

## RESEARCH ARTICLE

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## Marine mammal stranding response in Mexico: Lessons learned

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## Abstract

1. Marine mammals are indicators of ecosystem health, and thus stranding records are an invaluable information source. The response to marine mammal stranding (RMMS) must be comprehensive, taking into account three components: (i) operations, (ii) research, and (iii) information dissemination. Although RMMS had previously been practised in several coastal locations in Mexico, the recent enforcement of a new regulation for RMMS has posed a challenge to actors as they adapt to it.
2. To understand the functioning of RMMS in Mexico, Bahía Todos Santos and Bahía de La Paz, two localities with over 20 years of experience in RMMS, were selected. To achieve this goal, a document review to identify the actors involved and their functions was undertaken together with a social network analysis to identify relevant actors in each locality and semi-structured interviews to identify key topics for RMMS.
3. The composition of the involved actors was similar at both locations. Some actors were found to have mandatory functions (i.e. governmental actors), while others (i.e. civil society organizations) performed functions beyond those established in official documents. Governmental agencies, the academic sector, and civil society organizations were the most connected actors and could help disseminate information, facilitate communication within the network, and influence decision-making.
4. The main topics identified were, in order of relevance: (i) economic constraints; (ii) actors' involvement; (iii) stranding response logistics; and (iv) recognition among actors.
5. In conclusion, several limitations to the RMMS exist at both localities, mainly related to the lack of economic resources, but actors involved in RMMS actions are motivated by their own interests. This study proposes the integration of actors into local networks that take into consideration the biological, physical, and social characteristics of each place.

## KEYWORDS

beach, coastal, legislation, marine mammals, ocean, public perception

## 1 | INTRODUCTION

Since most marine mammals die at sea and their carcasses may drift with the currents towards the coast, their stranding is common (Peltier et al., 2012). Any marine mammal found dead on the beach or floating nearby is considered stranded; cetaceans (i.e. whales and dolphins) found alive onshore are always considered stranded, but pinnipeds (i.e. sea lions or seals) are only considered stranded when some part of their body is entangled by fishing nets or fish hooks or they are injured or sick (Gulland, Dierauf & Rowles, 2001).

Marine mammal stranding is an invaluable source of information about their distribution, biology, physiology, morphology, diversity, and health (Wilkinson & Worthy, 1999; Bravo et al., 2005). Stranding records are useful for establishing the causes of these events, for example: (i) natural (diseases, predation, anomalous oceanic events, such as El Niño or algal blooms); (ii) interaction with coastal activities (fisheries); and (iii) anthropogenic pollution due to the high trophic level occupied by marine mammals (Delgado-Estrella, Ortega-Ortiz & Sánchez-Ríos, 1994; Bossart, 2011; Byrd et al., 2014; Goetz et al., 2014). Zoonosis – diseases that are transmissible among human beings and animal species – represent a possible social implication of marine mammal stranding (Cowan, House & House, 2001). Ideally, all this information must be available to stakeholders to establish informed measures for marine mammal conservation.

To accomplish this availability of information, a comprehensive response to marine mammal stranding (RMMS) should be implemented, which implies performing diverse functions (actions), beginning with the stranding report, followed by operational activities (corroborating reported stranding in the field, gathering data, and disposing of the organisms) and ending with the use of information for research (e.g. determining the causes) and, ultimately, the dissemination of the results. These functions are performed by three types of actors: (i) governmental agencies, (ii) the academic sector, and (iii) organized and unorganized civil societies (Martínez & Chávez-Ramírez, 2014; SEMARNAT, 2014).

In Mexico, a legal framework exists establishing actions focused on the conservation of marine mammal species and their populations; it is regulated by the General Law of Ecological Equilibrium and Environmental Protection (Székely et al., 2005; SEMARNAT, 2012). However, it was not until 2000 that the General Wildlife Law (SEMARNAT, 2016) gave special consideration to marine mammals by prohibiting their use or the use of their derivatives for sustenance or commercial use. In 2014, the procedures for RMMS were issued in the Protocol of Response to Marine Mammal Stranding (hereafter called Protocol; SEMARNAT, 2014), which defines RMMS as: “a set of previous, immediate response, and monitoring actions by the authorities and voluntary support groups involved in response of marine mammals stranding. These actions include, but are not limited to, the strengthening of capabilities, rescue of live specimens in its case, analysis of stranding causes, and final disposal of the mammals”.

All marine mammal species in Mexico are under a risk category (SEMARNAT, 2010); thus, only the Mexican Federal Attorney for

Environmental Protection (PROFEPA by its Spanish acronym; see Appendices A and B for all the acronyms) is legally authorized to manage them. Before publication of the Protocol, no clear regulation existed for the involvement of non-governmental actors in RMMS; however, this regulatory instrument now allows their participation under the coordination of the PROFEPA (SEMARNAT, 2014). To comply with the Protocol, since 2015, the PROFEPA and the Secretariat of Environmental and Natural Resources (SEMARNAT by its Spanish acronym) have begun implementing RMMS networks as instruments to identify the involved actors and assign their functions. To date, RMMS networks have been installed in 10 of the 17 coastal states in Mexico (Figure 1).

Thus, the objective of this study was to identify the issues related to RMMS in Mexico and find similarities and differences. For this purpose, two localities with an established system for RMMS were selected, considering the possibility of generalizing the results at the national scale. To accomplish these objectives, the following goals were proposed in order to identify: (i) key actors and their functions within the RMMS process; (ii) their interactions through the application of interviews; (iii) the main topics involved in RMMS based on the actors' opinions; and finally, (iv) issues through a strength, weakness, opportunity, and threat (SWOT) analysis.

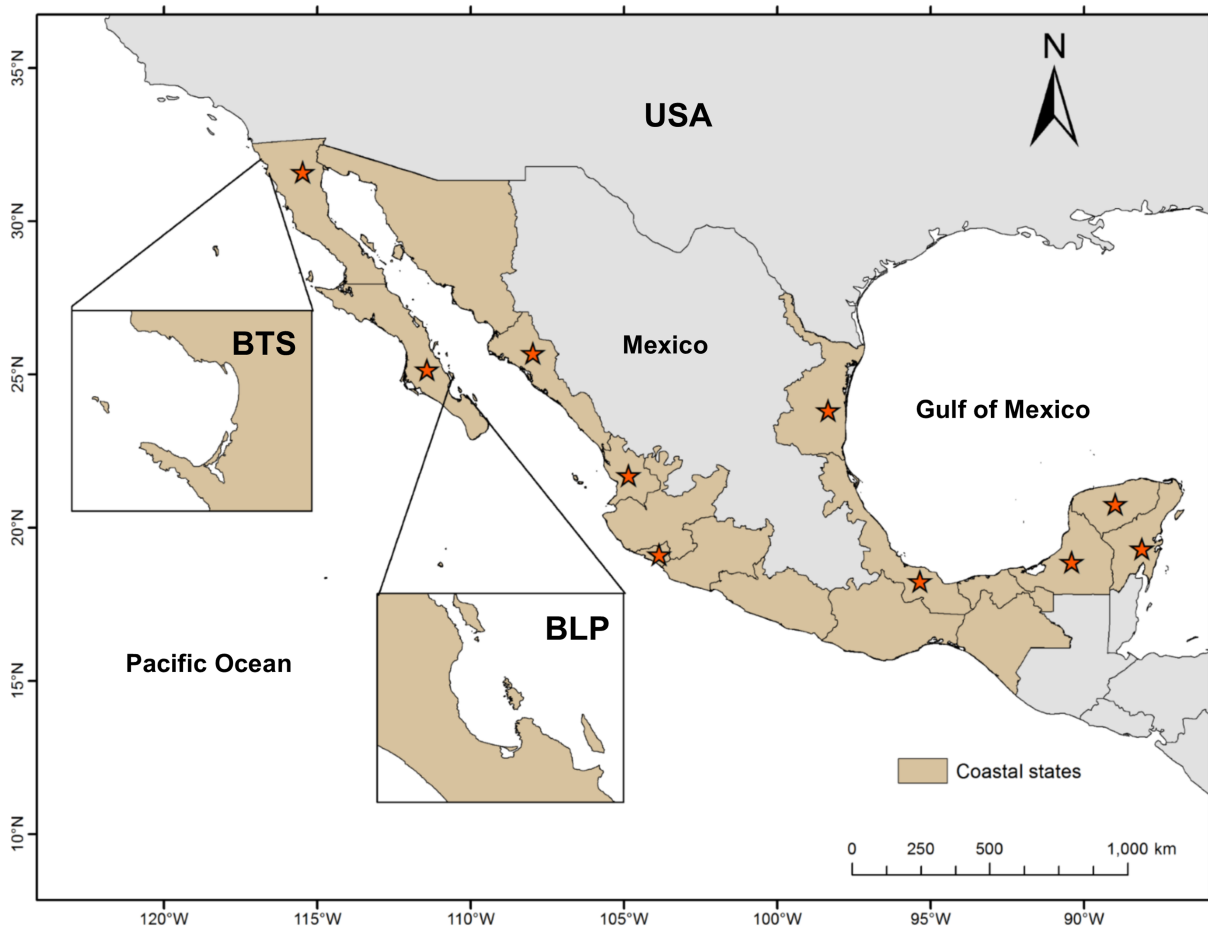
## 2 | METHODS

### 2.1 | Context of the study

This study analysed the RMMS system using two bay localities in Mexico as case studies: Bahía Todos Santos (BTS) in the state of Baja California and Bahía de La Paz (BLP) in the state of Baja California Sur (Figure 1). Despite BTS being located on the north-west Mexican Pacific coast and BLP on the western coast of the southern Gulf of California, both localities share a similar context as related to this study: they have similar economic coastal activities, such as fisheries, mariculture, international ports, and tourism (including marine mammal watching; Rosales-Casian & González-Camacho, 2003; Labrada-Matagón, Auriolles-Gamboa & Martínez-Díaz, 2005; Heckel, Espejel & Fischer, 2010). Both regions also show high marine mammal diversity, which has been related to particular oceanographic features, such as current circulation and high biological productivity. In addition, these localities were chosen because they have been involved in RMMS for over 20 years.

### 2.2 | Identification of key actors and their functions

A document review and semi-structured interviews (Table S1) were performed (Azhoni, Holman & Jude, 2017) to identify the key actors involved in RMMS at BTS and BLP and their functions. The document review included the Protocol, as well as the document derived from the establishment of the State Marine Mammal Stranding Networks (hereafter, State Stranding Network) from both Baja California and



**FIGURE 1** Location of the studied localities Bahía Todos Santos (BTS), Baja California, Mexico, and Bahía de La Paz (BLP), Baja California Sur, Mexico. All Mexican coastal states are shaded brown. Stars indicate the states having formation acts of State Networks for responding to marine mammal stranding events

Baja California Sur. In addition, key actors were also identified during the interviews through the recommendation of other respondents (Martínez-Salgado, 2012). The key actors were classified based on the following: governmental agencies (federal, state, or municipal), academic sector (scientific community), civil society organizations (CSOs), private sector and general public (Sorensen, McCreary & Brandani, 1992) (Appendices A and B). The functions of each actor in RMMS were identified from the: (i) description of functions in official documents (SEMARNAT, 2014; SEMARNAT, 2015a; SEMARNAT, 2015b); (ii) compilation of information obtained from interviews; and (iii) functions of non-interviewed actors identified by interviewees.

### 2.3 | Interactions among actors

To understand the interactions among the actors in each locality, a social network analysis was performed based on the information obtained from interviews. For this purpose, an interaction was defined as the collaboration among actors that were mentioned during interviews. All of the information collected from interactions was used to build an adjacency matrix, assuming that any interaction between two actors was reciprocal. From the adjacency matrix, the centrality

index was calculated, which represents a measure of the relative importance of each node and its vertices. Both the adjacency matrix (i.e. interactions among actors) and the centrality index (i.e. relevance of each actor within the network) were represented in social network diagrams using Socnetv, 2019 (<https://socnetv.org>).

### 2.4 | Key topics in RMMS

In 2017, a total of 16 semi-structured interviews were conducted with key actors from both localities: nine in BTS, including five governmental agencies (two federal and three municipal), two academic representatives, one CSO, and one private sector representative, and seven in BLP, including three governmental agencies (two federal and one municipal), two academic representatives and two CSOs (see Appendix A for definitions of all the acronyms). Interviews were recorded with the consent of the interviewees. The transcripts of the interviews were analysed with the software ATLAS.ti, 2019 (<https://atlasti.com>) following unified criteria, which allowed identification of the main topics and sub-topics (i.e. discourse analysis). The interview covered three main topics (*stranding response, actors, and legal framework*); however, other topics were identified during the analysis

of the interviews (*difficulties*, *advantages*, and *recommendations*). Afterwards, the percentage of times each topic was mentioned during the interviews was calculated to determine their relevance.

## 2.5 | Issue identification

Using the discourse analysis from the interviews with key actors, their opinions about the current situation of the RMMS in their locality were used to build a SWOT matrix to identify the current strengths, opportunities, weaknesses, and threats in the RMMS in each locality (Helms & Nixon, 2010).

## 3 | RESULTS

Twenty-five actors were identified at each location (BTS and BLP; Appendices A and B) from the document review (Protocol and State Stranding Network) and interviews. In BTS, 15 government actors were identified, five from CSOs, three representatives from the academic sector, one from the private sector, and one from the general public. In BLP, 15 government actors were identified, four representatives from the academic sector, three from CSOs, two from the private sector, and one from the general public. Most of the federal government actors were identified in the Protocol, while those from state and municipal governments, as well as the academic actors and certain CSOs, were found in the State Stranding Network.

Three types of function were identified: (i) operational, for actors who carry out response activities in the field and coordinate logistics with other actors; (ii) technical–scientific, for those whose main activities are providing expert advice and veterinary care; and (iii) information dissemination for those actors who are responsible for issuing press releases and preparing material for environmental education. However, the most frequently performed activities were the operational and technical–scientific types.

The analysis identified PROFEPA, out of all the government agencies, as the agency that carries out the highest number of activities, mainly operational; it is the responsible authority for the RMMS in Mexico and, in accordance with the Protocol, its participation is mandatory. The Protocol specifies the participation of other governmental actors; however, according to the interviews, some of those actors showed no activity. Likewise, some actors demonstrated important involvement even though they did not have mandatory participation (Figure 2), for example, the CSOs performed a large number of activities related to all functions (operational, technical–scientific, and dissemination of information). Similarly, other actors participated in the RMMS, although they were not specified in official documents (e.g. Protocol and State Stranding Network; Table S2). It should be noted that some actors engaged in a reduced number of activities, often related to their attributions; however, those activities were relevant to specific functions within the RMMS, such as the stranding informants (e.g. public or private institutions, as well as the general public; Figure S1).

The social network analysis (Figure 3) used to describe interactions among actors showed that a higher number of actors involved in the RMMS were recognized (20 of 25 identified actors) in BLP. Sixteen of 25 identified actors for the social network were from BTS. By contrast, with respect to the centrality index, which is an indicator of how well-recognized an actor is within a social network, there was a higher number of levels in BLP than in BTS (11 vs. nine levels, respectively; Figure 3), which suggests that in BTS, actors will recognize each other more often.

Regarding the interactions among actors, this study found that, in BTS, PROFEPA and the Faculty of Marine Science, Universidad Autónoma de Baja California, were the most connected actors, followed by Marine Mammal Research and Conservation of Ensenada and the Ensenada Center for Scientific and Higher Education of Ensenada in Ensenada, B.C. In BLP, PROFEPA was the most connected actor, followed by the Secretariat of the Navy and Whale and Marine Sciences Museum, A.C. in La Paz, B.C.S. It is important to note that this analysis just indicated that the actors recognized each other and that they participated in the RMMS, but it did not reflect the degree of the relationship between them (Figure 3).

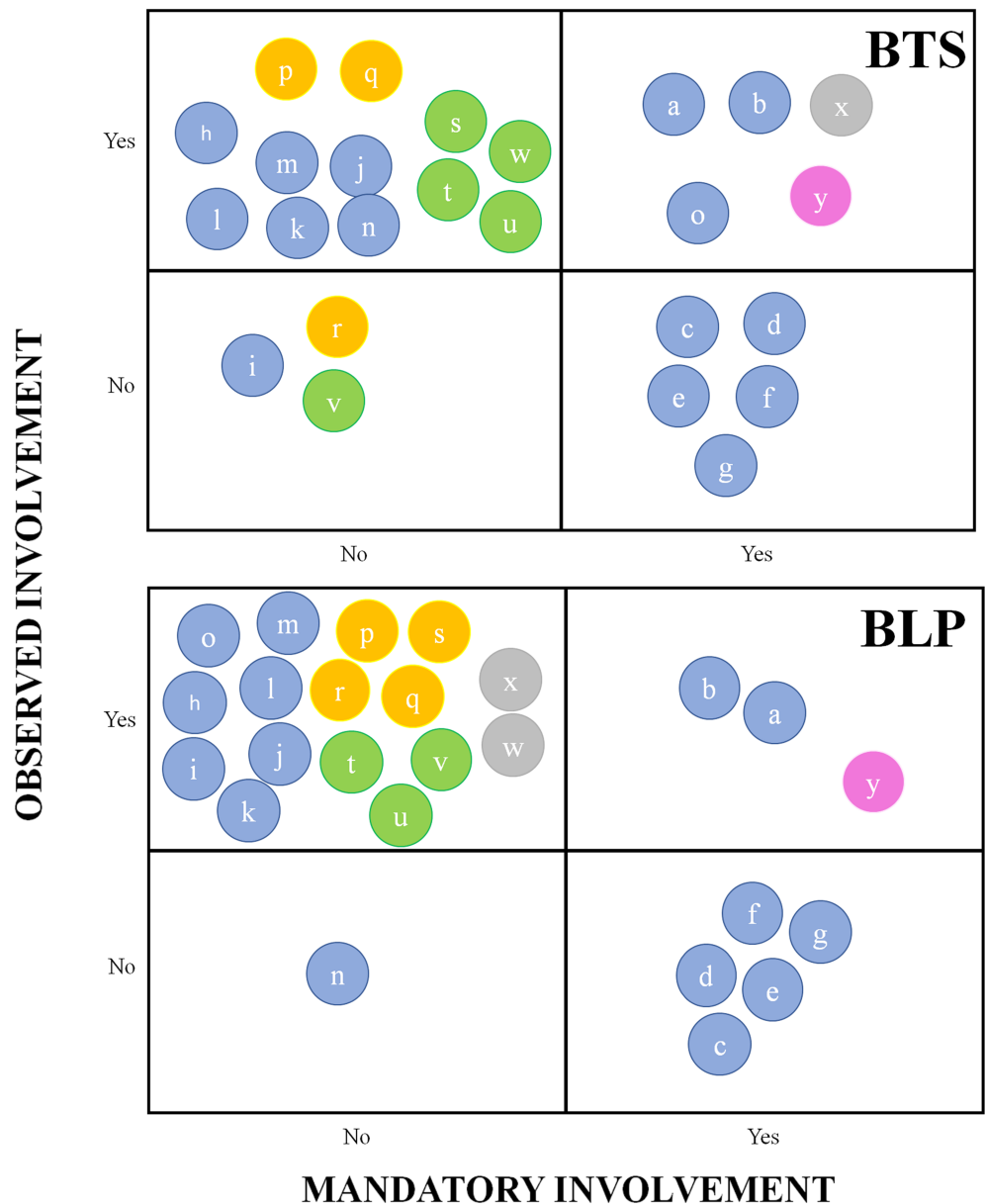
With the interview analysis, five main topics were identified (*actors*, *stranding response*, *difficulties*, *legal framework*, and *recommendations*), as well as several sub-topics for each (Table S3). The most frequent topics were *stranding response* and *difficulties*, while *legal framework* was the least frequent. At both locations (BTS and BLP), the main topics showed a similar proportion (Table S3). Similarly, some sub-topics had similar proportions of citations identified in the discourse analyses at both locations. For example, with regard to the topic *actors*, the sub-topics *involvement* (BTS = 45% and BLP = 40%) and *participants* (BTS = 31% and BLP = 26%) were quite similar (Table S3). In contrast, the *involvement* sub-topic within the *difficulties* topic was more frequent in BTS (23%) than in BLP (3%).

Discourse analysis also allowed a SWOT matrix to be completed (Table 1), where key issues in the RMMS were identified and classified as either strong issues (strengths and opportunities) or vulnerable issues (weaknesses and threats) where improvements were needed. In general, the main issue detected was the lack of economic resources, with actors working with limited resources, which represents a threat to their ability to carry out all the activities related to the RMMS. Another identified issue was the lack of local stranding networks, beyond the state-level organization (i.e. State Stranding Network), which highlighted the need to consider the particular needs of each place and to install local groups for RMMS. Moreover, similar strengths were identified for both locations, such as: (i) the presence of specialists in marine mammals (mostly academic and private sector actors); and (ii) interviewed actors showing a good relationship with authorities, among others (Table 1).

## 4 | DISCUSSION

RMMS has been conducted around the world for a long time, with records since the 1900s (Pyenson, 2010), but only from the 1980s to

**FIGURE 2** Observed involvement–mandatory involvement matrix for actors in the response to marine mammal stranding for Bahía Todos Santos (BTS) and Bahía de La Paz (BLP). Colours identify actor type: governmental (blue), academic sector (yellow), civil society organizations (green), private sector (grey), and general public (magenta). Letters indicate the actors' names for BTS (see Appendix A) and BLP (see Appendix B)

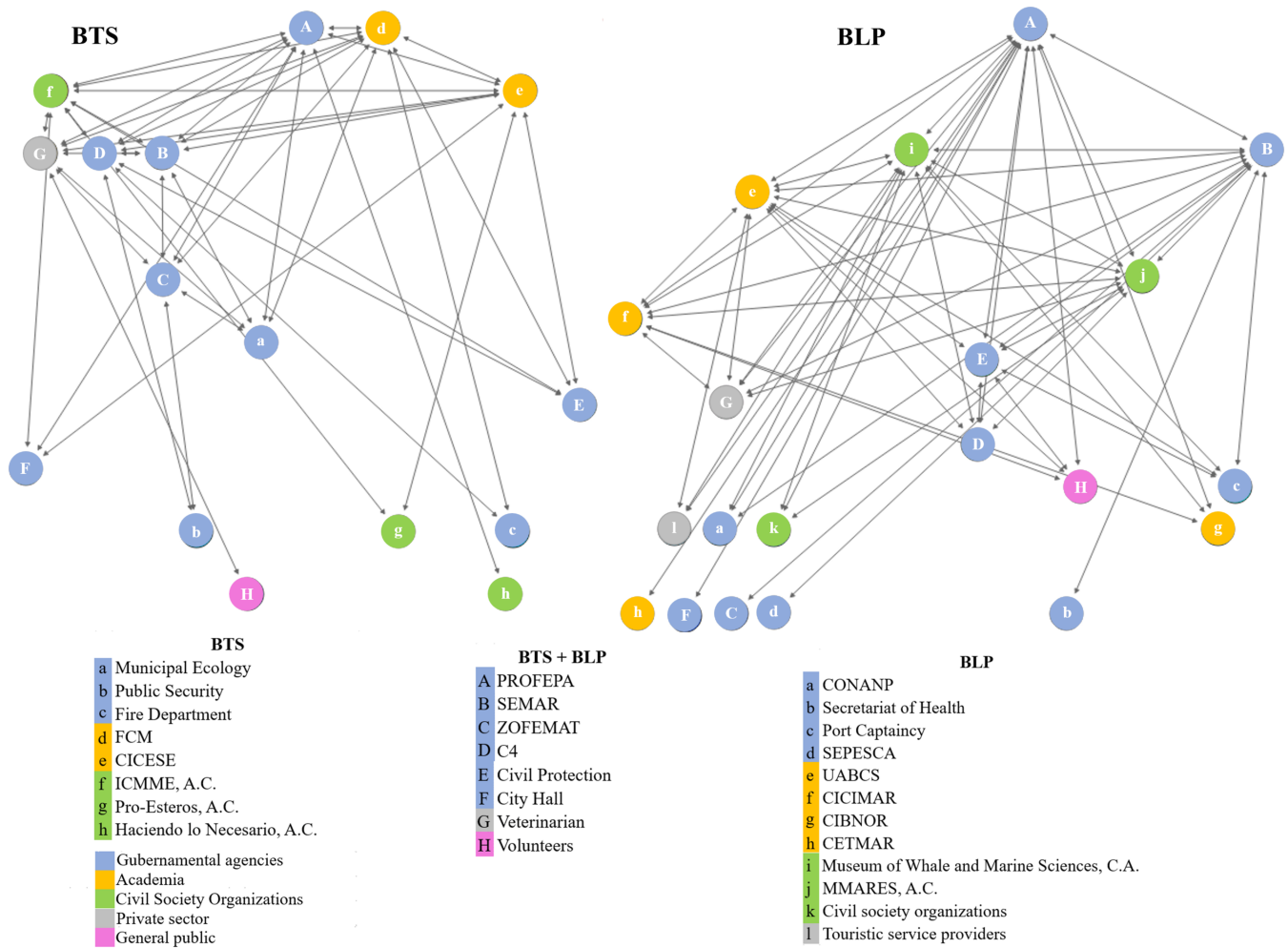


1990s did better organizations begin to carry out the RMMS in a systematic manner. Stranding response recordings allow the identification of natural causes of strandings, the detection of anthropogenic interactions, the detection of marine environmental pollution, and the prevention of zoonosis (Delgado-Estrella, Ortega-Ortiz & Sánchez-Ríos, 1994; Cowan, House & House, 2001; Bossart, 2011; Byrd et al., 2014; Goetz et al., 2014). Thus, systematic monitoring of stranded marine mammals provides information to stakeholders that helps them to implement conservation plans (Peltier et al., 2013).

One strategy for successfully establishing marine mammal stranding monitoring programmes has been the implementation of RMMS networks integrated by environmental authorities, marine mammal specialists and diverse non-specialist actors (Wilkinson & Worthy, 1999; Peltier et al., 2013). The objectives of these networks are: (i) to provide timely and efficient care to live organisms to ensure their well-being and to ensure the best quality for data gathered from

carcasses; (ii) to have a long-term systematic record to identify trends in strandings; and, consequently, (iii) to contribute information to conservation plans (Geraci & Lounsbury, 1993; Pyenson, 2010; Peltier et al., 2013). Some countries have well-established stranding networks, such as the USA (National Marine Fisheries Service, 2020), UK (UK Cetacean Strandings Investigation Programme, 2020), France (Centre de Recherche sur les Mammifères Marins, 2020), the Netherlands (National Forest and Nature Agency, 2020), and Belgium (Royal Belgian Institute of Natural Sciences, 2020), among others. In Mexico, the coordination of RMMS started in the 1980s with the formation of regional, state, and even local networks; however, none of these were official (Gómez-Hernández et al., 2020). It was not until 2015 that some State Stranding Networks were formally established.

In Mexico, the RMMS is part of a strategy within public policy to regulate and control the use of natural resources and the quality of



**FIGURE 3** Social network of actors involved in the response to marine mammal stranding in Bahía Todos Santos (BTS) and Bahía de La Paz (BLP). Actors with more connections are shown at the top of the network and less connected actors at the bottom. The nodes (circles) correspond to different actors while vertices (lines) indicate that at least one of the actors knows each other (reciprocal adjacency matrix). Letters identify each actor: (i) capital letters indicate when actors were present in both localities and (ii) lowercase letters indicate they were present in a specific locality. Colours identify actor type: governmental (blue), academic sector (yellow), civil society organizations (green), private sector (grey), and general public (magenta)

the environment to guarantee environmental sustainability and improve quality of life; this aim led to the generation of the Protocol, the only document that regulates this activity (SEMARNAT, 2012; SEMARNAT, 2014).

According to the Protocol and the State Stranding Network, the actors involved in the RMMS belong to government entities (either federal, state, or municipal), academic institutions, CSOs, veterinarians, and volunteers. This structure is similar to those in other regions in the world, where a government authority figure exists and the other actors are, in general, rehabilitation centres, aquariums, academic institutions, and specialized veterinarians, among others (Wilkinson & Worthy, 1999); however, their spatial scale (monitoring coverage) and functioning (coordination among them) are different.

Most areas with well-established RMMS networks work at a regional level, while in Mexico, the scale is local. The local response for well-established networks is carried out by a single actor in the network (e.g. rehabilitation centre, academic institution) that has the

required capabilities and resources to perform the stranding response independently. This scenario does not occur in Mexico, since, according to the legal framework and their capacities, the actors involved are not capable of performing RMMS on their own, so they must work as a network at the local level.

Regarding network functioning, for example, in the UK (Brownlow, Davison & ten Doeschate, 2015), Canada (Department of Fisheries and Oceans, 2006), and the USA (Becker, Wilkinson & Lillestolen, 1994), the role of the government authority in the RMMS is restrained to the expedition of permits/certifications that allow other actors to carry out the RMMS under the corresponding legal framework, and the authority does not actively participate in the RMMS. In contrast, in Mexico, according to the analysis carried out in this work, the assignment of functions and activities is skewed towards government entities (SEMARNAT, 2014; SEMARNAT, 2015a; SEMARNAT, 2015b); such activities represent a strong demand for resources because they must be appended to other

**TABLE 1** Strength, weakness, opportunity, and threat matrix for both localities (Bahía Todos Santos and Bahía de La Paz)

	Bahía Todos Santos	Bahía de La Paz
Strengths	<ul style="list-style-type: none"> <li>Actors are open to collaboration.</li> <li>Most actors have a good relationship with the main responsible entity for responding to marine mammal stranding (PROFEPA).</li> <li>Presence of scholars specialized in marine mammals.</li> <li>Presence of a veterinarian with experience in marine mammals.</li> <li>Existing Protocol and State Stranding Network.</li> <li>Creativity is used to compensate for the lack of resources or inputs.</li> </ul>	<ul style="list-style-type: none"> <li>Good organization and cordiality among actors.</li> <li>Most actors have a good relationship with the main responsible entity for responding to marine mammal stranding (PROFEPA).</li> <li>Presence of scholars specialized in marine mammals.</li> <li>Presence of a veterinarian with experience in marine mammals.</li> <li>Existing Protocol and State Stranding Network.</li> <li>Existing facilities that have been used for rehabilitation of marine organisms.</li> <li>Existing volunteers willing to collaborate in response to marine mammal stranding.</li> </ul>
Opportunities	<ul style="list-style-type: none"> <li>Some actors (e.g. ICMME, A.C.) manage financial resources.</li> <li>Vigilance committees for different topics that could give support to the response to marine mammal stranding tasks.</li> <li>The Faculty of Marine Sciences offered a space to be conditioned as infrastructure for rehabilitation.</li> <li>Technology offers the opportunity for citizens to increase the number and quality of stranding reports.</li> </ul>	<ul style="list-style-type: none"> <li>Creation of an association (MMARES, A.C.) for managing financial resources.</li> <li>Social networks are useful to disseminate knowledge about stranding events and the responses to them.</li> <li>The facilities offered by the UABCS are being conditioned to become a rehabilitation centre.</li> </ul>
Weaknesses	<ul style="list-style-type: none"> <li>Lack of formal training for responding to marine mammal stranding.</li> <li>Gathering data systematically is lacking.</li> <li>A low number of veterinarians with experience in marine mammals.</li> <li>Lack of infrastructure for marine mammal rehabilitation.</li> <li>Limited funding and lack of equipment.</li> <li>No meetings are held for all actors to become acquainted.</li> <li>Lack of knowledge dissemination about what to do in case of stranding events.</li> </ul>	<ul style="list-style-type: none"> <li>Lack of formal training for responding to marine mammal stranding.</li> <li>Gathering data systematically is lacking.</li> <li>A low number of veterinarians with experience in marine mammals.</li> <li>Lack of infrastructure for marine mammal rehabilitation.</li> <li>Limited funding and lack of equipment.</li> <li>No time or availability from actors.</li> </ul>
Threats	<ul style="list-style-type: none"> <li>Few actors managing the financial resources.</li> <li>Lack of funding for conditioning and maintenance of rehabilitation facilities.</li> <li>Lack of systematization of gathering data hampers keeping a good record of the time series of stranding events and causes loss of valuable long-term information.</li> <li>Veterinary schools lack specialized training in marine mammal science.</li> <li>Some actors ignore the Protocol and the State Stranding Network.</li> </ul>	<ul style="list-style-type: none"> <li>Few actors managing the financial resources.</li> <li>Lack of funding for conditioning and maintenance of rehabilitation facilities.</li> <li>Lack of systematization of gathering data hampers keeping a good record of the time series of stranding events and causes loss of valuable long-term information.</li> <li>Veterinary schools lack specialized training in marine mammal science.</li> <li>Some actors ignore the Protocol and the State Stranding Network.</li> </ul>

(Continues)

**TABLE 1** (Continued)

Bahía Todos Santos	Bahía de La Paz
<ul style="list-style-type: none"> <li>The creation of local networks linking actors more directly with functions or activities is needed.</li> </ul>	<ul style="list-style-type: none"> <li>The creation of local networks linking actors more directly with functions or activities is needed.</li> <li>Bureaucracy for obtaining logistic support (e.g. equipment).</li> <li>Regulations are posed ignoring the existing issues.</li> </ul>

responsibilities, which leads to poor/partial participation in RMMS activities. By contrast, for non-government actors, such as academic institutions, CSOs, veterinarians, and volunteers, the assigned functions are highly specific, being mainly focused on the care of live organisms and clinical assessment. However, according to the interviews, those actors currently perform additional activities, including operational (e.g. actions with living and dead organisms and recording data, among others) and information dissemination, although their participation is not mandatory (Figures 3 and S1, Table S2). This discrepancy in the RMMS network functions between countries reflects on many occasions the different capabilities, interests, and resources available to each actor. This can be seen as a threat because it may lead to difficulties in decision-making and taking the actions required to achieve the RMMS; however, these difficulties could be avoided by an appropriate selection of actors to create a coherent balance between their capabilities and resources availability with the assigned functions and activities, allowing them to perform a timely and efficient RMMS.

Communication among actors within the network is also important because it facilitates the coordination of activities and functioning. The social network analysis allowed us to identify that PROFEPA was the most connected actor, followed by academic institutions and CSOs – both marine mammal specialists (Figure 3). With regard to PROFEPA, its centrality makes sense because it is the authority responsible for RMMS, and other actors are aware of this authority's role; while the other two actors' importance could be explained by the fact that they are specialists in marine mammals, and consequently, they have a higher involvement in RMMS. This involvement is related to seeking to answer research questions and promote marine mammal conservation. This finding supports the earlier discussion that these non-governmental actors are more involved in RMMS activities. Additionally, these actors can contribute to information dissemination, facilitate communication within the network, and influence decision-making (Zepeda-Domínguez et al., 2015).

With the SWOT analysis (Table 1), we were able to identify some problems that the actors must cope with and that hinder the efficiency of the RMMS in Mexico. However, it is important to note that, examining its strengths and opportunities, the current functioning of the RMMS could be improved. All the interviewed actors expressed that the main issue is a lack of economic resources and that each actor uses its own resources to conduct its activities. This scenario represents a threat because the currently available resources might be insufficient to carry out the RMMS in the long term. This

issue is not unique to Mexico; for example, in the USA, while the Texas Marine Mammal Stranding Network (TMMSN, 2020) performs its own economic resource management, there are a large number of RMMS networks with financial support from the government. However, in Mexico some actors, mainly CSOs, make dedicated efforts to obtain the necessary economic resources to carry out the RMMS exclusively, although it is recommended that more actors join this action. Another issue identified was the lack of infrastructure for the rehabilitation of live organisms, although in some cases, coordinated participation among actors has allowed a resolution to these scenarios. For example, in some universities there are facilities that have served to rehabilitate small organisms, and, for BLP, work on facilities at the Universidad Autónoma de Baja California Sur to allow it to function as a rehabilitation centre are underway.

Likewise, other issues that were identified as possible threats (Table 1) for which solutions must be found in the medium term were: (i) a lack of training for members/actors of the network on the RMMS; (ii) a lack of veterinarians specialized in the care of wildlife animals; (iii) a lack of a systematic record from the RMMS events, as well as database compilation; and (iv) a lack of understanding of the legal framework by members of the network, which would imply that those actors do not understand their assigned functions or which functions can they perform during the RMMS.

Despite these issues, the strengths and opportunities (Table 1) identified reflect the hard work the RMMS groups have done in Mexico. The existence of the Protocol and the State Stranding Network sets a framework for a better organization and thus improves the RMMS. In addition, the fact that the RMMS is currently carried out, despite the lack of resources, reflects the great interest among the members of the various networks in improving the response time of the RMMS to live organisms to provide for their welfare and gather the information necessary to assess long-term stranding trends and causes, which can serve as a tool for decision makers when generating plans for the conservation of these species and prevent unnecessary public health risk (Geraci & Lounsbury, 1993; Pyenson, 2010; Peltier et al., 2013).

Considering that Mexico has a long coastline and that the current functioning of the RMMS is at a local scale, we recommend the implementation of local networks along the coastline. This approach can be very successful for gathering a more complete record of marine mammal strandings. Taking into account that each locality has a particular combination of actors, diversity of marine mammal species, and specific socio-economic conditions, this study proposes that the



establishment of RMMS local networks should consider (i) identifying potential actors to participate in RMMS; (ii) assigning specific functions to each actor, coherent with their defined capabilities, resources, and interests; (iii) knowing the biotic (e.g. species diversity) and abiotic (e.g. beach morphology, oceanographic features) characteristics of each locality; and (iv) carrying out evaluations to assess the success of the coordinated RMMS, using indicators to measure the performance of each activity.

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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## APPENDIX A

## LIST OF ACTORS AND THEIR ACRONYMS FROM BAHÍA TODOS SANTOS. LETTERS ARE RELATED TO FIGURE 3

Actor type	Actor	Acronym
Governmental agencies	<b>Federal government</b>	
	(a) Mexican Federal Attorney for Environmental Protection (Procuraduría Federal de Protección al Ambiente) <sup>a</sup>	PROFEPA
	(b) Secretariat of the Navy (Secretaría de Marina) <sup>a</sup>	SEMAR
	(c) National Water Commission (Comisión Nacional del Agua)	CONAGUA
	(d) Secretariat of Environment and Natural Resources (Secretaría del Medio y Recursos Naturales)	SEMARNAT
	(e) National Institute for Ecology and Climate Change (Instituto Nacional de Ecología y Cambio Climático)	INECC
	(f) National Commission of Natural Protected Areas (Comisión Nacional de Areas Protegidas)	CONANP
	(g) Secretariat of Health (Secretaría de Salud)	---
	(h) General Direction of the Federal Maritime and Terrestrial Zone (Zona Federal Marítima y Terrestre) <sup>a</sup>	ZOFEMAT
	<b>State government</b>	
	(i) Secretariat of Fisheries (Secretaría de Pesca)	SEPESCA
	<b>Municipal government</b>	
	(j) Civil Protection (Protección Civil)	---
	(k) Direction of Urban Administration, Ecology and Environment (Dirección de Administración Urbana, Ecología y Medio Ambiente) <sup>a</sup>	---
	(l) Public Security	---
	(m) Control, Command and Computation Center <sup>a</sup>	C4
	(n) Fire Department	---
	(o) Ensenada City Hall	---
	Academic Sector	(p) Facultad de Ciencias Marinas, Universidad Autónoma de Baja California <sup>a</sup>
(q) Centro de Investigación Científica y de Estudios Superiores de Ensenada <sup>a</sup>		CICESE
(r) Facultad de Ciencias, Universidad Autónoma de Baja California		FC
Civil society organization	(s) Investigación y Conservación de Mamíferos Marinos de Ensenada, A.C. <sup>a</sup>	ICMME, A.C.
	(t) Haciendo lo necesario, A.C.	---
	(u) Pro Esteros, A.C.	---
	(v) Pronatura, A.C.	---
	(w) Contacto Salvaje, A.C.	---
Private sector	(x) Specialized veterinarian <sup>a</sup>	---
General public	(y) Volunteers	---

<sup>a</sup> Interviewed key actors.

## APPENDIX B

## LIST OF ACTORS AND THEIR ACRONYMS FROM BAHÍA DE LA PAZ. LETTERS ARE RELATED TO FIGURE 3

Actor type	Actor	Acronym
Governmental agencies	<b>Federal government</b>	
	(a) Mexican Federal Attorney for Environmental Protection (Procuraduría Federal de Protección al Ambiente) <sup>a</sup>	PROFEPA
	(b) Secretariat of the Navy (Secretaría de Marina) <sup>a</sup>	SEMAR
	(c) National Water Commission (Comisión Nacional del Agua)	CONAGUA
	(d) Secretariat of Environment and Natural Resources (Secretaría del Medio y Recursos Naturales)	SEMARNAT
	(e) National Institute for Ecology and Climate Change (Instituto Nacional de Ecología y Cambio Climático)	INECC
	(f) National Commission of Natural Protected Areas (Comisión Nacional de Areas Protegidas)	CONANP
	(g) Secretariat of Health (Secretaría de Salud)	---
	(h) General Direction of the Federal Maritime and Terrestrial Zone (Zona Federal Marítima y Terrestre)	ZOFEMAT
	(i) Port Captaincy, Ministry of Communications and Transportation (Capitanía de Puerto, Secretaría de Comunicaciones y Transportes)	---
	<b>State government</b>	
	(j) Secretariat of Fisheries (Secretaría de Pesca)	SEPESCA
	<b>Municipal government</b>	
	(k) Civil Protection (Protección Civil) <sup>a</sup>	---
	(l) Direction of Urban Administration, Ecology and Environment (Dirección de Administración Urbana, Ecología y Medio)	---
	(m) Public Security	---
	(n) Control, Command and Computation Center	C4
	(o) La Paz City Hall	---
	Academic Sector	(p) Centro Interdisciplinario de Ciencias Marinas, Instituto Politécnico Nacional de México <sup>a</sup>
(q) Universidad Autónoma de Baja California Sur <sup>a</sup>		UABCS
(r) Centro de Investigaciones Biológicas del Noroeste, S.C.		CIBNOR
(s) Centro de Estudios Tecnológicos del Mar		CETMAR
Civil society organization	(t) Museo de la Ballena y Ciencias Marinas, A.C. <sup>a</sup>	---
	(u) Megafauna Marina: Atención, Rescate, Ecología y Sociedad, A.C. <sup>a</sup>	MMARES, A.C.
	(v) Sociedad Mexicana de Mastozoología Marina, A.C.	SOMEMMA, A.C.
Private sector	(w) Specialized veterinarian	---
	(x) Tourism service providers	---
General public	(y) Volunteers	---

<sup>a</sup> Interviewed key actors.