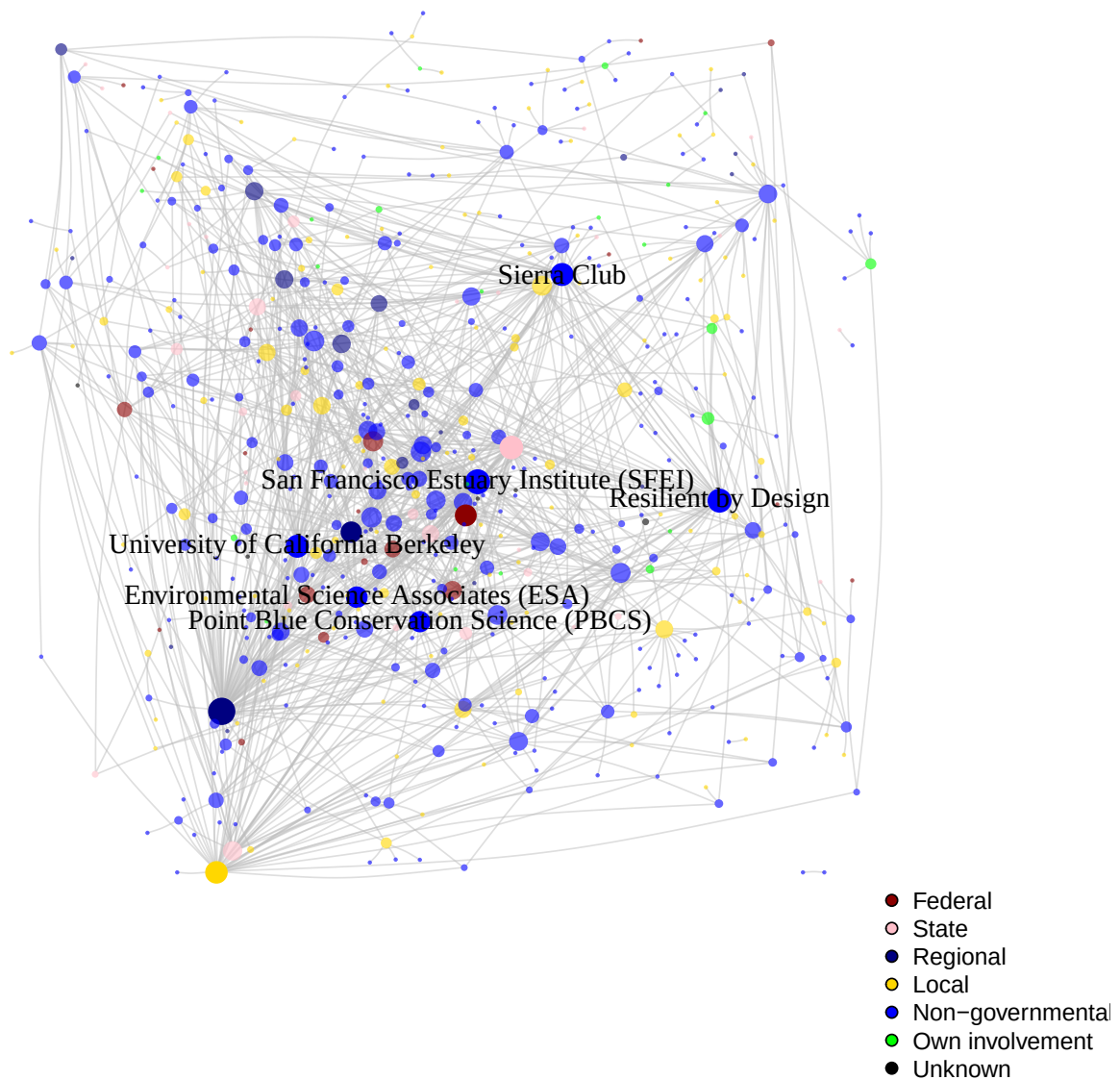


Figure 25: Sea level rise governance network - non-governmental organizations

To prevent labels overlap, the most connected nodes in the full network in figure 26 are indicated by their organizational acronym. The organizations are: The Association of Bay Area Governments (ABAG), the San Francisco Bay Regional Water Quality Control Board (RWQCB), the United States Army Corps of Engineers (USACE), the United States Fish and Wildlife Service (USFWS), the Bay Conservation and Development Commission (BCDC), the Bay Area Regional Collaborative (BARC), the California Department of Transportation (Caltrans), the California State Coastal Conservancy (SCC), the San Francisco Estuary

Institute (SFEI), San Mateo County and Marin County.

**Sea level rise in the San Francisco Bay Area – respondents' network
(only actors with >50 connections are labelled)**

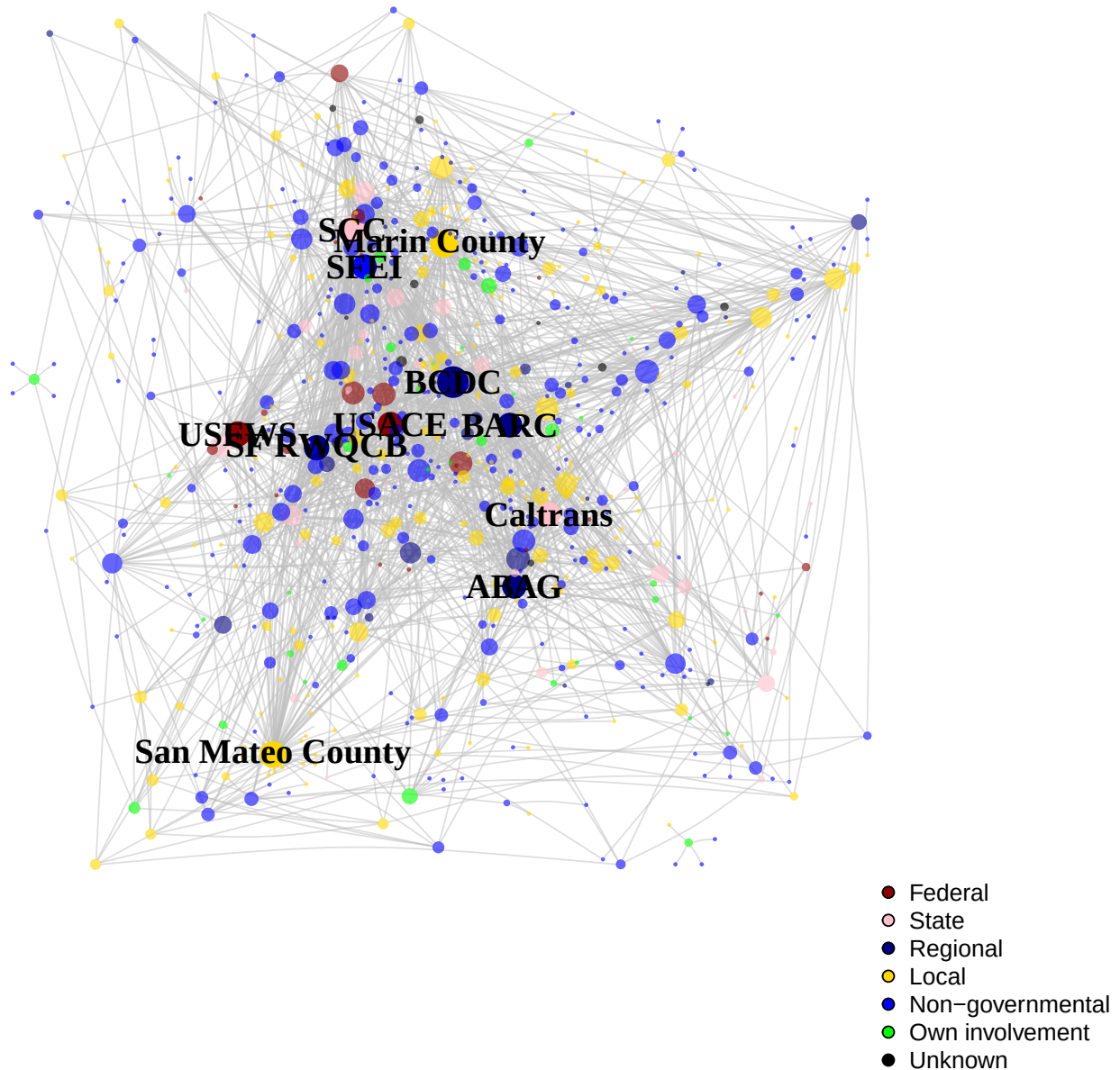


Figure 26: Sea level rise governance network - all respondents.

As the figures show, respondents have varying amounts of collaborative ties to other actors in this governance system. Overall, the vast majority of our respondents have between 1 and 10 strong collaborative ties as concerns sea level rise in the Bay Area. Only few organizations have more than 20 ties. This type of

distribution is typical of social networks. We can visualize the distribution of collaborative ties in this governance network by means of figure 27. Higher level agencies (state and/or regional) as well as a handful of non-governmental organizations (primarily consultancies, universities, and environmental groups) possess the highest number of connections. They can be thought of as bridges across the various parts of the governance network. Indeed, as shown in figure 28, the longest distance between any two actors in the network is 8 steps. This means that in the governance network of sea level rise of the Bay Area any actor can reach any other in 8 steps or fewer.

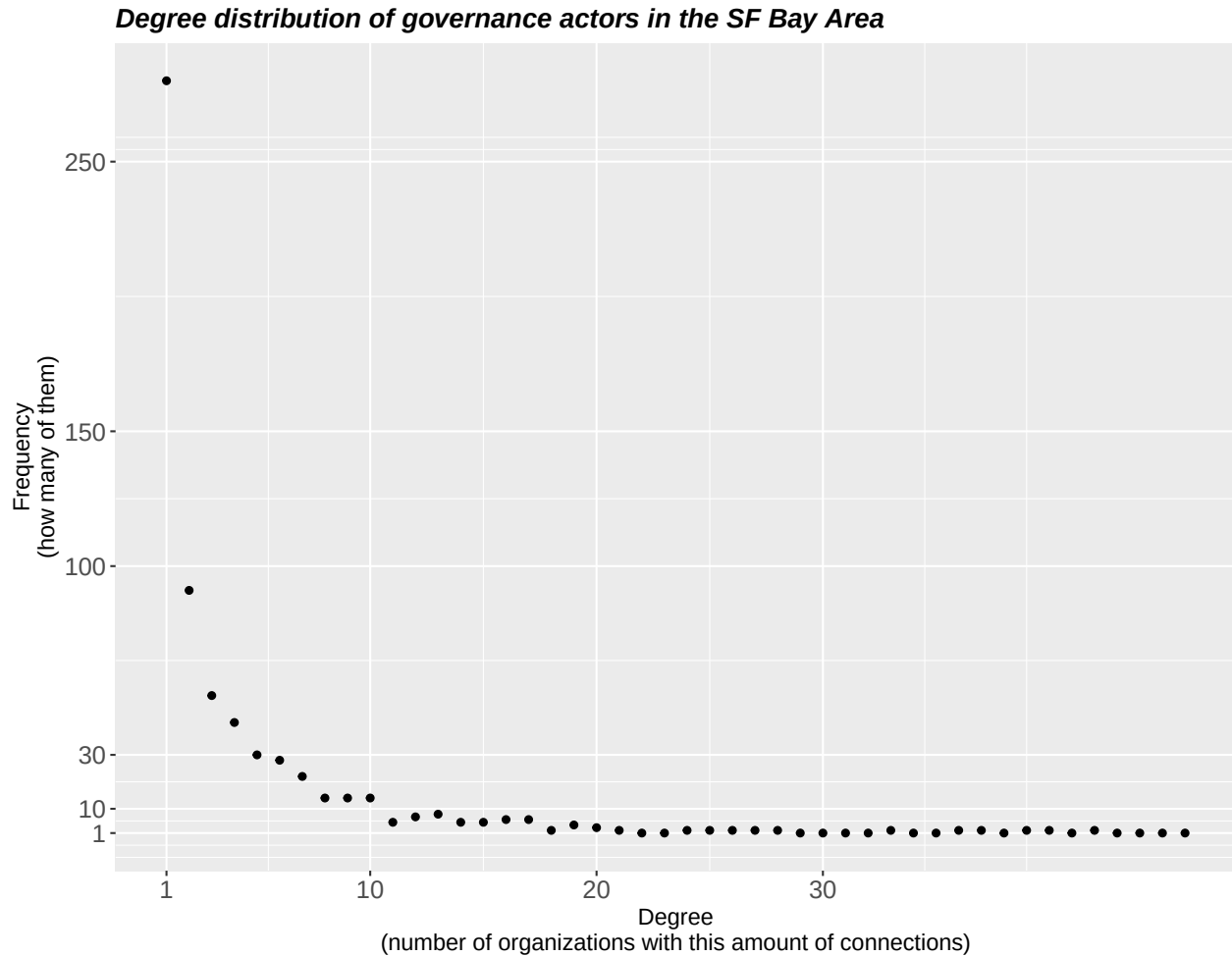


Figure 27: Sea level rise governance network - amount of connections by respondent.

Sea level rise in the San Francisco Bay Area – respondents' network diameter (only actors along the network diameter are labelled)

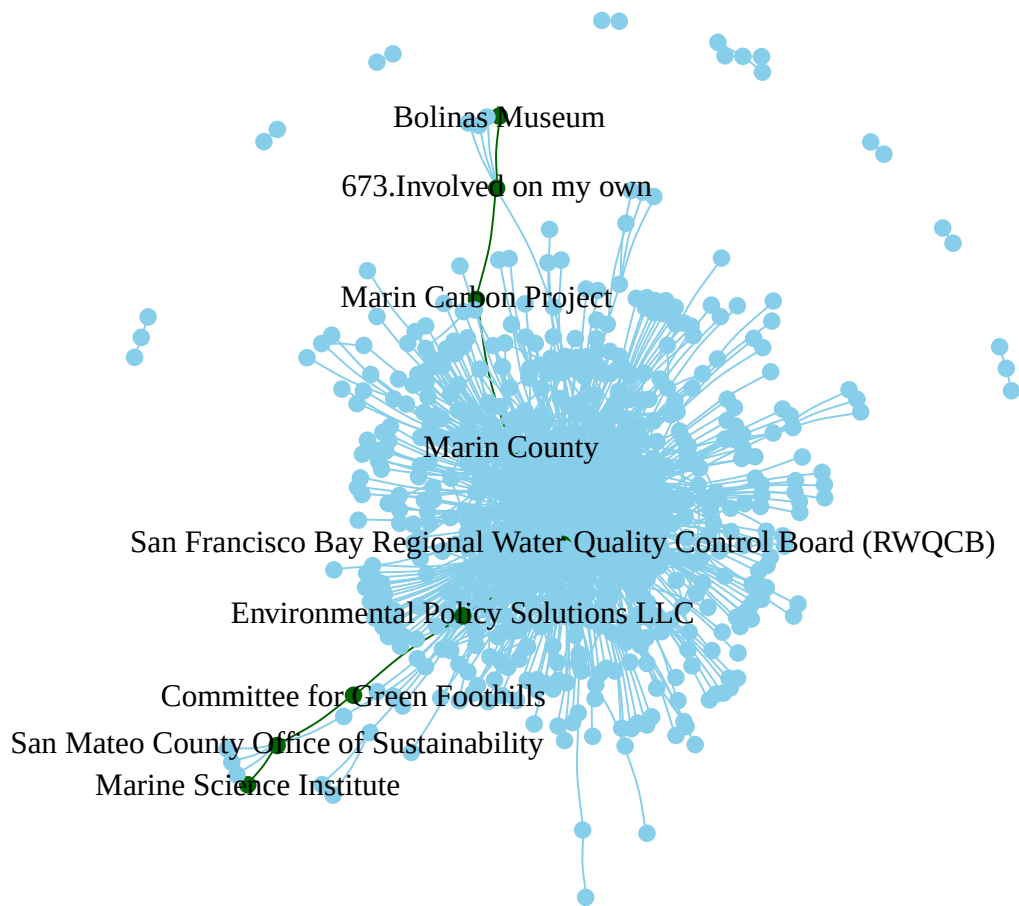


Figure 28: Sea level rise governance network - diameter.

6.1 How survey respondents choose their collaboration partners.

The overall picture emerging from the survey suggests that respondents maintain both horizontal (i.e. with actors at their same level of governance) and vertical (i.e. with actors placed at a different level of governance) informal collaboration ties. Choosing collaboration partners is an important consideration; in climate adaptation, time is of the essence and stakeholders cannot afford to spend resources in developing unfruitful collaborative relationships. The survey asked respondents to indicate the importance of different factors in choosing organizations to collaborate with. Specifically, respondents were asked to rank the importance of each factor on a scale from 0 to 10 where zero meant “not important at all” and 10 meant “extremely important”. Results are in figure 29. For ease of reading, in the figure we report the average of all values.

This question was answered by 507 respondents in total.

As figure 29 shows, reputation emerges as the overall most important factors determining the choice of collaborators. The most desirable collaboration partners are organizations with a good reputation and access to information. From social science research, we know that trust and reputation are critical resources for collaboration. Reputation is a function of shared values, a history of credible commitments, and capacity for carrying out stated goals. Hence, we surmise that the very high importance of organizational reputation reflects the importance of three main characteristics of desirable collaborators:

- the embeddedness of collaboration partners in the governance system;
- the quality of existing collaborative relationships among organizational representatives;
- the overall history of interaction and conflicts among organizations.

Furthermore, organizational similarity emerges as overall less important than complementarity in the choice of collaborators. This suggests that respondents use collaborative relationships as resources to compensate for the information, resources or functions that they do not possess. Less important reasons for collaboration include the extent to which collaboration partners have a broad network or capacity to make decisions. One conjecture is that these other reasons may become more important at later stages of the policy process, as collaboration shifts from planning to more on-the-ground project implementation.

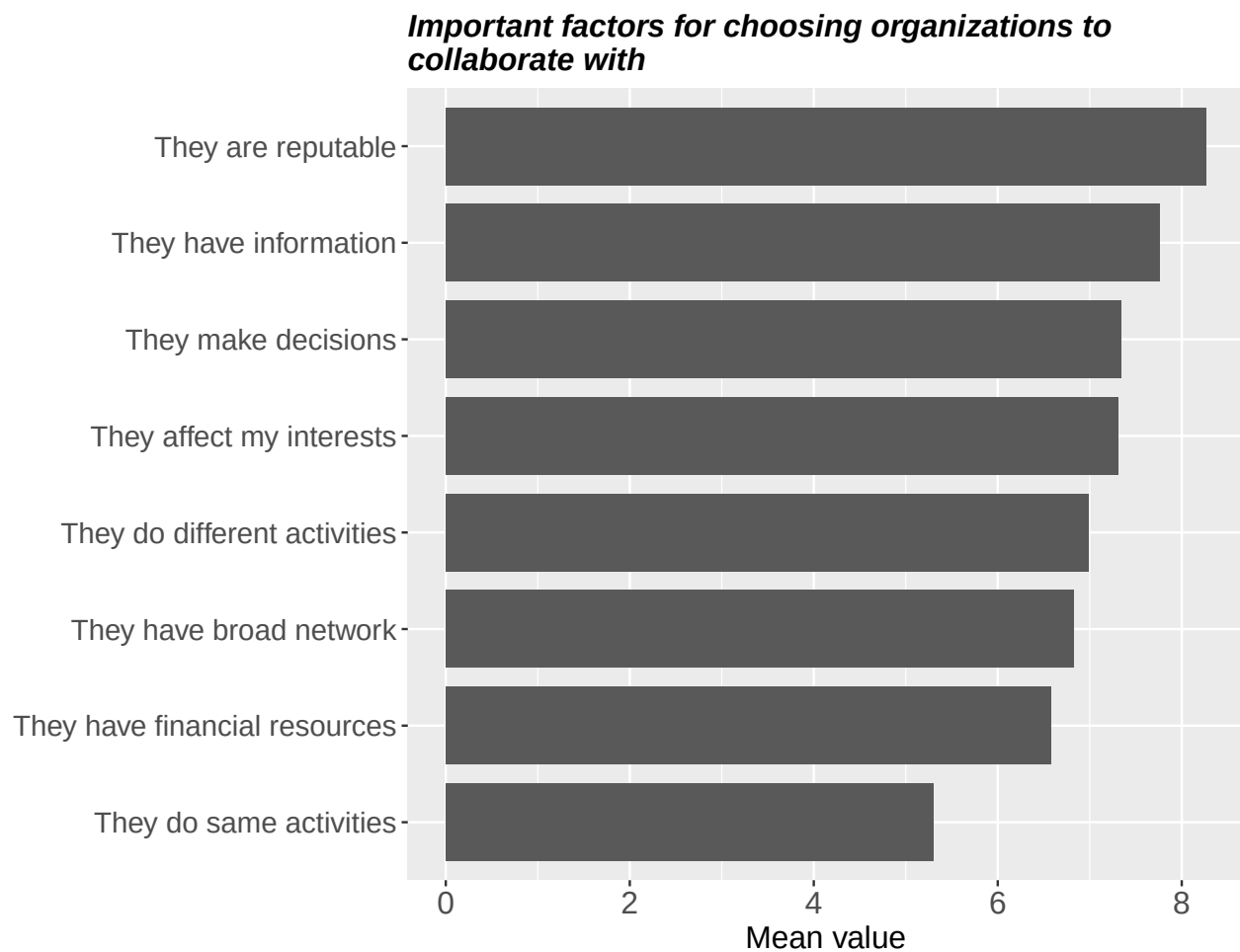


Figure 29: The most important factors in choosing organizations to collaborate with.

7 Collaborative initiatives focused on sea level rise in the San Francisco Bay Area.

Besides developing networks of relationships between their organizations, stakeholders collaborate within the framework of myriad governance initiatives focused on sea level rise in the Bay Area. These vary in scope: some have Bay Area-wide scope, some are local; some focus on specific infrastructure corridors, others focus on assessing vulnerability for whole areas and various types of infrastructure, etc. The survey asked respondents to list up to five collaborative initiatives focused on the governance of sea level rise that they take part in. It then asked respondents questions about each of the initiatives they listed. These questions concerned their perceptions on the quality of the cooperation between stakeholders, the fairness of the decision-making process and the impact of the initiative on their organizational goals as well as in terms

of making progress towards addressing sea level rise in the Bay Area.

In total, our respondents listed over 350 individual collaborative initiatives. The ten most mentioned initiatives, together with the number of respondents reporting having taken part into them, are listed in Table 2. In the following two sections, we report on the top five most mentioned initiatives, whose scope ranges from the regional to the local level. Table 2 also comprises collaborative initiatives that are not focused on a specific area or infrastructure but rather constitute networks of information exchange and aim at achieving informal coordination among local communities (i.e. CHARG and BayCAN). In the following figures, we compare respondents’ perceptions of the collaborative process and the success of several of these initiatives. In the figures, percentage sums do not always round up to 100%; this is because not all respondents have replied to all questions for each initiative that they mentioned.

Table 2: Most mentioned collaborative initiatives

Collaborative initiative	Participating respondents
Resilient by Design	256
Adapting to Rising Tides	140
SeaChange San Mateo County	35
BAYWAVE Marin County	33
SR37	31
Bay Area Climate Adaptation Network (BayCAN)	26
San Francisco Bay Restoration Authority	26
CHARG	24
San Francisco Seawall Project	20
C-SMART Marin	15

7.1 Regional initiatives: Adapting to Rising Tides and Resilient by Design.

The vast majority of our respondents ($n = 256$) took part in the Resilient by Design competition. The second most mentioned initiative was Adapting to Rising Tides ($n = 140$). We compared their score on each of the questions respondents were asked to reply to in figures 30 and 31. In the figures, we compare percentages of respondents providing answers to each question. Overall, respondents perceived the collaborative process within Adapting to Rising Tides as fairer and more inclusive. Resilient by Design scores higher in the innovative thinking category. Respondents see the biggest barriers for both initiatives as residing in lack of formal authority and insufficient funding. Respondents portray both initiatives as somewhat useful to their goals.

When interpreting these results, the different nature of the two initiatives should be borne in mind: Adapting to Rising Tides aims at gathering and diffusing information on vulnerabilities to sea level rise at the local and regional level through workshops as well as a dedicated website and mapping tool; Resilient by Design was a design competition, where teams of architects, engineers and designers were tasked with producing innovative design solutions for adaptation to sea level rise in specific portions of the Bay. In other words, whereas Adapting to Rising Tides provided local communities with access to information and resources they would perhaps not be able to attain otherwise, Resilient by Design was a design competition aimed at proposing adaptive infrastructural solutions for different segments of the Bay. Moreover, Resilient by Design involved a broad range of stakeholders, ranging from local governments and citizens to teams of designers and architects. For all of these reasons, the collaborative process within the initiative may have engendered a more heated debate, given that agreement on the concrete actions to undertake in order to adapt to sea level rise in the Bay Area is still lacking.

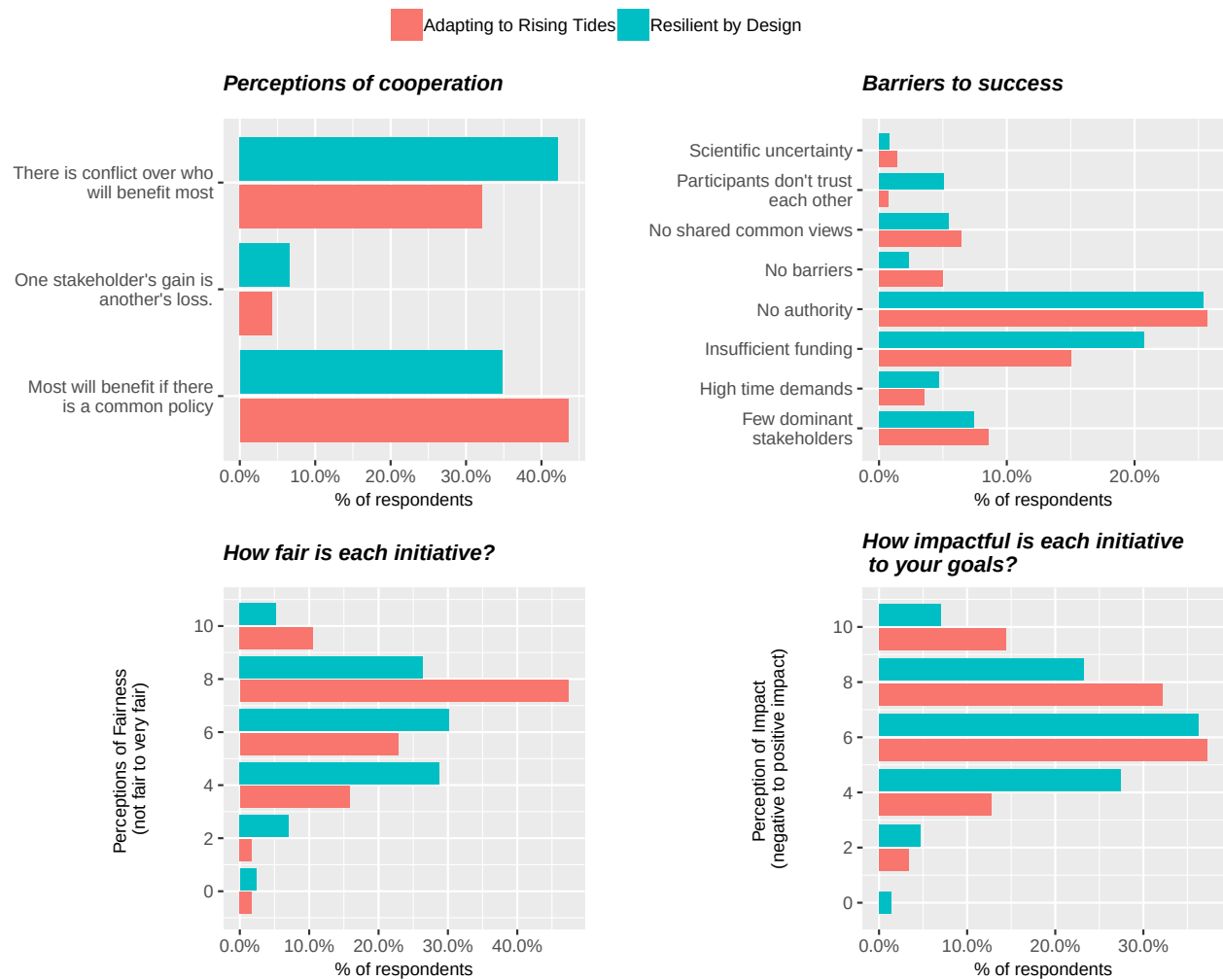


Figure 30: Participants' perceptions of cooperation, barriers, fairness, and impact of Adapting to Rising Tides and Resilient by Design.



Figure 31: Participants' perceptions of cooperation, barriers, fairness, and impact of Adapting to Rising Tides and Resilient by Design.

7.2 Smaller local collaborative initiatives.

A few dozen respondents reported having taken part in collaborative initiatives at the local level. The highest counts of respondents were obtained for the BayWave initiative held in Marin ($n = 33$), the SeaChange initiative in San Mateo County ($n = 35$) and the State Route 37 (SR37) collaborative governance process focused on adaptive solutions for State Route 37, spanning Solano, Sonoma, Napa and Marin county ($n = 31$). Figures from 32 to 33 report on the survey respondents' perceptions of the collaborative process in each initiative. Overall, BayWave and SeaChange display similar scores on all questions: they were perceived as rather fair, impactful initiatives where most participants can benefit if they can develop common policy.

Respondents seem to perceive the governance process surrounding SR37 as relatively more conflictual than

the other two initiatives. Interestingly, lack of formal authority is not a barrier to the success of this initiative for any of the respondents; rather, participants mention lack of sufficient funding and diverging views among participants. However, most participants recognize that the initiative led to progress and innovative thinking, as well as that all participants' goals were taken into account in the collaboration process, although some respondents perceived that certain stakeholders have dominated it. We surmise that the trans-jurisdictional scope of the road, and the multiplicity of stakeholders involved across different counties, may render the collaborative process more conflictual given the wider range of interests involved. At any rate, the most recent development in this collaborative initiative is the signature of a Memorandum of Understanding between the agencies involved (i.e. the Bay Area Toll Authority, the California Department of Transportation, the Solano Transportation Authority, the Sonoma County Transportation Authority, the Transportation Authority of Marin, and the Napa Valley Transportation Authority), which represents a strong commitment to coordinated decision-making for adaptive measures for the road.

Once again, the aims and features of each collaborative initiative should be taken into account: whereas BayWave and SeaChange aimed at producing vulnerability assessments, the governance process around State Road 37 is aimed at deciding about concrete infrastructural solutions to protect the road from sea level rise and/or create viable alternatives to it for users in the area. As we underlined with regard to Adapting to Rising Tides and Resilient by Design, collaborative initiatives aimed at diffusing, gathering and generating information on the prospected consequences of sea level rise embed lower conflict than collaborative initiatives aimed at making actual decisions concerning adaptive infrastructural solutions.

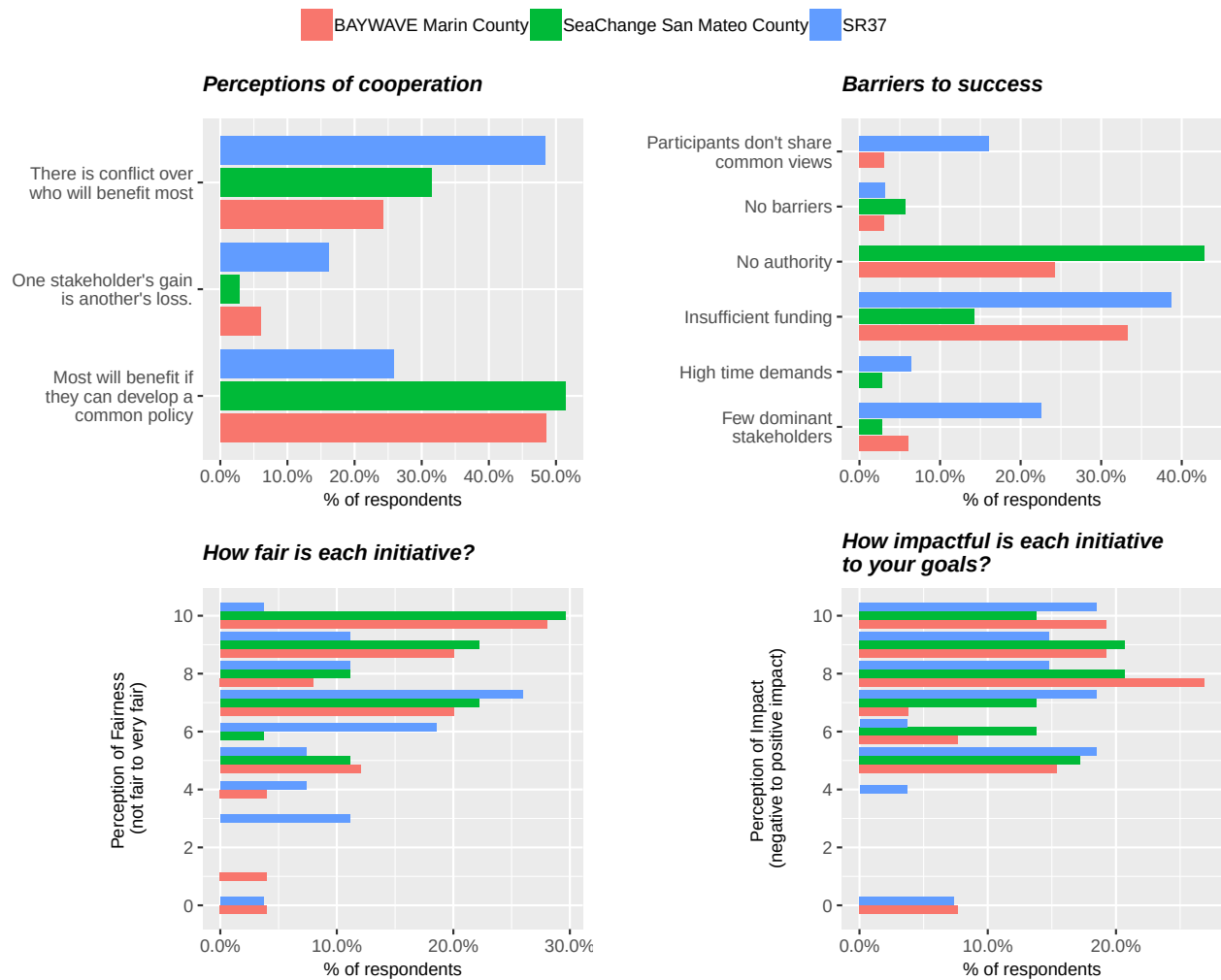


Figure 32: Participants' perceptions of cooperation, barriers, fairness, and impact of BayWave Marin, SeaChange San Mateo and SR37.

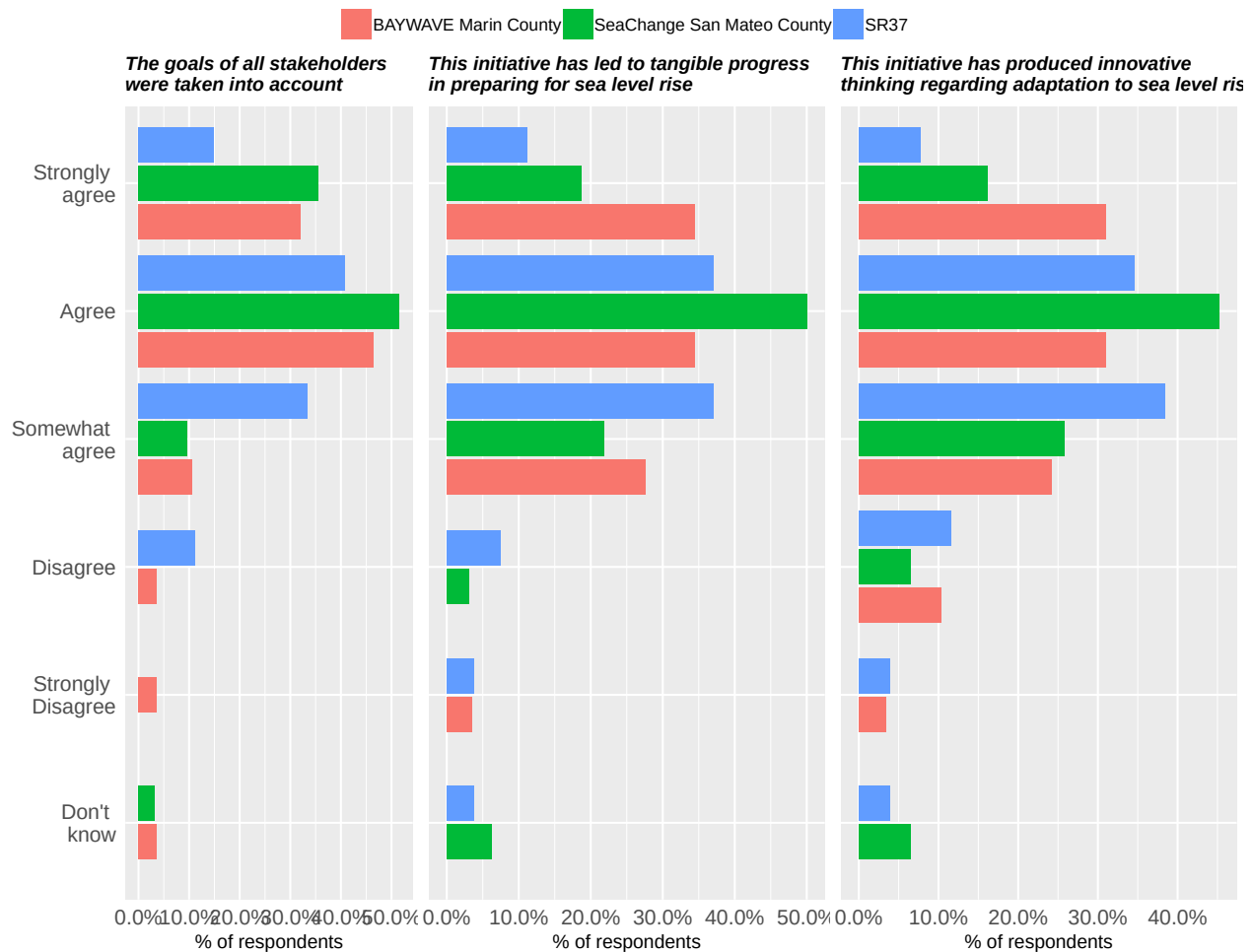


Figure 33: Participants' perceptions of the collaborative process in BayWave Marin, SeaChange San Mateo, and SR37.

7.3 BayCAN and CHARG.

Finally, we compare the perceptions of respondents that have taken part in BayCAN ($n = 26$) and CHARG ($n = 24$). BayCAN is a recently launched network of stakeholders focusing on climate adaptation (including, but not limited to, sea level rise) across the whole Bay Area. CHARG is an informal stakeholder network that began in 2014 as a local governments initiative; it was recently revamped as a strategic initiative of the Bay Area Flood Protection Agencies Association (BAFPAA), aimed at engaging flood control districts and stakeholders from the Bay Area.

Figures 34 and 35 report on respondents' perceptions of the collaborative process within each initiative. Figure 34 suggests that respondents perceived the collaboration within CHARG to be more relative more

conflictual than in BayCAN. Lack of authority emerges as a major barrier for the success of CHARG, while fewer respondents commented on barriers to BayCAN's success - probably because this network was launched only very recently. In fact, figure 35, reporting results on the questions concerning whether stakeholders' goals were taken into account, whether the initiative made tangible progress and whether it generated innovative thinking on sea level rise, shows that the most clicked reply option by respondents participating in BayCAN has been "Don't know". As for CHARG, although it appears that respondents' perceived that stakeholders' goals were considered, they are more skeptical that the initiative led to tangible progress on sea level rise, although they make a positive assessment concerning innovative thinking.

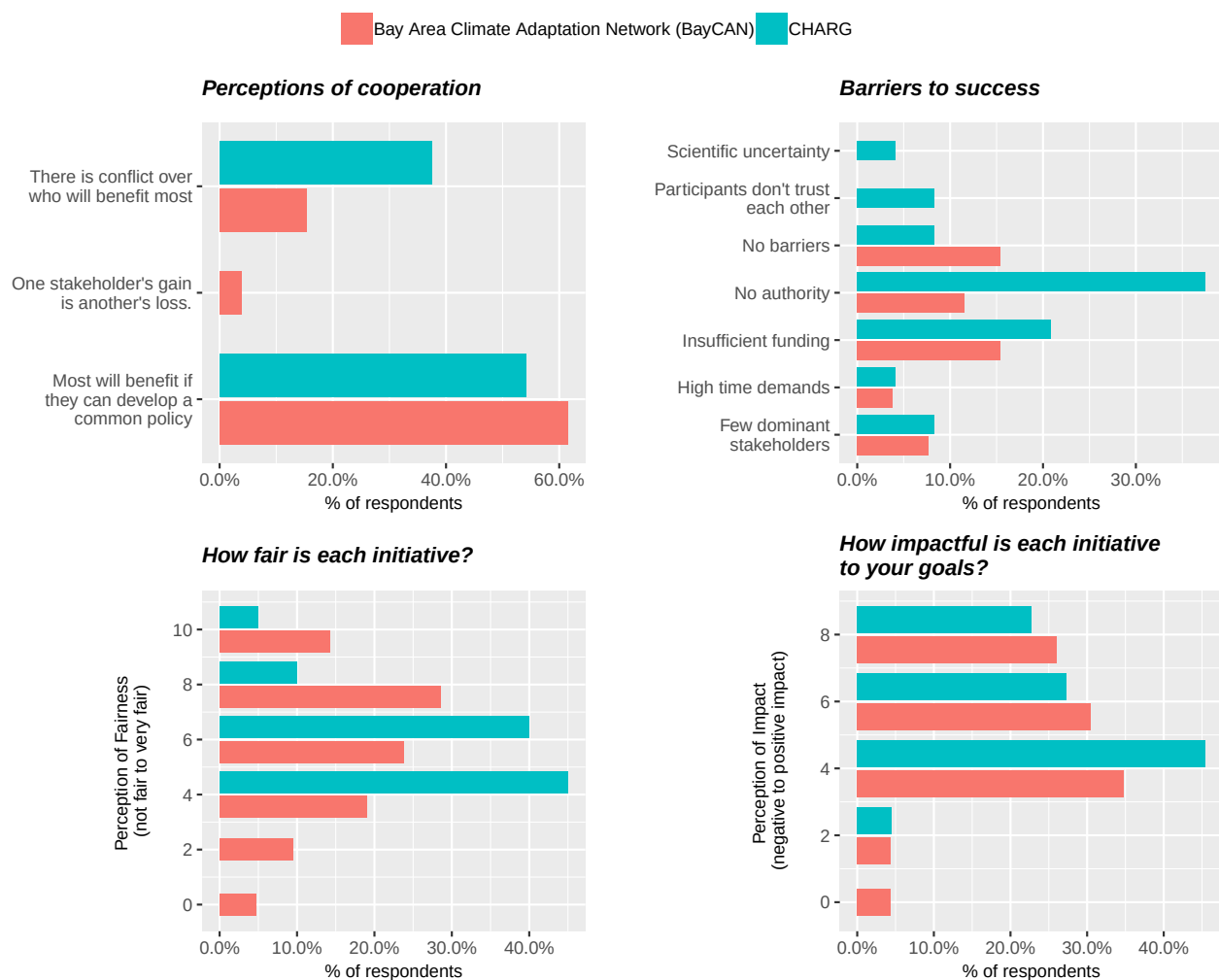


Figure 34: Participants' perceptions of cooperation, barriers, fairness, and impact of BayCAN and CHARG.

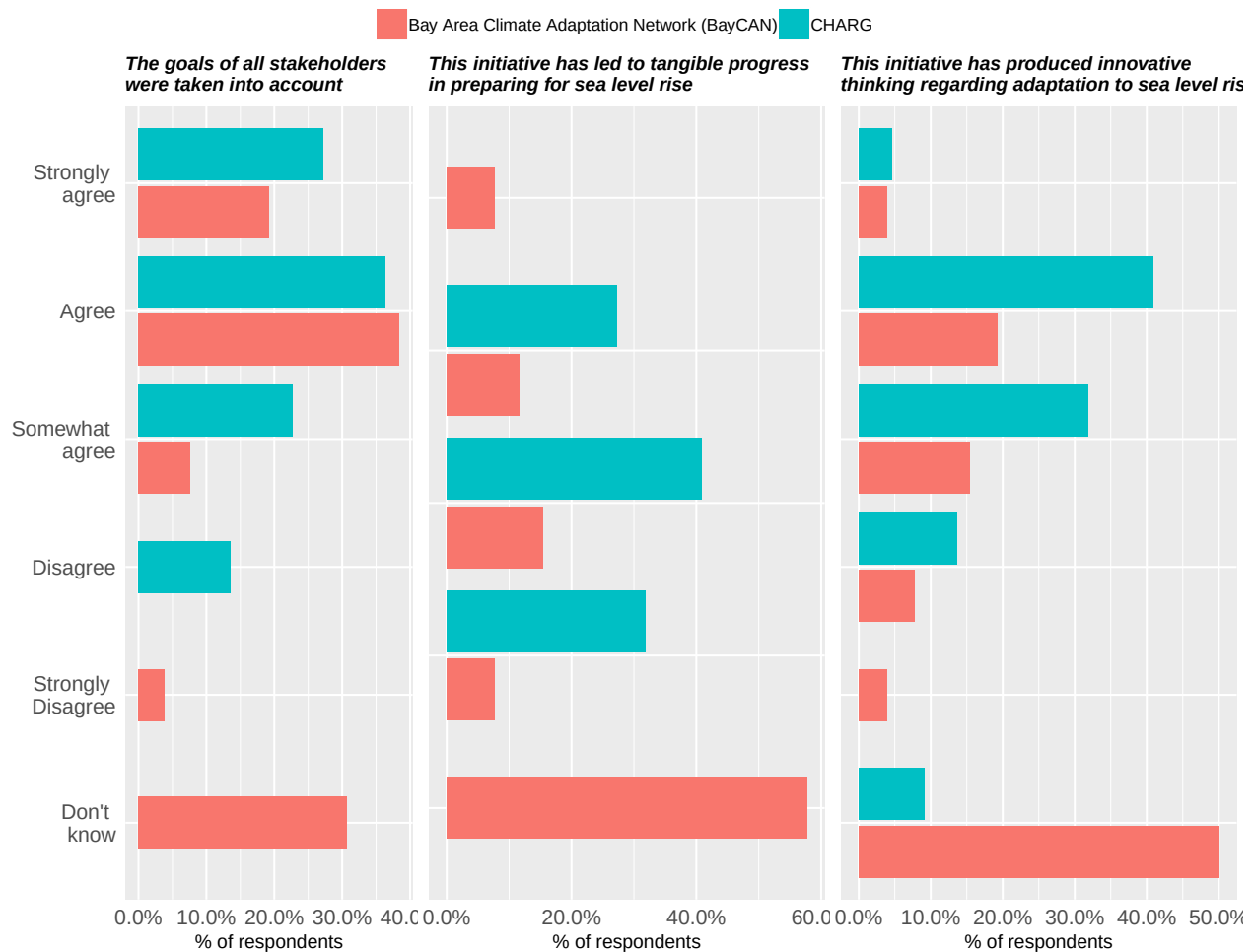


Figure 35: Participants' perceptions of the collaborative process in BayCAN and CHARG.

8 Conclusions

This report presented the key results of a governance survey focused on the governance of adaptation to sea level rise in the San Francisco Bay Area. In the summer of 2018, we invited a broad range of stakeholders from all levels of governance to complete the survey. We obtained replies from a broad sample of governance actors, comprising primarily local government officials and professionals in non-governmental sectors such as consultants and education specialists, but also officials in regional, state and federal agencies. Most of our respondents are project managers and planners, followed by communication specialists and policy analysts. For most respondents, dealing with sea level rise issues represents only part of their job duties.

The survey investigated respondents' perceptions of sea level rise as a policy issue in the Bay Area. Respondents reported perceptions of relatively high agreement among stakeholders on the risks posed by sea level

rise, but low agreement on the actions to be undertaken in that regard. Key concerns in terms of vulnerability comprise transportation and storm water and wastewater infrastructure, along with disadvantaged communities. The Bay Area is a heavily in-built and inhabited area, where the impacts of sea level rise, particularly in combination with other climate events, such as storms, could cause immense damage. Thus, the results of the survey suggest that governance actors are highly aware of the issue and engaged in myriad collaboration activities, both bilaterally with other organizations and as participants in broad collaborative initiatives.

However, collaboration appears to be still in the early stages. Most respondents engage in exchange of information and outreach activities jointly with other organizations; they also perform research activities and joint applications for funding. However, deeper and more formal types of collaborative activities, e.g. signing a formal agreement, coordinating permitting processes, etc. are rare. When asked about the barriers preventing them from engaging in collaborative activities, respondents mentioned the lack of coordinated planning as well as lack of political leadership on the issue of sea level rise. Resource gaps and lack of public support for sea level rise-related policies appear as the third and fourth biggest barriers, and appear most pronounced for local actors. As concerns the policies that respondents would prioritize, the development of a regional plan for adapting to sea level rise emerges as the top priority, together with collaboration between existing agencies and stakeholders. However, differences emerged across respondents, with no policy priority receiving overwhelming support - this confirms that agreement on the actions to adapt to sea level rise is still lacking.

The governance network resulting from the survey displays a core comprising key agencies and stakeholders from various levels of governance. The network appears to densify at progressively lower levels of governance, going from the federal to the local. Also, non-governmental actors (comprising consultants, research centers, universities and informal associations) are present at all levels of governance, particularly at local level. Overall, most respondents have a limited number of collaborative ties to other actors; most have only one. However, a small subset of actors emerge as very highly connected, with more than 50 ties to others. These actors span across governance levels and bridge the various parts of this composite network; indeed, the diameter of the network (i.e. the shortest distance between the two most distant nodes in the network) is 8 steps. This means that any actor involved in the governance of sea level rise in the Bay Area can reach any other in 8 steps or fewer.

As concerns the collaborative initiatives that respondents take part in, our results suggest that the nature of the initiative needs to be taken into account in its assessment. Overall, respondents perceived the collaboration process within initiatives aimed at gathering and diffusing information on sea level rise as fairer, more open and less conflictual than the collaboration process in initiatives where stakeholders need to reach agreement on more concrete adaptation actions, such as building infrastructure. The latter touch more directly upon participants' diverging interests, whereas the former provide them all with instruments and

resources to understand the policy issue and devise solutions. However, our research experience suggests that informal collaboration is essential to build trust among participants and to build reputations for being reliable collaboration partners. In point of fact, respondents indicated reputation as the most important characteristic they value in prospective collaboration partners. Eventually, mutual trust and reputation built through informal collaboration should foster and underpin coordinated adaptation decisions among stakeholders across the Bay Area.