CHAIRE DE RECHERCHE EN GÉOSCIENCE CÔTIÈRE

Laboratoire de dynamique et de gestion intégrée des zones côtières | UQAR

Resilience

ADAPTATION TO COASTAL HAZARDS IN THE CONTEXT OF CLIMATE CHANGE: A PORTRAIT OF THE NEEDS AND TOOLS FORMULATED BY THE STAKEHOLDERS OF THE GOLFE-DU-SAINT-LAURENT MRC

NOVEMBER 2017




This report synthesizes the results of the first phase of the project titled ***Vulnérabilité et résilience de la zone côtière aux aléas côtiers dans un contexte de changements climatiques: vers le développement d'outils et de solutions d'adaptation durables pour les municipalités côtières de l'Est du Québec***. This project was funded by the Green Fund (*Fonds vert*) as part of the Government of Quebec's 2013-2020 Climate Change Action Plan (*PACC 2013-2020*).

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Finally, we would like to thank all the representatives of these ministries, the various MRCs and coastal municipalities, the members of the First Nations, as well as the regional organizations, for getting involved with us in this project.

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PRESENTATION OF THE PROJECT

This report synthesizes the results of the first phase of the project titled "*Vulnérabilité et résilience de la zone côtière aux aléas côtiers dans un contexte de changements climatiques: vers le développement d'outils et de solutions d'adaptation durables pour les municipalités côtières de l'Est du Québec*" led by the *Laboratoire de dynamique et de gestion intégrée des zones côtières* of Université du Québec à Rimouski (translated title: "Vulnerability and resilience of coastal zones to coastal hazards in the context of climate change: Developing sustainable adaptation tools and solutions for coastal municipalities in Eastern Québec," herein the "Coastal Resilience Project"). The main objective of the project is to reduce the vulnerability of coastal communities and ecosystems to coastal erosion, to develop tools to improve land-use planning and ecosystem protection in coastal areas, and to facilitate the selection of climate change adaptation solutions. Results for the regional county municipality[1] of Golfe-du-Saint-Laurent are also presented.

In winter 2017, an initial workshop was organized in each of the 17 coastal MRCs of Eastern Québec (Côte-Nord, Bas-Saint-Laurent, Gaspésie–Îles-de-la-Madeleine). The aim was to share the most up-to-date coastal hazard knowledge with local and regional stakeholders, to gather local information on coastal zone usage, and to discuss the needs and tools that would facilitate coastal hazard management. Stakeholders invited to the workshops comprised administrative personnel of local municipalities and coastal MRCs, professionals from the relevant ministries, and professionals from local and regional organizations. Separate meetings were held with elected local officials. All participants were asked to formulate the most suitable adaptation and decision-making tools for their community in terms of public safety and infrastructure protection (Objective 1 of the project) and the management of priority coastal ecosystems (Objective 2). Within each MRC, these stakeholders compose the Local Committee whose role is to work with the researchers throughout the project. Stakeholders were also asked to prioritize a list of needs and tools through a voting process. The role of ecosystem identification criteria in biodiversity conservation was also discussed during the workshops. Following the workshop, a questionnaire was sent to all those who attended, as well as those who were invited but could not attend, in order to share the ideas presented at other workshops and to give stakeholders an opportunity to reprioritize the tools. In all, 357 local and regional stakeholders attended the various workshops and meetings, and 169 stakeholders responded to the post-workshop questionnaire. Only five stakeholders from the Golfe-du-Saint-Laurent MRC could attend the initial workshop due to a combination of harsh weather conditions and long travel distances. Despite this low turnarout, a large number of stakeholders from the MRC had expressed interest in the project, reflecting its importance for the region.

[1] In French: municipalité régionale de comté (MRC)

SYNTHESIS OF RESULTS FOR EASTERN QUÉBEC

A wide range of proposed needs and tools to improve public safety and infrastructure protection

Participants formulated a total of 188 needs relating to public safety and infrastructure protection (Objective 1), grouped into 19 different categories. Two types of needs garnered the most votes overall: **communication/awareness/information** and **knowledge and access to data**. The other types of needs included securing and coordinating projects and stakeholders; adapted regulation; financing; assistance; identification of adaptation solutions; and appropriate governance.

A wide range of practical tools (193 in all) were proposed to improve adaptive capacity. Among the 23 categories, the most popular was **communication/awareness/information** (good practice guide on the coastal zone; interpretation guide for laws and regulations; tools to raise public awareness about coastal hazards for residents, elected officials and school children; etc.), which is consistent with the results of the needs survey. Tools to identify solutions were also given high priority (a solution identification key (decision tree); a solution guide for different coastal types; cost-benefit analysis; etc.) and, to a lesser degree, mappings tools for coastal dynamics and hazards, dissemination tools for data on the coastal environment, and vulnerability mapping tools.

In the post-workshop survey, which listed 25 proposed tool categories (Table 1), the most popular were **mapping tools for erosion-prone areas** (9.1% of the votes), **infrastructure exposed to erosion** (8.2%), and **priority intervention zones** (8.1%) (Figure 1). These were followed by safety margins for coastal erosion and submersion (a regulatory tool), coastal evolution maps and tools to identify solutions. This latter category (now 6th) ranked considerably higher during the initial workshop (2nd). Communication tools, another initially popular category, also fell much farther down the list during the post-workshop survey, specifically: information sessions for citizens on local issues (17th); coastal hazard awareness tools and adaptation measures (20th); interpretation guide for laws and regulations relating to coastal risks (22nd); and educational tools for schools on coastal hazards and issues (25th). However, it should be noted that the communications category was split into several tools (combined they represent 7.3% of the votes), and some of the maps in the mapping tool category could be used as communication tools to raise awareness.

Table 1: The 25 categories of tools relating to public safety and infrastructure protection in areas facing coastal hazards

1. Mapping of coastal dynamics (currents, sediment flux, etc.)
2. Mapping of past and future coastal evolution (retreat and advance of the coastline)
3. Mapping of erosion-prone areas (coastal retreat) and submersion (coastal flooding)
4. Mapping of buildings and infrastructures exposed to erosion and submersion (in the short, medium and long term)
5. Mapping of priority intervention zones (defence structures, relocation, beach replenishment)
6. High-resolution mapping of the local topography (LiDAR coverage)
7. Distribution of mapping data in digital format
8. Web platform for the management and dissemination of existing data on the coastal environment (with data updates)
9. Economic evaluation tool for coastal risks
10. Integrated coastal zone management plan (territory description, stakes, vision, action plan)
11. Regulatory tool: safety margins for coastal erosion and submersion (areas of construction and development restrictions)
12. Regulatory tool: Definition of the high tide and riparian strip in the coastal environment
13. Identification tool for coastal hazard adaptation measures in an economic, social and environmental framework (multi-criteria analysis, cost-benefit analysis)
14. Identification tool for coastal hazard adaptation measures (identification guide, decision tree, works that should be promoted or avoided, etc.)
15. Detailed information for each portion of the coast (coast type, historical and recent changes, photos, recommendations for adaptation measures, etc.)
16. Assessment of the state and effectiveness of defence structures in your territory
17.Compilation of coastal hazard adaptation measures used around the world (innovative methods, effectiveness, constraints)
18. Administrative procedures guide for implementing coastal hazard adaptation measures (authorizations, steps, etc.)
19. Interpretative guide of the laws and regulations relating to coastal risks (web document or other format)
20. Citizen information sessions on local issues (coastal hazards, problems, regulations, etc.)
21. Educational tools for schools on coastal hazards and issues
22. Awareness-raising tools on coastal hazard adaptation measures (video clips, 3D video, radio and the web, local newspaper, etc.)
23. Directory of specialized resources for coastal environments (consulting firms, research groups, NGO, contractors, etc.)
24. Elaboration/review of emergency measures plans
25. Development of a local alert system for extreme weather events

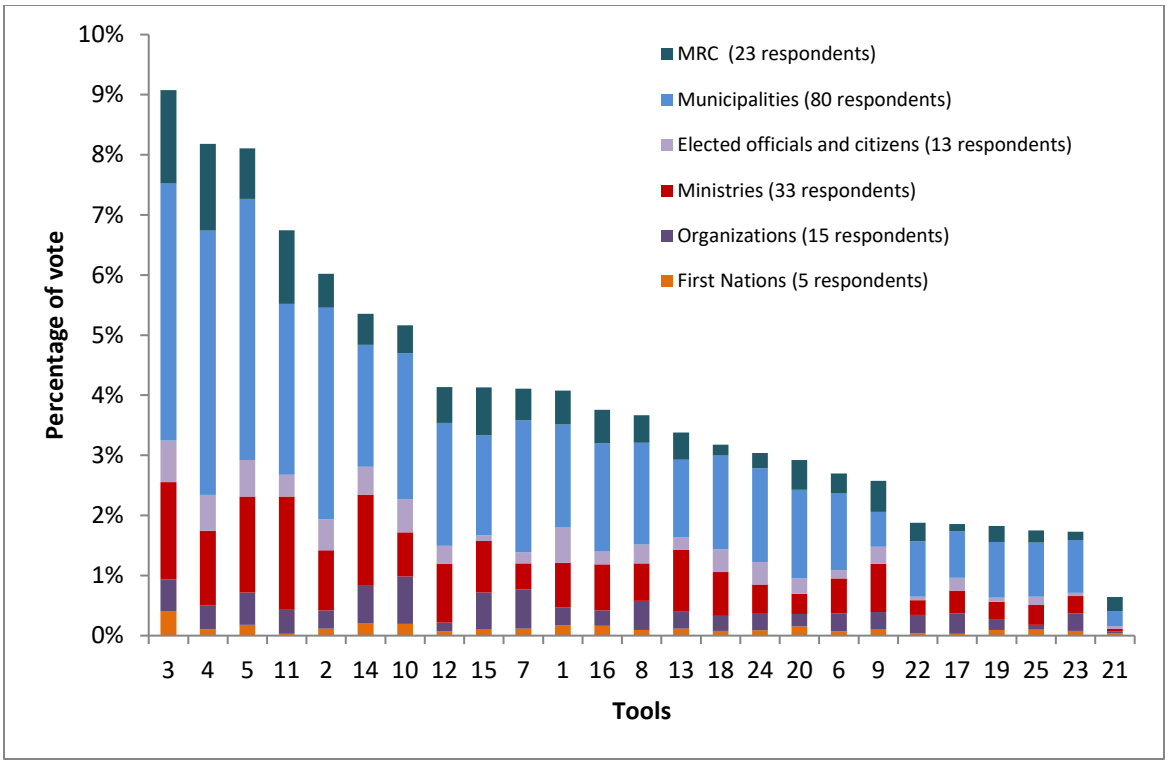

Figure 1: Results of the post-workshop vote on Objective 1 tools for all regions, according to stakeholder type (see table 1 for category descriptions).

Significant concern about coastal ecosystem conservation and maintenance of ecological services

Participants expressed a total of 85 needs relating to coastal ecosystem conservation and the maintenance of ecological services (Objective 2), grouped into 27 categories.

By far, the most articulated need was **public awareness**. Other priorities included the consideration of ecosystems in the selection of adaptation solutions, access to information and resource people, and assistance.

Eight-five (85) tools were proposed for coastal ecosystem conservation. As expected, **public awareness** tools ranked the highest among the 15 categories. Next was ecosystem mapping (vulnerability and use, priority ecosystems for conservation, coastal zones and freedom spaces), followed by ecosystem fact sheets.

In the post-workshop survey, **mapping tools** were prioritized above public awareness tools (Table 2 and Figure 2), specifically: mapping ecosystem vulnerability to coastal hazards and human occupation; mapping coastal ecosystem types; a tool to identify priority coastal ecosystems for conservation (according to economic, social, and environmental criteria); a good practice guide on the coastal zone, adapted to each MRC or region; mapping of past and future coastal ecosystem evolution; and an ecosystem management plan.

Table 2: The 19 categories of tools relating to coastal ecosystem conservation and maintenance of ecological services

1. Recent aerial photographs of the coast
2. Mapping the different types of coastal ecosystems (beaches, wetlands, eelgrass beds, etc.)
3. Mapping the ecological services of the coastal zone
4. Mapping the past and future evolution of coastal ecosystems (size, location)
5. Mapping ecosystem vulnerability to coastal hazards and human occupation
6. Tool to identify priority coastal ecosystems for conservation (according to economic, social and environmental criteria)
7. Register of coastal ecosystems for potential restoration (e.g.: to carry out compensation projects)
8. Integration of the coastal ecosystem freedom space concept into land-use plans (NB: freedom space is the space needed to accommodate ecosystem migration and maintenance)
9. Tools to identify coastal hazard adaptation measures that take into account ecosystem maintenance (ex. identification guide, decision tree)
10. Tool to predict the impact of coastal hazard adaptation measures on ecosystems and their uses
11. Elaboration/review of emergency measures plans to take into account coastal ecosystems
12. Coastal system management plan (territory description, stakes, vision, action plan)
13. Web platform for the management and dissemination of existing data on coastal ecosystems (with data updates)
14. Detailed information for each portion of the coast (ecosystem types, ecological services, biodiversity, threats, compatibility of use)
15. Guide on possible conservation measures (sensitivity, revegetation, nesting box installation, voluntary conservation, etc.)
16. Good practice guide on the coastal zone, adapted to each MRC or region
17. Interpretation guide for laws and regulations relating to coastal ecosystems
18. Awareness-raising tools on coastal ecosystems (video clips, 3D video, radio and the web, local newspaper, etc.)
19. Educational tools for schools on coastal ecosystems

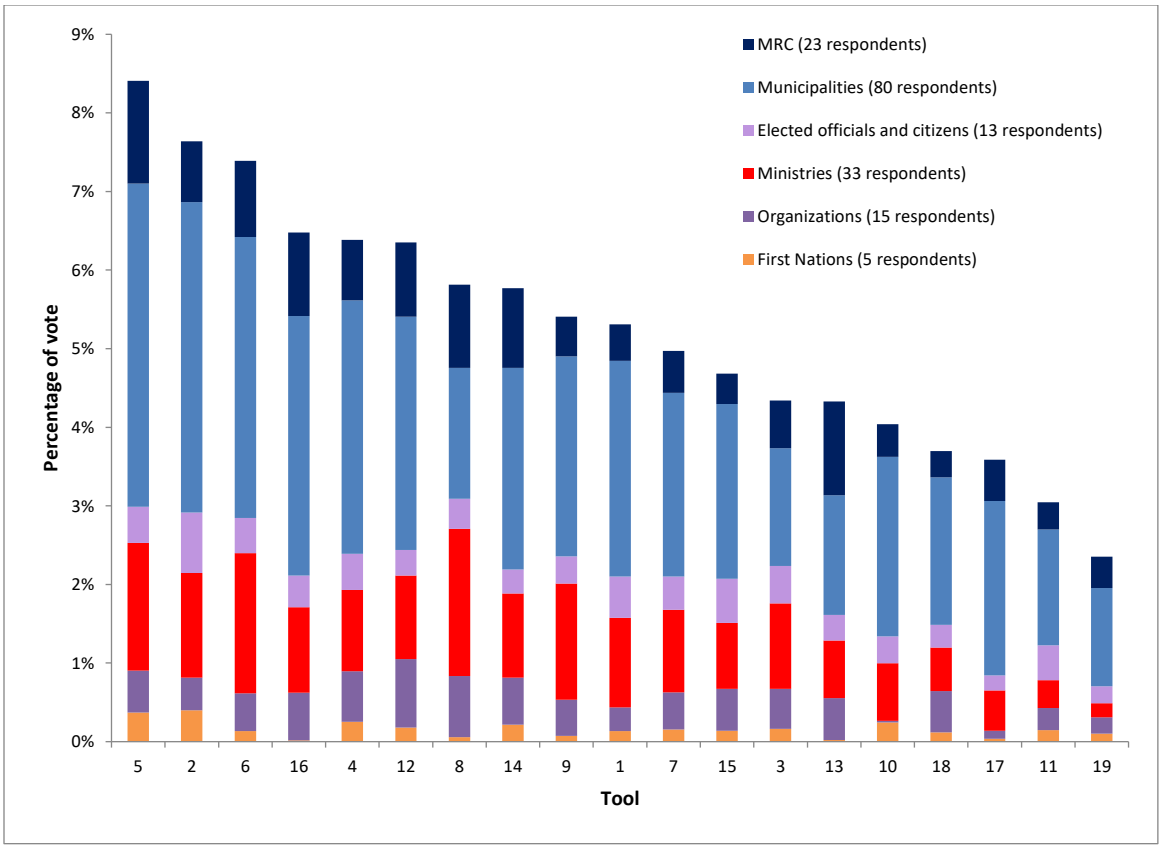

Figure 2: Results of the post-workshop vote on Objective 2 tools for all regions, according to stakeholder type (see table 2 for category descriptions)

Workshop participants ranked a set of criteria to identify priority ecosystems for conservation. Of 13 *a posteriori* categories, the indicators grouped under **ecological services** (hazard protection, landscapes, uses, crops, etc.) received the most votes, followed by biodiversity indicators (special status species, indicator species, outstanding ecosystems, etc.) and vulnerability indicators (threats to ecosystems). Stakeholders also selected 10 conservation measures they felt should form the basis of ecosystem management. The public awareness category (video clips, meetings with citizens, science popularization articles in newspapers, conferences, etc.) clearly came out on top among the measures to implement, ahead of guidance on laws and regulations.

Post-workshop ranking emphasizes practical land-use planning and management tools for territories and ecosystems

The results of the post-workshop questionnaire, which allowed participants to prioritize the proposed tools for all of Eastern Québec and not just their own MRC, were generally consistent with the workshop results. However, there was a tendency to rank the communication and

public awareness tools lower in the post-workshop survey, and this was true for both objectives. The subdivision of these tools into several categories may have played a role. Stakeholders prioritized **functional land-use planning and management tools for territories and ecosystems**. Moreover, **ecosystem vulnerability mapping**, which ranked lower during the workshops, except for Îles-de-la-Madeleine, garnered more votes in all regions during the post-workshop questionnaire. Although the results of the post-workshop questionnaire are undoubtedly less representative than those of the workshops and meetings (only 169 respondents for the former case, versus 357 participants for the latter), the distribution of stakeholder type and place of origin remained the same.

Proposed tools and needs according to region

Differences, at times pronounced, were noted between regions and MRCs, particularly for Objective 1.

The results obtained for the Côte-Nord were by far the most similar to the findings for eastern Quebec as a whole, particularly on the subject of coastal ecosystems. This region is distinguished by its higher level of interest in planning tools (during the workshops) and past and future coastal evolution mapping (post-workshop questionnaire), and by its more pressing needs for adapted regulation, assistance for local and regional authorities, and stakeholder coordination (the latter from elected officials).

In the Bas-Saint-Laurent, stakeholders formulated more needs and tools than other regions. Those relating to communication, while still considered important, generally ranked lower during the workshops than for stakeholders elsewhere. Access to information and stakeholder coordination were the highest-ranking needs for this region, which distinguishes it from other areas. It may be relevant that this region has launched complementary projects to the Coastal Resilience Project. Moreover, elected officials in the Bas-Saint-Laurent are calling for adapted regulation and more financing. Among the choice of tools, maps proved very popular throughout the process. Two of the tools under Objective 2 — coastal ecosystem valuation by multicriteria analysis and integrating the concept of ecosystem freedom space into land-use plans — garnered many of the votes from this region.

The results for the Gaspésie are similar to those of Bas-Saint-Laurent. Participants expressed a strong need for access to information (this time on the part of elected officials) and they assigned high importance throughout the process to mapping tools, particularly the tool for integrating coastal ecosystem freedom space into land-use plans. Unique to this region, the highest-ranking Objective 2 tool during the workshops comprised fact sheets describing the coastal environments and adaptation solutions that take ecosystems into account.

The stakeholders from Îles-de-la-Madeleine prioritized their needs and tools very differently than other parts of Eastern Québec. They are ready to enter a more operative phase and

therefore awarded the most votes to financing and implementation solutions under Objective 1. Mapping tools and solution identification tools were somewhat less cited during the Îles-de-la-Madeleine workshops than in other regions, whereas inventory and information synthesis tools were given higher priority. In the post-workshop questionnaires, more distinctive tools ranked higher, reflecting a deep understanding of the subject: tools to identify coastal hazard adaptation measures; distribution of mapping data in digital format; and assessment of the state and effectiveness of defence structures. On the subject of coastal ecosystem protection and maintenance of ecological services, stakeholders in the archipelago further distinguished themselves during the workshop stage by clearly prioritizing measures that facilitate conservation (among the needs) and mapping ecosystem vulnerability (among the tools). In the questionnaire, the register of coastal ecosystems for potential restoration was another tool that received a lot of votes.

The next phases of the Coastal Resilience Project will respond to the expectations of municipal stakeholders by specifically adapting to the needs of different MRCs in Eastern Québec by developing tools for the short, medium and long term.

Distinctions amongst stakeholders

The ranking of proposed needs and tools is not the same for all stakeholders. Not only are differences noted within each region, but very few common traits can be distinguished between stakeholder types in the overall assessment of workshops and meetings, whether for Objective 1 or Objective 2. The post-workshop questionnaire, which allowed stakeholders to vote again on the same proposals, sheds some light, but the differences are not always obvious. Although the overall workshop results generally align with the needs and tools prioritized by elected officials during their dedicated meetings, what stands out is the greater willingness of elected officials to take action. Typically, however, for a given region the needs proposed by elected officials, and in some cases the tools, are different from those proposed by the region's other stakeholders. For example, the high importance placed by elected officials on coordination, cooperation, financing, and adapted governance and regulation was not always shared by other stakeholders from the same region. In the post-workshop questionnaire, the only unique aspect of the responses from elected officials was the very high importance assigned to integrated coastal zone management and the mapping of ecosystem types.

Municipal stakeholders appear to rank the following more highly than other stakeholders: financing needs for adaptation solutions; their implementation; access to ecosystem information and resource people; and the mapping tool for population and infrastructure vulnerability.

First Nations assigned a high priority to assistance as well as access to information and qualified human resources, for both coastal hazards and coastal ecosystems. These stakeholders placed greater importance than other stakeholders on planning tools, ecosystem valuation by

multicriteria analysis, maps of ecosystem types, and identifying priority ecosystems for conservation.

MRC professionals are distinguished for their tendency to prioritize ecosystem tools. They most often prioritized the mapping of ecosystem freedom spaces, ecosystem valuation by multicriteria analysis, a web platform for the management and dissemination of existing data, and a good practice guide on the coastal zone. MRC representatives also emphasized adapted regulation (Objective 1) and an interest in the mapping of coastal dynamics and coastal hazards.

Ministry professionals also placed greater importance on adapted regulation. In the questionnaire, both the regulatory tool concerning safety margins for coastal erosion and flooding, and the integration of the concept of ecosystem freedom space into land-use plans received a lot of votes. These stakeholders also emphasized the need to take ecosystems into consideration when selecting adaptation solutions and the tool for prioritizing ecosystems for conservation.

Like the Ministry and MRC representatives, the professionals from organizations ranked the need for adapted regulation highly, although they also emphasized assistance (Objective 1) and measures to facilitate ecosystem conservation. Integrated coastal zone management plans and coastal ecosystem management plans rated highly in the questionnaire, as did the integration of the ecosystem freedom space concept.

The original approach of the Coastal Resilience Project relies on the engagement of local and regional stakeholders right from the beginning, and on their collaboration in improving and executing the project. Stakeholders are able to express what they believe are the most useful needs and tools for their MRC to adapt to coastal hazards. In our view, this aspect, along with the direct collaboration with local and provincial governments, is essential if we are to significantly reduce the vulnerability of coastal communities and bolster their resilience and that of their ecosystems. The aim of the second phase of the project, already underway, is to characterize coastal environments and define vulnerabilities in order to identify priority areas where adaptation solutions and ecosystem conservation should be implemented, while taking into account the specific needs expressed by each MRC.

RESULTS FOR THE GOLFE-DU-SAINT-LAURENT MRC

1. Results of the workshop held in the Golfe-du-Saint-Laurent MRC

Bad weather prevented quite a few stakeholders from attending the workshop for the Golfe-du-Saint-Laurent MRC, and the results compiled below reflect the responses from only five participants. Moreover, only one elected official made it for a portion of the workshop, and that portion did not concern needs and tools. For this reason, no results are presented for elected officials from this MRC.

Needs relating to public safety and infrastructure protection

In the Golfe-du-Saint-Laurent MRC, stakeholders ranked the need for knowledge and access to data the highest (Figure 3). Participants emphasized the need for a portrait of the past and present coastal situation, more information on laws and regulation, and technical information on defence structures. The need to implement a financing program to facilitate adaptation ranked second.

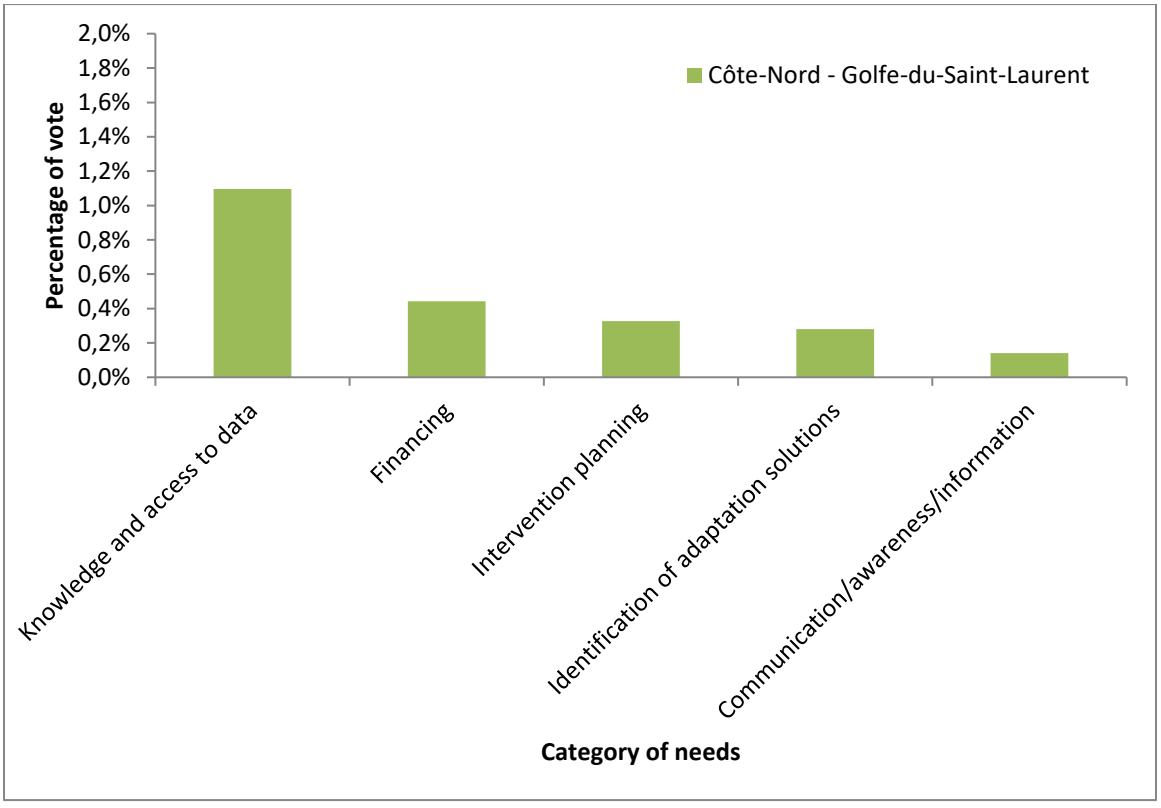

Figure 3: Prioritization of public safety and infrastructure protection needs during the Golfe-du-Saint-Laurent MRC workshop, ranked by category.

Tools relating to public safety and infrastructure protection

The highest-ranking category was mapping tools (Figure 4). Participants emphasized coastal evolution maps and LiDAR coverage (high-resolution topography of coastal territory). This was followed by the elaboration of a prevention plan. Participants also underscored the importance of setting up a monitoring network for coastal conditions and having access to maps and GIS shape files.

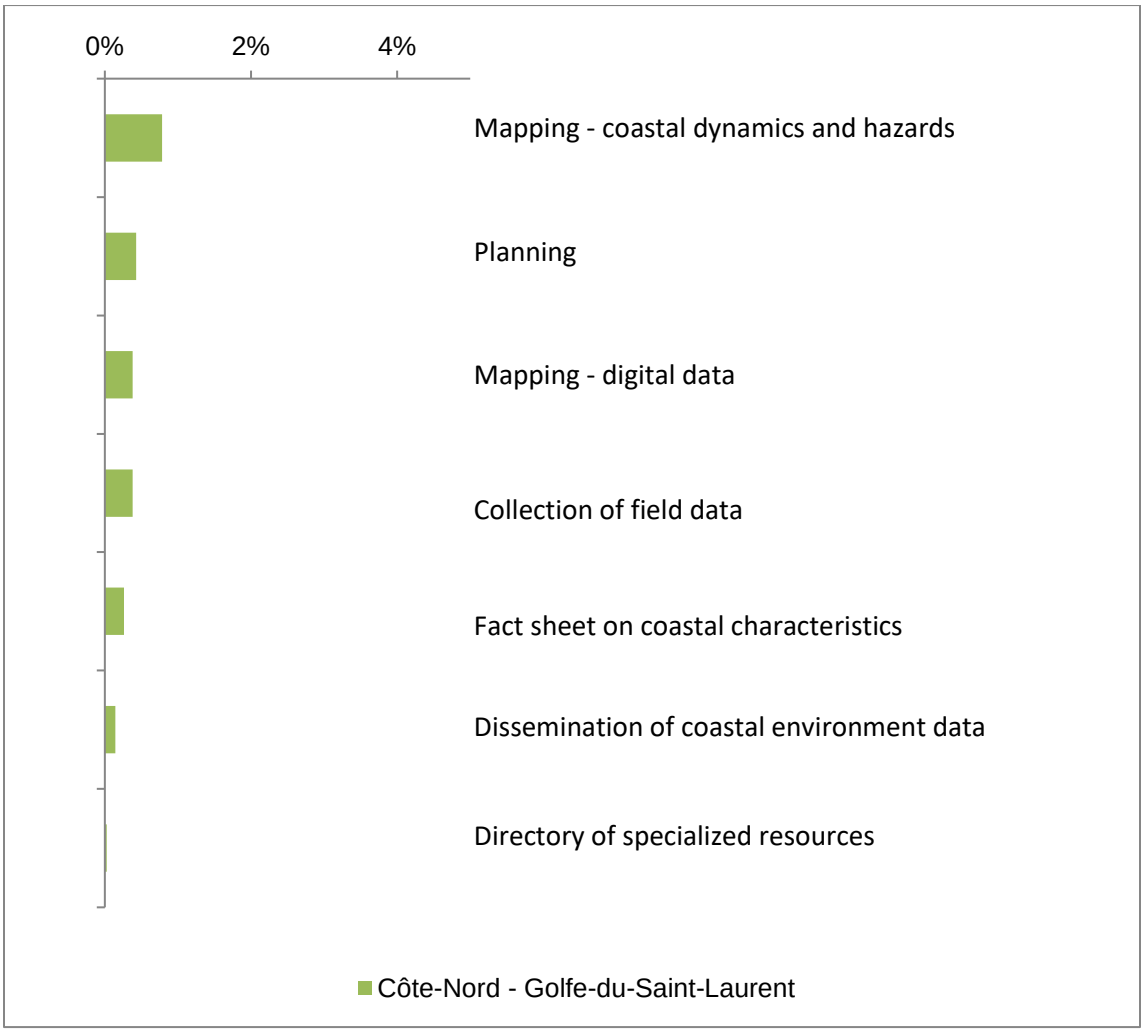

Figure 4: Prioritization of public safety and infrastructure protection tools during the Golfe-du-Saint-Laurent MRC workshop, ranked by category.

Needs relating to coastal ecosystem protection

Participants formulated three categories of coastal ecosystem management and conservation needs during the workshop (Figure 5), with public awareness ranking the highest. Specific needs in this category were raising awareness about coastal erosion and human activities that exacerbate the problem (e.g.: ATV circulation in sensitive areas and tree cutting), and the natural protection that some coastal ecosystems may provide against coastal hazards. Also emphasized was the need for authorized coastal access for pedestrians and ATVs in order to reduce erosion in sensitive areas, particularly in the communities of Chevery and Blanc-Sablon.

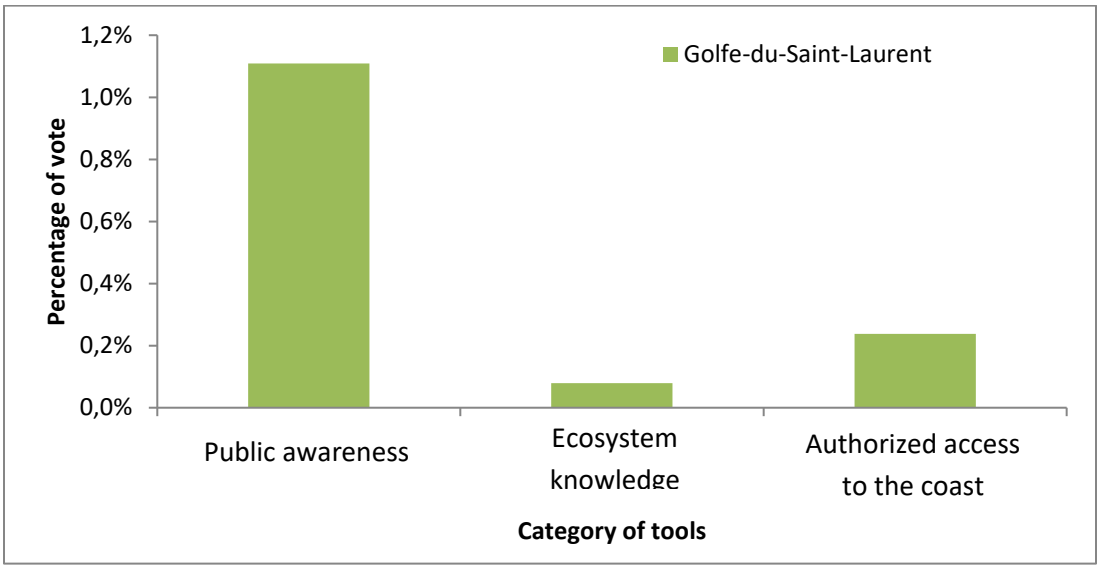

Figure 5: Prioritization of ecosystem conservation needs during the Golfe-du-Saint-Laurent MRC workshop, ranked by category

Tools relating to coastal ecosystem conservation

Five categories of coastal ecosystem management and conservation tools were identified during the workshop (Figure 6). Two of these were deemed particularly important: public awareness tools and mapping of coastal zones (ecosystems, tenure, uses, etc.). Public awareness tools obtained most of the votes. Ways to raise awareness included the media (radio and internet), citizen information sessions, summer camps for youth, and school activities. Under the category of coastal zone mapping (ecosystems, tenure, uses, etc.), specific mapping tools were not identified, although participants did mention at the workshop that they want more mapping tools at their disposal.

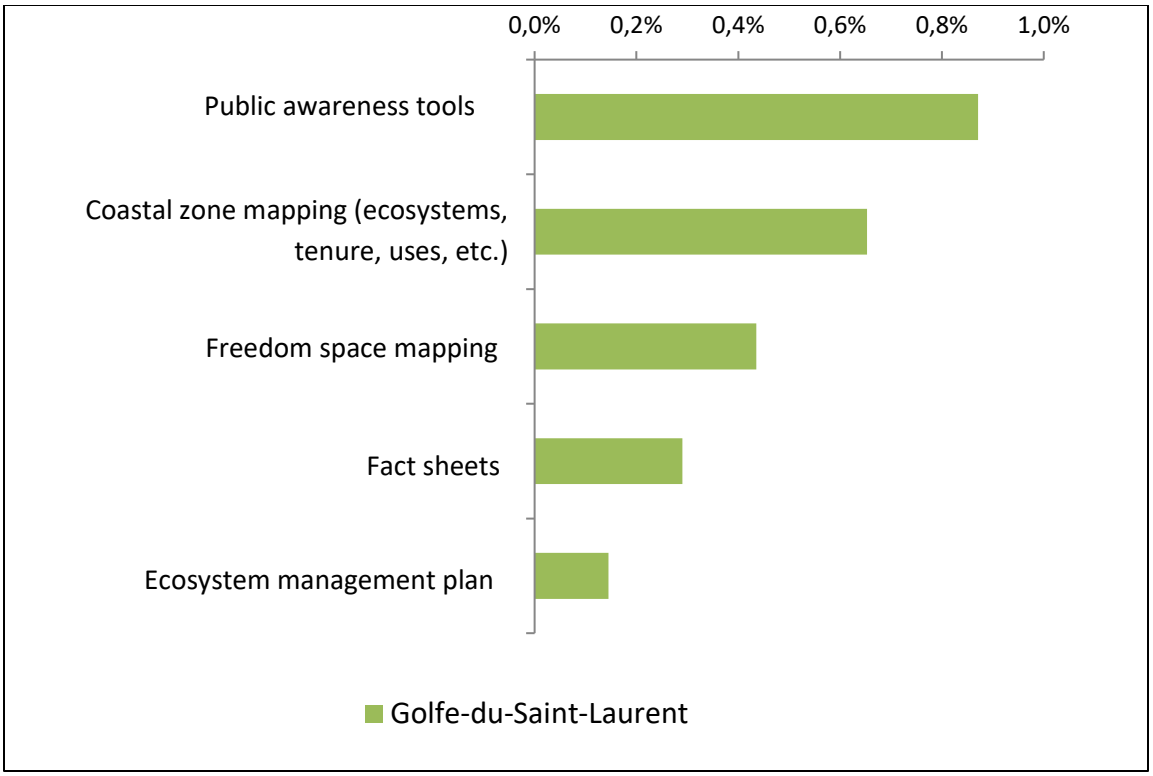

Figure 6: Prioritization of coastal ecosystem conservation tools during the Golfe-du-Saint-Laurent MRC workshop, ranked by category

2. Responses to the post-workshop questionnaire from Golfe-du-Saint-Laurent MRC stakeholders

Only seven stakeholders from the Golfe-du-Saint-Laurent MRC answered the post-workshop questionnaire, the aim of which was to share the ideas presented at other workshops and allow stakeholders to reprioritize tools relating to public safety and infrastructure protection in areas facing coastal hazards (Table 1) or coastal ecosystem conservation and the maintenance of ecological services (Table 2).

Tools relating to public safety and infrastructure protection

Tool 1 (mapping coastal dynamics) garnered the most votes (Figure 7). This tool came in fourth place overall for the entire Côte-Nord region. Tools 3 and 2 also received a significant number of votes, notably higher than the other proposals (Figure 7).

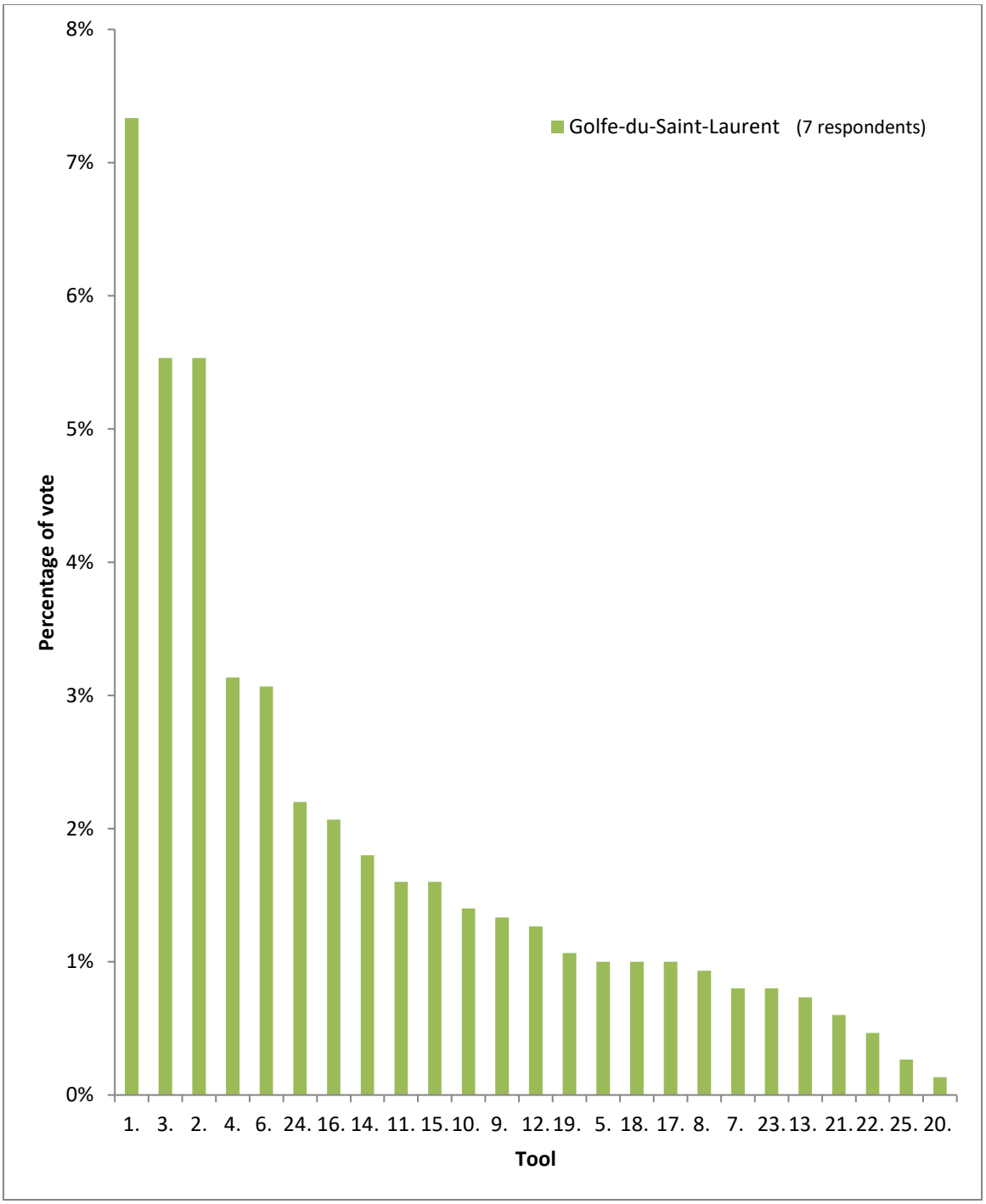

Figure 7: Results of the post-workshop vote by stakeholders of the Golfe-du-Saint-Laurent MRC on public safety and infrastructure protection tools (see Table 1 for category descriptions).

Tools relating to coastal ecosystem conservation

The highest-ranking tools for the Golfe-du-Saint-Laurent MRC are the mapping of coastal ecosystem types and recent aerial photographs of the coast (Figure 8). These are followed by tools 2, 12, 4, and 10 (Figure 8).

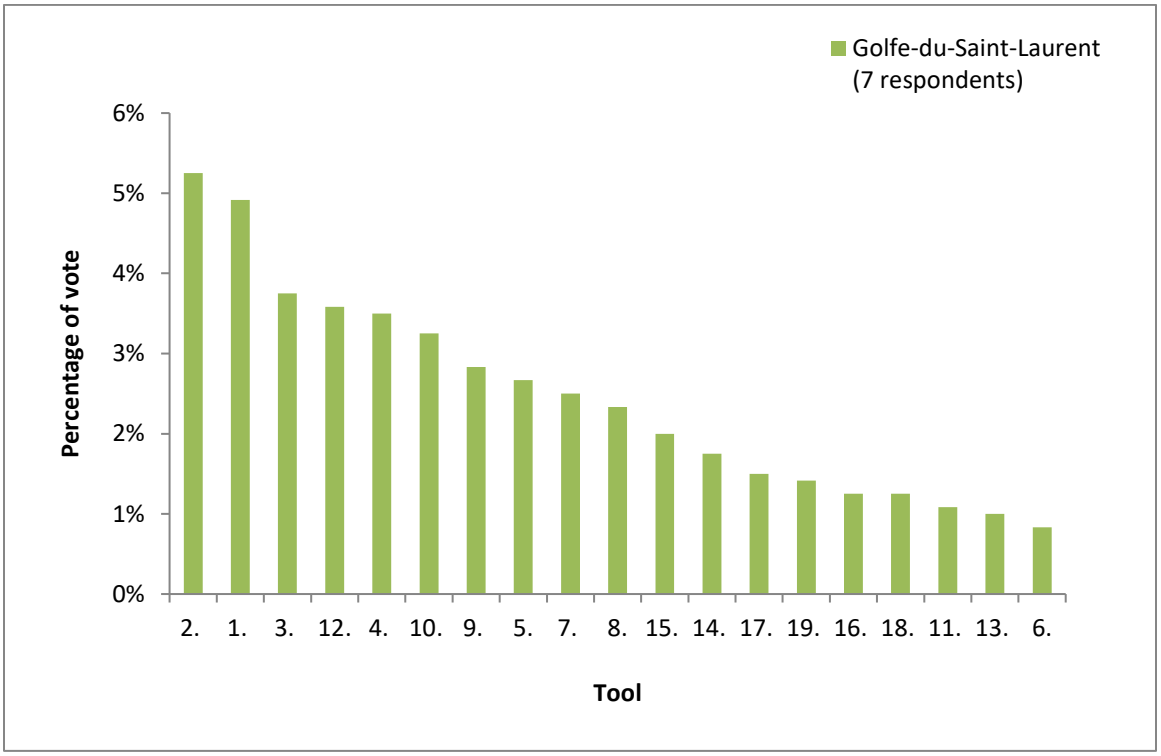

Figure 8: Results of the post-workshop vote by stakeholders of the Golfe-du-Saint-Laurent MRC on coastal ecosystem conservation tools (see Table 1 for category descriptions).