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Untangling Humpback Whale-Watching Management Networks: Collaboration and Conflict in the Northeast Pacific

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Abstract: Humpback whales face emerging anthropogenic challenges such as entanglement in abandoned fishing gear and stranding during their winter migration. Such challenges require collective action solutions involving diverse stakeholders across jurisdictions, social sectors, and geographies. Collaborative governance systems involve conflictual and collaborative interactions. We used a quantitative approach (social network analysis) to map the structure of three social networks: Collaboration in disentanglement, collaboration in stranding, and conflict. We administered a face-to-face survey to 38 stakeholders from four social sectors across seven coastal localities from April to November 2021. We also obtained perspectives from the same stakeholders about pressing conflicts, rule compliance, and law enforcement regarding whale-watching management in the region using a semi-structured questionnaire. We found hints of different dimensions of collaboration occurring simultaneously: Coordination, cooperation, and conflict. Networks played distinct roles in promoting collaboration across sectors, and while the disentanglement network coordinated civil society and the public sector, the stranding network facilitated cooperation within the public sector. The most pressing social conflicts detected by stakeholders were pleasure boats, abandoned fishing gear, and poor rule compliance regarding the distance between boats and whales. Our results suggest that in the context of institutional weakness, collaborative social networks play a crucial role in the management and conservation of coastal and marine common-pool resources.

Keywords: collaboration; conflict; humpback whale; environmental collaborative governance; entanglement in fishing gear; convergent mixed method; strandings; whale watching tourism

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Citation: Langle-Flores, A.; López-Vázquez, Z.; Chávez Dagostino, R.M.; Aguilar-Rodríguez, A. Untangling Humpback Whale-Watching Management Networks: Collaboration and Conflict in the Northeast Pacific. *Water* **2023**, *15*, 3975. https://doi.org/10.3390/w15223975

Academic Editor: Yuqiang Tao

Received: 19 September 2023
Revised: 25 October 2023
Accepted: 26 October 2023
Published: 16 November 2023

1. Introduction

The Northeast Pacific is a global hotspot for humpback whale-watching tourism, generating millions of dollars in revenue and supporting hundreds of jobs [1,2]. However, these marine mammals face emerging challenges during their winter migration including entanglement in abandoned fishing gear, collisions and disturbance by boats, noise, impacts on habitats and prey, and pollution [3–6]. The main challenge for whale conservation is to adapt to accelerated ocean-dependent economic growth with minimal impacts, with collaboration between governments, civil society organizations, and scientists [7,8]. Thus, the conservation of whales relies on society's willingness to overcome marine conflicts, reduce anthropogenic impacts, and implement effective conservation strategies across silos and jurisdictions [9].

Effective management of humpback whales requires systemic approaches that involve diverse stakeholders working together to protect the whales in a human-dominated ocean [10–12]. In such collaborative arrangements, stakeholders agree on shared rules and practices for resource use, conflict resolution, information exchange, and the building of common knowledge [13]. Multiple social processes occur in such environmental governance networks: Cooperation, conflict, negotiation, and learning [14]. Collaboration has also been seen as a means for the construction of environmental governance and the implementation of policies and agreements to ensure compliance with environmental objectives [15]. Collaboration encompasses three dimensions: Coordination, cooperation, and conflict [11,16,17]. Coordination is the process based on agreements of aligning stakeholders and activities efficiently to achieve common goals [11,13]. Cooperation involves stakeholders compromising and reaching a consensus to address specific problems for mutual gain [17]. This last aspect of collaboration implies that one or more stakeholders concede on their positions and compromise to reach a point of consensus.

Conflict interactions in open access to common pool marine resources have been widely analyzed from a collaborative governance perspective [18–21]. This theoretical framework brings knowledge and concepts from different perspectives such as conflict reduction, environmental management, and collective action. Also, it emphasizes the importance of multiscale collaboration among diverse stakeholders in addressing complex social-ecological problems such as inclusive decision-making processes, recognition of multiple sources of knowledge, facilitation of collective social learning, and institutional arrangement [22].

On one side, conflict reduction in open access to common pool marine resources has focused on the analysis of strategies and mechanisms for effective communication, enhancing connectivity and governance in multilevel social-ecological systems and facilitating social capital [21], which can foster the emergence of networks and relationships that enable effective communication, collaboration, and conflict resolution among stakeholders [21]. On the other side, evidence from environmental management studies suggests that the implementation of strategies at the local level can reduce conflicts in the context of common pool marine resources. Ref. [23] found that empowering local communities to participate in decision-making processes and take responsibility for the sustainable management of marine resources can improve management.

Furthermore, involving local stakeholders, conflicts can be minimized, as they have a better understanding of the local context and can develop rules and regulations that are tailored to their specific needs and circumstances [23]. Also, ref. [21] highlights the importance of local-level management in addressing the common problem in Turkish coastal fisheries. In the same way, ref. [9] explores marine and coastal cross-sectoral governance conflicts and how important the inclusion of a diversity of stakeholders is in institutional management regimes. The environment management approach is in line with the collective-choice rules of institutions and governance in the context of collective action, and the need for collaboration to determine norms and rules to regulate natural resources [24].

Finally, collaboration in the context of common pool marine resources has emphasized the importance of collective action in addressing environmental conflicts. For instance, ref. [11] considers that collaborative governance not only involves the participation of multiple stakeholders in the decision-making processes but also involves collaborative mechanisms that promote inclusivity, transparency, and trust-building for conflict resolution. Following these ideas, ref. [18] pointed out the role of bridging organizations and enabling legislation in conflict reduction in social-ecological systems. On one hand, bridging organizations act as intermediaries between different stakeholders and facilitate collaboration and conflict resolution. On the other hand, enabling legislation and governmental policies provide a supportive framework for self-organization and adaptive co-management efforts [18]. By creating platforms for dialogue and cooperation, conflicts can be addressed more effectively, and collective action can be fostered.

However, conflict related to collaboration in open access to common pool marine resources has received little attention in the literature on collaborative governance framework. Nevertheless, those works have rarely explored cooperation and conflict simultaneously [17]. To contribute to the collaborative governance framework, we will analyze the untangling humpback whale governance networks assuming that stakeholders are immersed in collaborative, cooperative, and conflict relationships that work simultaneously.

Social Network Analysis (SNA) is a quantitative approach because it utilizes methods that focus on the collection and analysis of numerical data to obtain quantitative and measurable results [25,26]. SNA examines the patterns of interactions between stakeholders within a social network [26]. This approach offers insights into the structure, functioning, and effectiveness of collaborative governance efforts [11,18,27].

In this study, we used an SNA approach to compare the diversity of social networks with different functions that have emerged to address humpback whale emergencies in the context of a growing ecotourism market and institutional weakness in the Northeast Pacific of Mexico. We also used a qualitative approach to assess stakeholders' opinions about the most pressing conflicts, rule compliance, and law enforcement in the 2020–2021 whale-watching season.

2. Materials and Methods

Study area. Banderas Bay, a coastal region in Mexico, is a geographic area where three coastal municipalities in two states (Jalisco and Nayarit) converge to form a single metropolitan area, Puerto Vallarta-Bahía de Banderas (Figure 1) [1452 km^2] [28]. This metropolitan area is also home to the tourist destinations of Puerto Vallarta and Riviera Nayarit, which received over 2 million international visitors in 2022 [29]. Whale-watching is a major nature-based tourism activity in the bay, conducted during the winter migration of the humpback whales from December to March [30,31]. In addition, there are environmental management initiatives in Bahía de Banderas with stakeholders trained to rescue humpback whales in emergencies, such as the Whale Disentanglement Network [32–34] and the Stranding Attention Network, which operate under a federal government protocol [35].

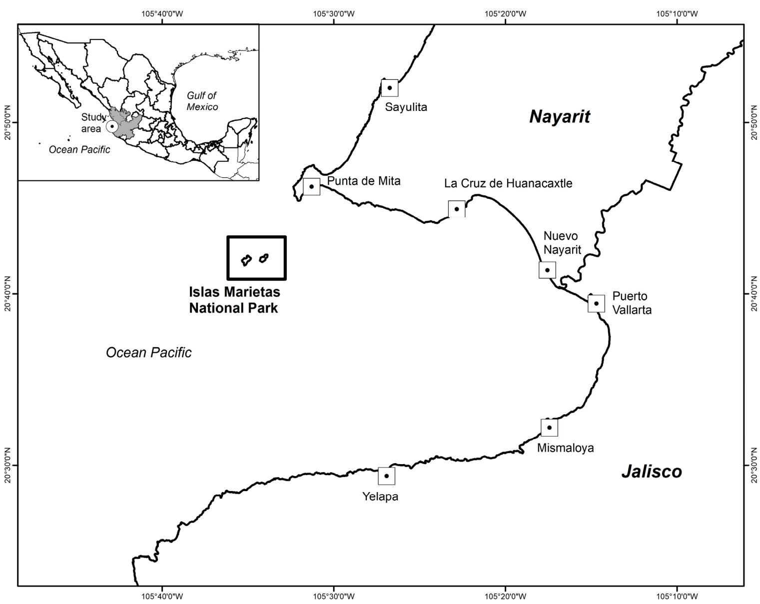


Figure 1. Bahía de Banderas is located in the Northeast Pacific in Mexico. The population of this metropolitan area is growing rapidly, with Bahía de Banderas municipality (Nayarit) having one of the fastest growth rates (51.1%) in Mexico [28] (source: Own elaboration).

Social relationships between stakeholders are more complex due to the ecotourism industry expansion in the region. The number of permits issued to boats for whale-watching has increased in recent years, increasing by 30.6% from 2014 to 2020, reaching a total of 239 permits in 2020 [36]. This surge can be attributed primarily to the diversification of economic activities of tourist service providers, who engage in sport fishing. This is a year-round activity that can be combined with the whale season of approximately 14 weeks (December–March), which coincides with the high season for foreign visitors to the bay and represents an economic opportunity, so sport fishing operators also apply for a whale-watching permit. In this regard, the Federal Environment Ministry regulates aspects of whale-watching: Distance and time of observation, number and types of vessels, restriction zones, and speed of vessels [37].

In this research, we used a convergent mixed method model (Figure 2), which is a concurrent, multimethod research approach that integrates qualitative and quantitative data with an equal emphasis on corroborating and expanding findings. This design is particularly useful for exploring complex phenomena by comparing and contrasting data from diverse sources and perspectives [38].

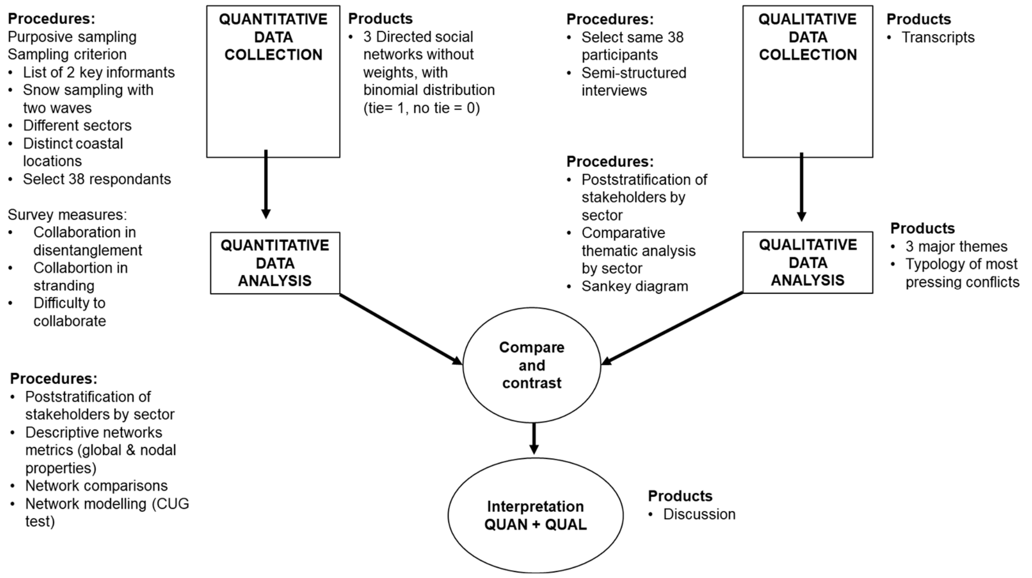


Figure 2. A convergent model mixed method model was used in this study. Adapted from [38].

2.1. *Quantitative Component*

2.1.1. Quantitative Data Collection

We conducted a purposive sampling base on four criteria, and this technique allows researchers to intentionally choose stakeholders who can provide valuable insights and information [39]. The sampling criterion was (i) appearing on the list provided by two key informants about stakeholders involved in humpback whale emergency rescue activities in Bahía de Banderas, Mexico; (ii) appearing on a non-probabilistic two-wave snowball sampling [40,41]; (iii) belonging to different social sectors; and (iv) belonging to distinct coastal communities. We reached 43 stakeholders (N = 43) from April to November 2021 and 38 of them accepted to respond to the face-to-face survey. Concerning the ethics process, we read aloud the free, prior, and informed consent forms to each research participant before the survey; this form described their role in the research, and they signed it once they agreed to participate [42].

Survey. We used a name generator [41] to map three different social networks between the same set of 38 stakeholders [43]: (i) Collaboration in disentanglement, (ii) collaboration in stranding, and (iii) difficulty in collaboration. We collected binary information about the presence (1) or absence (0) of each type of tie among the 38 respondents. We used one specific question for each type of social tie: *With whom did you collaborate on whale disentanglement in the last season (December 2020 to March 2021) in Bahía de Banderas? With whom did you collaborate on whale stranding in the last season (December 2020 to March 2021) in Bahía de Banderas? Who of these stakeholders you mentioned was difficult to collaborate with?* There was no limit to the number of names each respondent could provide.

2.1.2. Quantitative Data Analysis

We performed post-stratification of the 38 stakeholders surveyed into four sectors: Private tour operators, non-governmental organizations (NGOs), government agencies, and universities. This classification was based on the stakeholders' affiliations at the time of the survey. To preserve the anonymity of the participants, the nodes are labeled with a combination of the sector and the company/organization to which they belong. The number following differentiates between different stakeholders from the same sector and institution [44]. We built three sets of 38 × 38 adjacency matrixes to represent the three distinct types of social networks (collaboration in disentanglement, collaboration in stranding, and conflict). We used difficulty in collaboration as a proxy for conflict. Each cell in the matrix represents a tie between two stakeholders, where a value of 1 indicates that the two stakeholders extended a tie and a value of 0 indicates that they did not extend a tie. Then we analyzed and compared the global and nodal properties of the three directed social networks using R package statnet [45] and VOSviewer for network visualization [46]. The global properties of the networks refer to the network structure as a whole, such as the number of nodes and ties; in contrast, the nodal properties refer to the relational attributes of the individual nodes, such as the degree of centrality [26] (See Table S1 in Supplementary Material for network terminology).

Global properties.

The density of a directed network is the ratio of the number of present ties in a network to the number of possible ties. Density is equal to $E/N * (N - 1)$, where E is the number of ties in the network and N is the number of nodes in the network [26]. Therefore, the density ranges from 0 to 1. Networks with higher density (those with values closer to 1) are associated with higher levels of trust and social support. Krackhardt's connectedness is a measure of how many pairs of nodes in a network can reach each other. This measure of connectivity is defined as $1 - (V/(N \times (N - 1)/2))$, where V is the number of pairs of nodes that are not mutually attainable; this means there is no direct path from one node to the other, divided by the maximum number of possible pair combinations [47]. Reciprocity is the proportion of pairs of nodes (dyads) in a network that are mutual ($i \rightarrow j$, $j \rightarrow i$), which means that i extends a tie to j and j extends a tie to i. This indicator of trust and cooperation is defined as $2 \times M/(2 \times M + A)$, where M is the number of mutual dyads in the network and A is the number of asymmetric dyads [26]. Transitivity is the proportion of triads in a network that are transitive ($i \rightarrow j \rightarrow k > i$), and this means that i is connected to j, j is connected to k, and k to i. Transitivity is calculated by dividing the number of transitive triads (T) by the number of potentially transitive triads (P) [45]. The degree of network centralization is a measure of the extent to which a node or a small group of nodes dominate the whole structure. First, the degree centrality of each node in the network is calculated. Then the observed degree centrality of the most central node is divided by the maximum possible degree centrality [48]. An extremely centralized network looks like a star with one central node that is tied to all other nodes.

Nodal properties.

The degree centrality of node i is calculated as the number of times that node i extends to other nodes in the network [49]. Finally, we used a Conditional Uniform Graph (CUG) test to compare the observed properties of social networks to the properties of simulated networks [50].

2.2. Qualitative Component

2.2.1. Qualitative Data Collection

First, we built a typology of the most pressing conflicts in humpback whale management based on two key informants and a literature review [4,8]. After a set of pilot interviews, these options were adjusted. Second, we applied a semi-structured questionnaire to the same 38 stakeholders to understand the most pressing conflicts that need to be resolved, rule compliance, and law enforcement in humpback whale management. The questionnaire consisted of three items: *(1) From the following conflicts, select three that you* *consider urgent to address. From 1 to 3, where 1 is the most urgent and 3 is the least urgent: (i) lack of social participation, (ii) collisions between boats and whales, (iii) pleasure boats doing tours without permits, (iv) nautical traffic, (v) distance between the boats and the whales, (vi) navigation in restricted areas, (vii) speeding boats, (viii) Lack of agreements across Jalisco and Nayarit authorities, (ix) jet skis and (x) abandoned fishing gear. (2) From your point of view to what extent did whale-watching operators comply with the rules in the season 2020–2021? Who did impose sanctions when whale-watching operators violated the rules*?

2.2.2. Qualitative Data Analysis

First, we post-stratified stakeholders by sector, and second, we conducted a thematic analysis to compare and synthesize stakeholder semi-structured responses, searching for patterns of meaning, known as themes, within the textual data [51].

2.3. Data Integration

Finally, we compared and contrasted the qualitative and quantitative findings, looking for convergence or divergence between the two sets of data [38].

3. Results

The majority of the respondents were tour operators (18), followed by government officials (13), NGO members (5), and researchers (2). The respondents belonged to 21 organizations, and 55% of them held managerial positions. Furthermore, 47% of them had two jobs, some of them combined tourism with NGO activities, tourism with property management, government with consultancy, tourism with commercial fishing, tourism with sport fishing, and government with advocacy. On average, they had 15.5 years (SD 8.7) of experience in whale-watching management. Of these, 52.63% receive income from their regular jobs, while 47.36% receive income from activities linked to humpback whales, such as tourism and research. In the case of tourism operators, one-third of their annual income came from humpback whale-watching. The most common place of residence for respondents' stakeholders was Puerto Vallarta (16) followed by La Cruz de Huanacaxtle (7), Punta Mita (4), Sayulita (3), Nuevo Nayarit (2), Mismaloya (1), Yelapa (1), and Tepic (2) (Figure 1). In the survey, 76.3% of the respondents mentioned that they were the owners of their vessels. The mean number of vessels per organization was 5.5 (SD 13.6). The majority of these vessels were skiffs (87%), followed by catamarans (5.2%), sailboats (3.1%), saltmarsh skiffs (2.1%), and yachts (1%). Lastly, 45% of respondents also mentioned that their vessels had federal permits for whale watching.

3.1. Global Properties of Collaboration in Disentanglement, Collaboration in Stranding, and Conflict Networks of Humpback Whales

We observed differences in the global properties of the three networks. The disentanglement (0.059) and stranding (0.055) networks showed similar levels of density, while the conflict network was less dense (0.010). As regards the degree of centralization, the disentanglement network (0.522) was slightly more centralized than the stranding network (0.194), and the conflict network was the least centralized (0.045) (Table 1). Regarding transitivity, the stranding network showed the highest value (0.299), followed by the disentanglement network (0.222). In contrast, the conflict network showed a complete absence of transitivity (0).

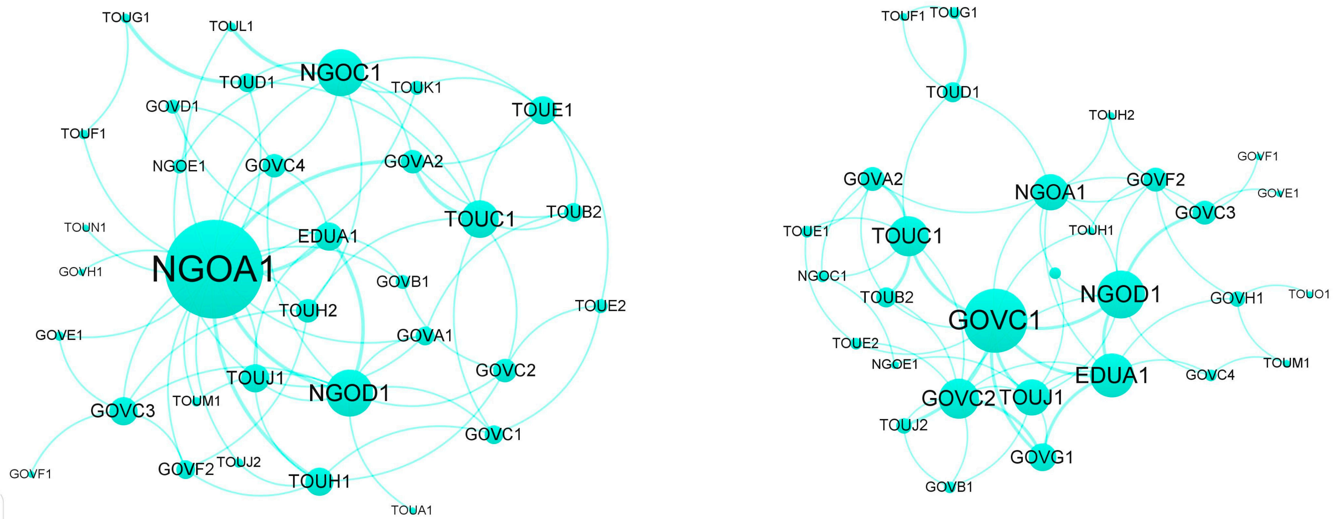
The univariate conditional uniform graph test (CUG test) revealed that the frequency distribution of hypothetical networks consistently fell below the observed transitivity values. In brief, the analyzed collaboration networks consistently exhibit higher transitivity values than those expected by random chance (Figure S1). With regards to reciprocity, the three networks exhibited remarkably elevated values, with the conflict network recording the highest value (0.980), followed by the stranding network (0.927) and the disentanglement network (0.905). The CUG test revealed that the observed collaboration networks had more reciprocity than expected by chance. This was especially true for the collaborative stranding network. We could not assess the conflict network because we did not have enough data (Figure S2).

Table 1. Global properties of collaboration in stranding, collaboration in disentanglement, and conflict networks of humpback whales in Bahía de Banderas, Mexico.

	Disentanglement	Stranding	Conflict
Number of nodes	38	38	38
Number of ties	83	14	14
Density	0.059	0.055	0.010
Degree of centralization	0.522	0.194	0.045
Reciprocity	0.905	0.927	0.980
Transitivity	0.222	0.299	0.000
Connectance	0.518	0.327	0.014

3.2. Nodal Properties of Collaboration in Disentanglement, Collaboration in Stranding, and Conflict Networks of Humpback Whales

Regarding the degree of centrality, the stakeholder with the highest value in the disentanglement network was NGOA1, a member of a civil society organization. Other central stakeholders in this network were NGOC1 and NGOD1, both also from the non-governmental sector, although not to the same extent as NGOA1 (Figure 3 and Table 2).



(**a**) (**b**)

Figure 3. Visualization of collaboration on disentanglement network (**a**,**b**) collaboration on stranding network. The nodes represent the stakeholders and the lines of their collaboration ties. The size of the nodes represents the betweenness centrality of the stakeholders. The first three letters of the label indicate the sector to which they belong: Tour operators (TOU), government agencies (GOV), non-governmental organizations (NGOs), and universities (EDU).

In contrast, in the stranding network GOVC1, a federal government official showed the highest degree of centrality. However, other stakeholders from the federal government and the civil sector also had a high degree of centrality, including GOVC2, NGOA1, and NGOD1. EDUA1, a stakeholder from the academic sector, also had a certain level of centrality in this network. Nevertheless, the central positions in the conflict network were occupied by GOVA2, a government official, followed by EDUA1, and stakeholders belonging to a research institution (Figure 3, Table 2).

Table 2. Nodal properties of collaboration in stranding, collaboration in disentanglement, and conflict networks of humpback whales in Bahía de Banderas, Mexico. The table shows the top ten nodes with the highest degree centrality values. The remaining nodes are found in the Supplementary Material (Table S2).

Stakeholders	Degree Centrality		
	Disentanglement	**Stranding**	**Conflict**
NGOA1	21	9	2
EDUA1	6	8	3
TOUA1	1	0	0
TOUC1	8	7	2
TOUB2	4	4	2
NGOB1	0	0	0
TOUD1	4	4	0
TOUE1	6	3	1
TOUF1	2	2	0
TOUE2	3	3	0

3.3. Networks Visualizations

Although the majority of stakeholders denied having conflictual ties, SNA revealed that 44.73% of the stakeholders surveyed were in the conflict network. The conflict appears to be concentrated among stakeholders from all sectors, with negative relationships between stakeholders from different sectors, but not within the same social sector. However, government representatives do point to conflictual relationships with other government representatives (see Figure 4).

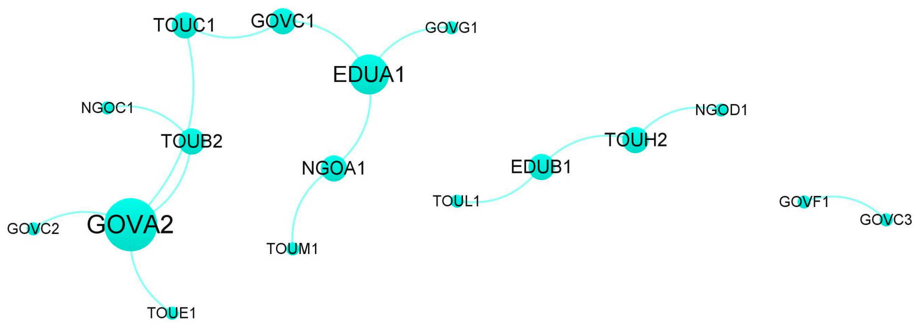


Figure 4. Visualization of conflict network. The nodes represent the stakeholders and the lines of their collaboration ties. The size of the nodes represents the betweenness centrality of the stakeholders. The first three letters of the label indicate the sector to which they belong: Tour operators (TOU), government agencies (GOV), non-governmental organizations (NGOs), and universities (EDU).

3.4. Perceived Most Pressing Conflicts in Humpback-Whales Management

The majority of stakeholders mentioned that the three most pressing conflicts in humpback whale management were private boats conducting whale-watching tours without permits and off-season, followed by abandoned fishing gear and poor compliance with the distance guidelines between humpback whales and boats. However, we observed subtle variations in this regard based on the affiliation of the stakeholders interviewed (Figure 5). We found that tour operators were most concerned with private boats (pleasure boats), jet skis, and abandoned fishing gear; in contrast, NGOs were more worried about private boats, nautical traffic, and navigation in restricted areas. In addition, government officials were most concerned with private boats, distance between boats and whales, and abandoned fishing gear; meanwhile, educators were most distressed with private boats, navigation in restricted areas, and abandoned fishing gear (Figure 5).

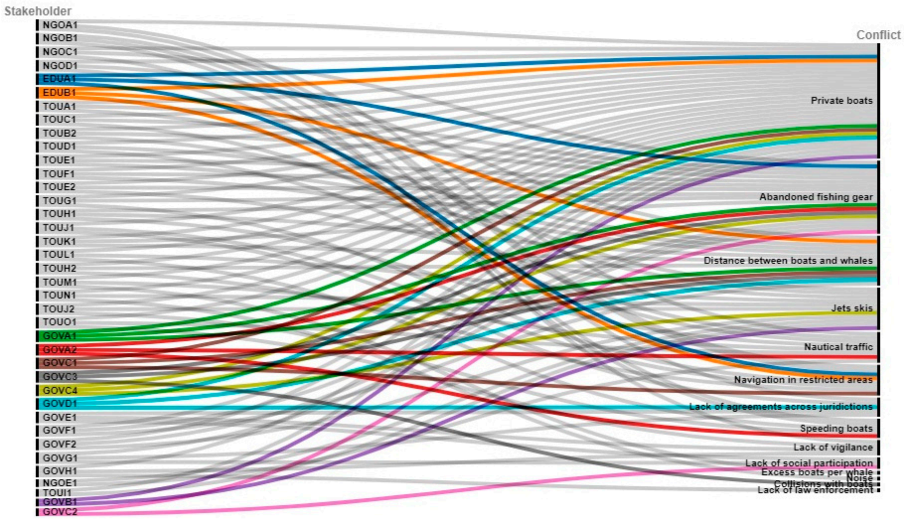


Figure 5. Sankey diagram between the type of stakeholders and the three most pressing conflicts that need to be resolved according to thirty-eight stakeholders involved in the humpback whale watching season of 2020–2021.

3.5. Compliance with Rules on Whale-Watching Season 2020–2021

We found opposing views regarding compliance with whale-watching rules. Tour operators, in general, considered that compliance was fair enough, while authorities had a more critical view. The main challenges associated with compliance with the rules were the distance between boats and whales and the presence of unauthorized boats (pleasure boats). Tour operators had mixed opinions on compliance with the regulations, highlighting the need for strong surveillance efforts by the authorities: *"Compliance was good, this year there were fewer boats, but without surveillance, there was harassment of the whales"*. *"The rules were followed as established in the regulations. No tickets were issued this year"*; *"I've seen some tour operators cutting corners and not following the regulations, which is unfair to the rest of us who are trying to do the right thing"*.

In contrast, NGO members emphasized emerging challenges to the humpback whales and the need for more training for tour operators to improve compliance. *"The compliance with the regulations is similar to other years, with an increase in whale watching by unauthorized fleets"*. *"Training is essential for tour operators to understand and comply with whale watching regulations. Without proper training, tour operators are more likely to make mistakes that could harm the whales or their environment"*. Nevertheless, government officials had a more critical view of rule compliance: *"We are working hard to improve compliance with the whale watching regulations, but it is a challenge. We need more resources and better coordination with other authorities"*. *"It has not improved, there are still cases of reports of bad practices. Surveillance is very necessary, if there is none, people approach the Marietas Islands National Park"*; *"I received complaints about non-compliance, boats were without flags (whale-watching permits) and got too close"*.

3.6. Law Enforcement in Whale-Watching Season 2020–2021

The majority of respondents (17) reported that the Federal Attorney's Office for Environmental Protection (FAOEP) imposed sanctions. The stakeholders also mentioned that the Ministry of Navy (5) and Marietas National Park officials (3) also performed law enforcement. NGOs were the most confident in FAOEP's ability to enforce regulations, *"We are confident that FAOEP is taking the necessary steps to enforce whale watching regulations and protect these important marine mammals"*; followed by tour operators: *"We are committed to complying with whale watching regulations and protecting these magnificent creatures. We believe that FAOEP is doing a decent job of enforcing the regulations, but there is always room for improvement"*. Meanwhile, researchers were less confident about this: *"We are concerned* *about the lack of enforcement of whale watching regulations. We believe that FAOEP needs to do more to protect whales from harassment and over-watching"*. And finally, government officials highlighted the need for stronger enforcement: *"We are working with FAOEP to develop a more coordinated enforcement strategy for whale watching regulations. We recognize that there is a need for stronger enforcement, and we are committed to doing everything we can to protect whales"*.

4. Discussion

We found diverse social networks with different structures and functions, which suggests that different collaboration processes occur simultaneously: Coordination, cooperation, and conflict in response to entangled and stranded humpback whales. The collaboration network in disentanglement showed features of coordination such as a high degree of centralization; in contrast, the stranding collaboration network showed features of cooperation such as high transitivity and reciprocity. Surprisingly, the conflict network also showed high reciprocity levels.

The observed social networks showed different structural properties and functions in promoting coordination (disentanglement network) and cooperation (stranding network) (Figure 3, Table 1). The CUG test showed that in both networks (disentanglement and stranding), the level of transitivity was higher than expected by chance (Figure S1 in Supplementary Material). In contrast, the observed value of reciprocity on the disentanglement network was at the higher limits of the models, but the reciprocity on the stranding network was higher than expected by chance (Figure S2 in Supplementary Material). Also, the disentanglement network showed higher levels of centralization than the stranding network (Table 1).

On one hand, our results suggest that the disentanglement network may be efficient in coordinating diverse stakeholders and resources to respond to emergencies; however, such highly centralized configurations can restrict information sharing and innovation [11,13]. This is in line with previous research on highly centralized environmental contingencies networks for invasive species management [52]. On the other hand, in the decentralized stranding network where ties are more evenly distributed, a wider range of stakeholders occupy central positions (government officials and NGOs) (Table S2 in Supplementary Material). Also, the high levels of reciprocity observed indicate that the stranding network promotes cooperation within the public sector [52,53].

Our results showed that collaboration and conflict between stakeholders occur simultaneously, which is in line with previous studies on environmental management in different contexts [17,54]. Regarding the conflict network (Figure 4), when the stakeholders were asked with whom it was difficult to collaborate, only 44.73% responded. We have two main hypotheses that can explain this result. First, the tendency of interviewees to avoid responding to socially undesirable behaviors and only admit to what is socially desirable (social desirability bias) is commonly found in observational studies [55,56]. Therefore, stakeholders may deliberately tend to hide or avoid answering a question that describes negative ties to their colleagues. Second, stakeholders tend to act strategically in a conflict environment and avoid revealing sensitive information about their adversaries. In this context, conflict can have a cost, especially in a small world where everyone knows each other and where both individual and collective benefits can be affected. This is true if we consider that the whale-watching tourism sector is characterized by a small, cohesive, and well-connected network where long-term relationships are important for the coordination and management of the sector. Furthermore, at the local level, there is strong competition among tour operators for access to a seasonal market that depends on their good reputation.

We found that different types of stakeholders occupied central roles in the different networks. An NGO occupied a central position in the disentanglement network; in contrast, in the stranding collaboration network, a government official occupied such a position (Figure 3a, Table 2). Our findings suggest that collaborative social networks led by NGOs have the trust of other stakeholders and can show higher adaptive capacity than government agencies in response to emergencies, which highlights the role that social networks play in achieving desired environmental outcomes [11,57]. The NGO's central position in the disentanglement network allows opportunities to facilitate collaboration and knowledge sharing among stakeholders, which in turn influences decision-making and shapes management practices for humpback whales [58].

In contrast, in the stranding collaboration network, a government official occupies a central position (Figure 3b, Table 2), which can facilitate the exchange of information, resources, and expertise between different stakeholders, enabling collective decision-making and action [59]. However, the effectiveness of networks led by government officials depends on several factors: The spatial-scale alignment between jurisdictions of government organizations and the distribution of environmental resources [60], the involvement of central government officials in local management, and the recognition of traditional management structures. In both networks (disentanglement and stranding), stakeholders with high centrality levels belong to higher economic tiers, which is in line with literature that highlights that stakeholders' attributes such as access to information and resources, can also shape their positions in social networks [61].

In the case of Mexico, weak governance might partly explain the need for brokers to fill gaps in the management of whale-watching and facilitate coordination [11,62]. On one hand, a highly hierarchical government with overlapping institutional arrangements lacks the resources to enforce regulations and coordinate local authorities to quickly respond to humpback whales' emergencies. On the other hand, civil society informal networks also face issues: Stakeholder heterogeneity, opposing views regarding rule compliance and law enforcement, competing stakeholders' interests, and lack of resources [9,17,19,63]. Network heterogeneity (number and diversity of organizations) is a predictor of conflicts in environmental policy forums [63,64].

Our results also showed that our mixed-method approach and our sampling criterion allowed us to capture key stakeholders involved in whale-watching management across different jurisdictions. Most of the respondents were in managerial positions, with extensive experience in whale-watching management, and from a wide spectrum of organizations (21). Such respondents mentioned a variety of pressing conflicts in whale-watching management including the disruption of cetacean behavior by pleasure boats, nautical traffic, and jet skis; the entanglement of whales on abandoned fishing gear; and the close approach of tourism boats to whales (Figure 5). Our findings are in line with evidence on the negative impacts of whale-watching on whales [4]. Whale behavior can be disrupted by human activities such as maritime traffic, fishing, and pleasure boating [65]. Concerning abandoned fishing gear, whales can become entangled in this gear, leading to injury or even death, which is a worldwide conservation concern for many species of marine mammals, including large whales [66]. A considerable proportion of the world's marine debris is attributed to fishing gear that is abandoned for a variety of reasons: Discarded, theft, illegal fishing, vandalism, and weather conditions. These accumulate and increase the risk of entanglement for whales, making them an unquantified threat [6].

The poor compliance found regarding the permitted distance between boats and whales (Figure 5) can also disrupt whale behavior and be a cause of cetacean stress [67]. This management issue is aligned with the existing literature, which illustrates a critical factor, in which tourists want to see whales closer and tour operators try to please them. Frequently, tourists are unaware of the rules [68], and although tour operators offer a talk about whales before the tour begins, they do not include topics about the regulation that limits the observation distance for the different vessels. That implies that the tour operators were not complying with the regulations.

Lastly, nautical traffic in whale-watching areas can also contribute to social conflicts. The increased number of boats and vessels can lead to congestion and competition for space, potentially causing disturbances to the whales [4]. The presence of jet skis can also be disruptive and noisy, causing stress to the whales and interfering with their communication [65]. To address the social conflicts detected in whale-watching management, we recommend the development of an association of whale-watching operators with a shared code of ethics, improving compliance with whale-watching rules through training and enforcement, and improving coordination between different government agencies and stakeholders.

The collaborative governance framework [11,17] helps to capture relationships of collaboration and conflicts simultaneously, but it is limited to capturing conflict. Our finding shows that SNA was more effective in capturing collaboration in disentanglement and collaboration in stranding, but less effective in capturing conflictual personal relationships—difficulty in collaboration among stakeholders (Figure 4, Table 1). Social desirability bias may have influenced the low response. In contrast, semi-structured questionnaires were more effective at capturing the main conflicts in the network-perceived most pressing conflicts in humpback-whales management. Finally, our results show that cooperation is not framed in the theory of collaborative environmental governance framework, which makes it difficult to differentiate cooperation from coordination networks [11].

The methodology of Social Network analysis relies on the use of a non-probability snowball sampling method (SMM) both as a data collection method and as an analytical tool for social network analysis (SNA). The former helps locate, access, and engage a target population that would otherwise be impossible to find in a random sample. SMM helps to reach hidden or hard-to-reach populations [69]. The latter is part of the SNA analytical tools that help to track network stakeholders using their references within the circle of their acquaintances and according to the relationships to be analyzed [41].

There are two common claims of SMM that we perceive as methodology limitations. First, SMM is not a representative sampling, so the results cannot be generalized to the population [41]. Here, we consider that the case of the humpback whale management network justifies the use of SMM since a random sample would make it impossible to locate the target population given the sample size and the peculiarity of our case. Second, SMM may have a risk of social desirability bias due to the reference system used to collect the data, especially about conflict analysis. The literature on the subject finds that there is a widespread problem of bias when collecting data on environmental conflicts, particularly in large samples [69]. In this context, we consider that our case is not alien to this problem, thus we used mixed methods to improve our analysis.

Future studies should explore different aspects of the management of whale-watching: (i) How competition ties between stakeholders can affect collaborative social networks [60]; (ii) understanding underlying factors that promote the formation of collaboration ties across stakeholders such as shared identity values [62,70,71]; (iii) methodological approaches that contribute to better framing of the elements of collaboration: Coordination, cooperation, and conflict to improve the design of the instrument [16]; (iv) the factors that contribute to compliance with whale-watching rules; and (v) the local impacts of whale-watching activities on humpback whales. Future studies should also include artisanal and industrial fishers, as well as other tourism sectors that might be in conflict with whale conservation.

5. Conclusions

This research contributes to creating knowledge that can be used to improve collaborative governance between stakeholders involved in the management of whale-watching and improve coastal management in general [11]. Our study extends our understanding of how informal collaborative networks can reduce the costs of whale management and conservation (resources, surveillance, law enforcement) and increase environmental law compliance (whale-watching guidelines) by fostering collaboration across sectors and jurisdictions in a context of institutional weakness [57,72]. Social networks can compensate for the limitations of the state in responding to environmental emergencies in coastal and ocean ecosystems. In line with theoretical evidence from social networks towards adaptive governance for ecosystem management, we find that the weaker the institutions, the greater the possibility that informal collaborative networks will emerge to fill institutional voids [18]. Uncertainty environments can create the conditions for the emergence of social networks since they allow for reducing the risk associated with the lack of enforcement and avoiding acts of opportunism [27]. The conservation of humpback whales and other marine resources relies largely on society's duty to reduce anthropogenic impacts on the oceans and to implement effective conservation strategies [7]. Policymakers and practitioners should support the creation of a diversity of collaborative social networks to address specific challenges facing coastal and marine resources. Collaborative social networks are a valuable tool in the management and conservation of common coastal and marine resources.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/w15223975/s1, Table S1: Definition of nodal and global measurement calculated for entanglement, stranding, and conflict networks, Table S2: Nodal degree centrality metrics for collaborative entanglement, collaborative stranding, and conflict networks. The highest values are indicated, Figure S1: Comparison of the distribution of transitivity values between simulated networks and the value observed in collaborative networks in disentanglement and in stranding., Figure S2: Comparison of the distribution of reciprocity values between simulated networks and the value observed in collaborative networks in disentanglements and strandings.

Author Contributions: Conceptualization, A.L.-F., Z.L.-V. and A.A.-R.; methodology, A.L.-F. and Z.L.-V.; software, A.L.-F.; validation, A.L.-F. and Z.L.-V.; formal analysis, A.L.-F. and Z.L.-V.; investigation, A.L.-F., Z.L.-V. and R.M.C.D.; resources, R.M.C.D. and A.A.-R.; data curation, Z.L.-V. and A.L.-F.; writing—original draft preparation, A.L.-F. and Z.L.-V.; writing—review and editing, A.L.-F., A.A.-R. and R.M.C.D.; visualization, A.L.-F.; supervision, R.M.C.D.; project administration, R.M.C.D.; funding acquisition, R.M.C.D. and A.A.-R. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by CONAHCYT postdoctoral grant I1200/320/2022.

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Research Ethics Committee of Centro Universitario de la Costa (protocol code: CUCPV/SAC/205/2022; date of approval: 19 September 2022).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data that support the findings of this study are available upon request from the corresponding author.

Acknowledgments: We thank the thirty-eight interviewees who kindly participated in this research. We thank Alfonso Miranda Caso Luengo and Juan José Von Thaden for their generous help and suggestions for improving this research. We also thank the reviewers for their comments that substantially improved this work.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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