

AN ABSTRACT OF THE DISSERTATION OF

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Title: Cooperation and Conflict Dynamics in Small-scale Fisheries

Abstract approved:

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Small-scale fisheries account for at least 40 percent of global fisheries catch, 90 percent of the people employed along capture fisheries value chains operate in small-scale fisheries, and 45 million women participate in small-scale fisheries globally. The past few years have brought warnings from policymakers and resource managers about risks to the peace and stability posed by fisheries conflicts. Collaborative environmental governance studies tell us that processes of cooperation and conflict work in tandem and one way to reconcile perspectives of cooperation and conflict involving natural resources is to focus on what small-scale fisheries actors are doing and why. A challenge with addressing how non-cooperative violent behaviors emerge in SSF is the lack of available data. This dissertation : 1) provides context and synthesizes literature from fisheries conflict research and fisheries cooperation research and provides recommendations for envisioning a unified framework that bridges the two subsequent chapters, 2) explores cooperation and conflict dynamics in the small-scale fisheries of Puerto Rico by presenting and applying a new framework that created the Fisheries Conflict and Cooperation in Puerto Rico Database (FCC-PR-D) via NexisUni media report content analysis in conjunction with social network analysis to understand where, when, and how trends emerge in the small-scale fisheries of the small-island U.S. territory of Puerto Rico, and 3) applies the framework in 2) alongside

semi-structured interview content analysis with women practitioners in the small-scale fisheries of Southwest Puerto Rico, to answer the question: what role have women played in fisheries cooperation and conflict in the Southwest region of Puerto Rico from 2010- early 2020?

From 2010-2019, a total of 35 fisheries conflicts and 133 fisheries cooperation events were identified. The primary drivers of all fisheries conflict events in Puerto Rico were maritime crime, an actual or perceived decline in fish populations, ecosystem change, cross national actors, poverty, marginalization, and strategic location of fisheries. The primary drivers of all fisheries cooperation events were an actual or perceived decline in fish populations and ecosystem change. Of all the cooperation events coded, nearly three quarters fell under meetings, third-party support, or negotiation requests. While half of the fisheries conflict events fell under fines, permit denials, or negotiations halted. social network analysis revealed a gap in direct cooperation networks between regional environmental managers and fishers, suggesting an opportunity for stronger co-management agreements; there is potential for these agreements to be incentivized by existing links between fishers and university actors and NGOs.

Furthermore, while reports suggest only 1% of active Puerto Rico fishers are women [1], ~18% of fisheries cooperation and conflict events involve at least one woman actor from 2010-2019. 20 fisheries conflict events and 17 fisheries cooperation events, extracted from semi-structured interviews with women (n=3) in Southwest Puerto Rico found that the three primary drivers of fisheries conflict described in the interviews were limitations on access to fishing grounds, weak governance (especially lack of public participation), and an actual or perceived decline in fish populations. The three primary drivers of all fisheries cooperation events were the supply or demand from markets, gender marginalization, and increased gear efficiency. Women are key actors and leaders in cooperation amongst other fisherwomen, fishermen, and local government figures in the region. The methods utilized in this research are cost effective and reproducible with moderate training and direct fisheries resource managers to priorities that need the greatest attention. The approach is readily complemented by qualitative approaches

such as semi-structured interviews to further deconstruct low-level conflicts not always reported by media outlets.

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Cooperation and Conflict Dynamics in Small-scale Fisheries

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Ciera Villegas

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I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

Ciera Villegas, Author

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CONTRIBUTION OF AUTHORS

In chapter 2, Ciera Villegas designed the overall research, synthesizing the results presented in chapter 3 and chapter 4 with other fisheries conflict and fisheries cooperation studies. CV led the writing with editorial assistance from Dr. Michael Harte, Dr. James R. Watson, and Dr. Anne Devan-Song.

In chapters 3, Ciera Villegas led the Conceptualization, Methodology, Validation, Formal Analysis, Investigation, Data curation, Writing- Original Draft Preparation, Writing - Reviewing and Editing, Visualization, and Project Administration. Nicolás Gómez-Andújar supported with Validation, Formal Analysis, Investigation, Writing- Original Draft Preparation, Writing - Reviewing and Editing, and Visualization. Dr. Michael Harte supported with Conceptualization, Supervision, Writing - Reviewing and Editing. Dr. Sarah M. Glaser supported Conceptualization, Methodology, and Writing - Reviewing and Editing. Dr. James R. Watson supported with Conceptualization and Supervision.

In chapter 4, Ciera Villegas designed the overall research, analytical methods, and the IRB with support from Dr. Michael Harte. Nicolás X. Gómez Andújar supported with edits for the translation of the semi-structured interview materials from English to Spanish. CV collected the data and conducted the analysis. CV led the writing with editorial assistance from Dr. Michael Harte, Dr. Anne Devan-Song, and Dr. Sarah M. Glaser.

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DEDICATION

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Mae Rosauero-Munoz

Chapter 1. General Introduction

1.1 Research motivation

This dissertation 1) provides context and a synthesis of fisheries conflict and fisheries cooperation literature and bridges the two with, 2) the creation and application of an adapted framework for analyzing fisheries cooperation and fisheries conflict events in the small-scale fisheries of Puerto Rico from 2010-2019 [2] and draws from a continuous scale in assessing transboundary fresh water conflict and cooperation [3], and finally 3) illustrates and applies the framework to a case study focused on women's roles in fisheries cooperation and conflict from 2010-early 2020 in Southwest Puerto Rico which draws from the coding method in (2) [4] and semi-structured interviews. Before diving into the three topics diffused in this dissertation, it is important that we state why small-scale fisheries are so important. Small-scale fisheries account for at least 40 percent of global fisheries catch, 90 percent of the people employed along capture fisheries value chains operate in small-scale fisheries, and 45 million women participate in small-scale fisheries globally [5].

In addition to the importance of small-scale fisheries we need to name why studying women's roles in fisheries conflict and fisheries cooperation is a necessity. The roles and responsibilities that women hold within the small-scale fisheries sector are largely underappreciated and often overlooked [6]. A 2020, study surfaced that women account for an annual catch of ~2.9 million tons of seafood a year and an estimated 2.1 million women participate in small-scale fisheries globally [7]. Since 2011, however, there has been no published research specifically focused on women's roles in the small-scale fisheries in Puerto Rico [8].

Finally, cooperation and conflict dynamics are important to study together within small-scale fisheries because collaborative environmental governance studies highlight that the

processes of conflict and cooperation often work in tandem. One way to address the complex dynamics involved in fisheries cooperation and fisheries conflict interactions is to focus attention on how actors are interacting and the reasons why (i.e. drivers) [9]. Collaborative environmental governance studies highlight that diverse sets of actors and stakeholders are often gathered in collaborative environmental governance. Therefore, environmental governance typically entails both conflict and cooperation, however the literature rarely studies these processes together [10].

The goal of this Ph.D. research is to provide a quantitative unified framework that brings light to women's roles in fisheries while serving as a bridge for future studies to analyze fisheries cooperation and fisheries conflict events in tandem in different regions and sites. With a unified framework that includes cooperation and conflict event analysis (including spatial and temporal variables, actor types, drivers, and event intensities), Nexis Uni media content analysis, and semi-structured interviews, the hope is that future researchers can utilize the framework presented to compare across case studies and that conflict resolutions emerge systematically.

1.2 Outline

Three research chapters comprise this dissertation (chapters 2-4). **Chapter 2** serves as a context providing chapter and synthesizes the literature on fisheries conflict, the literature on fisheries cooperation, and bridges fisheries cooperation and fisheries conflict using a framework developed in this dissertation in **chapter 3** and **chapter 4**.

Chapter 3 was published in the Journal of Marine Policy in October 2021, and answered the calls to understand where, when, and how fisheries conflict and fisheries cooperation trends emerge in the small-scale fisheries systems for the small-island U.S. territory of Puerto Rico. Exploration of the dynamics between the date, location, drivers, and actors involved in conflict and cooperation interactions related to fisheries resources was achieved by

creating a database via Nexis Uni media content analysis and a qualitative social network analysis approach.

Finally, **Chapter 4** explores the question: What role have women played in fisheries cooperation and conflict in the Southwest region of Puerto Rico from 2010- March 2020? Virtual semi-structured interviews were conducted in March 2020 with several women situated in a variety of roles in the small-scale fisheries sector in the Southwest region of Puerto Rico. The interview guide was adapted from the coding methodology from **chapter 3** [4]. Interviews were transcribed and qualitatively coded using NVivo. Women in Puerto Rico make up a small percentage of less than 1% of the commercial fishing sector [1], however the influence they have in shaping cooperation and conflict dynamics is evident. Despite their efforts often going unacknowledged within the literature, women are key actors and leaders in cooperation amongst other fisher women, fishermen, and local government figures in the region.

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Chapter 2. Traversing the crossroads between fisheries cooperation and fisheries conflict

Intended Journal: Frontiers in Marine Science

2.1 Abstract

This research provides initial context for the subsequent research chapters, synthesizes literature on fisheries conflict, literature on fisheries cooperation, and bridges the two using a framework developed in this dissertation. A framework is presented that utilizes a quantitative content analysis methodology to analyze fisheries cooperation and fisheries conflict dynamics simultaneously [1] with gender centric mixed methods practices to validate findings and elevate the voice of women in fisheries. Additionally, recommendations for increasing gender equity in conflict and cooperation analysis are provided.

2.2 Introduction

*“To survive the Borderlands
you must live sin fronteras
be a crossroads.”
~ Gloria E Anzaldúa*

In Puerto Rico, the spiny lobster (*Panulirus argus*) fishery is characterized by the deployment of traps as the primary gear use method. There is a long-standing territorial conflict between compliant trap fishers versus those that use traps with illegal characteristics (i.e the size of mesh and escape doors) and this conflict has expanded to include conflicts among trappers and the SCUBA diving sector; there are claims from trappers that SCUBA divers steal catch and vandalize traps [2]. Additionally, one interview from Chapter 4 mentioned the following incident,

“One fisherman just went and fished where he is not supposed to fish and the owner of the traps came and burned the boat so, “he will not fish anymore near my traps, (Interview R1, 2020).”

Additionally, conflicts between foreign fishermen and resident fishermen in the Buen Hombre coral reef fishery in the Dominican Republic have escalated to gun violence in some cases [3]. These vignettes are just a couple examples of the different types of contemporary fisheries conflicts that persist and negatively impact the safety and the potential for collaborative productivity within fishing communities. There have been many studies from the late 1990’s to

the early 2000's that provide a variety of typologies and frameworks to help us begin to understand the dynamics of fisheries conflict and the dynamics of fisheries cooperation as separate interactions amongst actors within the fisheries sector. However, only one published study has quantitatively bridged fisheries conflict and fisheries cooperation analysis according to temporal and spatial patterns, actor types, drivers of cooperation and conflict, using an intensity scale across a shared gradient, and incorporating disaggregated analysis according to gender [1]. The continued siloing of fisheries conflict and fisheries cooperation contributes to the risk that fisheries management efforts will fail to rise to challenges such as the effects of climate change on fisheries as an increased risk of exacerbating fisheries conflict [4].

2.3 Background

2.3.1 Assessing the literature for fisheries conflict typologies and frameworks

Fisheries conflicts have been documented for centuries. Recent fisheries conflict studies have incorporated theories of governance transformation in social-ecological systems (SES) while drawing from environmental justice and activism insights [5]. Earlier fisheries conflict research contributed to the typologies formation which guides our conceptualization of conflict patterns and aids in the creation of methodologies that can compare analyses from region to region. According to Bennett et al., “typologies aid in the codification of the real world. They enable the formation of hypotheses based on the unification of myriad facts under general categories,” [6]. Researchers in the past decade have critiqued inconsistencies in defining fisheries conflict typologies. For example, Spijkers et al. highlighted that current fishery conflict typologies often conflate conflicts over fish as a resource with general conflicts taking place within the fisheries space, leaving the concept “fishery conflict” poorly defined [7]. Seto provides a detailed synthesis of some of the foundational typologies that informed early fisheries conflict studies to illustrate the differences amongst these typologies [8].

Seto suggests there are two primary critiques of the three typographies listed in (**Table 2.1.**) The first critique is that each study describes conflict differently [9–11]. The second critique is that while each typology makes general recommendations about conflict resolution mechanisms, the actual potential for these mechanisms to address the drivers of conflicts is not clear. Seto goes on to draw attention to Pomeroy’s seminal work [12]. Pomeroy et al. used these three typologies above as a theoretical base, by applying an empirical method to test each for their impact on user conflicts over coastal fishery resources. The research team developed a comparative analysis framework composed of variables that are believed to impact multiple aspects of user conflicts relating to coastal fishery resources in Southeast Asia. The variables included:

1. Demographic characteristics
2. Social stratification
3. Security issues and civil tension
4. Resource condition and harvest activity
5. Community and resource conflict and resolution
6. Marine resource governance and tenurial arrangements, and
7. Community organization

Pomeroy et al.’s work described the complex and varied drivers of conflict related to fisheries such as food insecurity, crime, and existing levels of other conflict [12]. Further, the ‘fish wars cycle’ developed by Pomeroy et al. provides a foundation for understanding key drivers of fisheries conflict [13]. The 2016 study found that conflict over fisheries is perpetuated by three top-level components: competition over fisheries, existing levels of conflict, and fisheries scarcity. Each top-level component is defined by a host of qualitative measures that can be quantified. For example, competition over fisheries is affected by the presence of both commercial and small-scale fishing fleets. Existing conflict may include user group violence and crime against fishers. Fisheries scarcity may be affected by poor resource governance [13,14].

Devlin et al. reduced the number of variables presented by Pomeroy et al. and defined them in a way better suited for media coding while exploring fisheries conflict in six case study nations around the Horn of Africa and East Africa region; the study found that access to fishing grounds, illegal fishing, and the presence of foreign fishers were the three highest drivers of conflict in the region [15]. The study also explicitly defined fisheries conflict as, “an incident in which a fisheries resource is contested, disputed, or the source of conflict between a minimum of two actors, at a discrete temporal moment and in a discrete location. Actors could be individuals or groups,” [15]. While maintaining consistency with this definition, the third chapter in this dissertation created and applied an adapted content analysis methodology from the Devlin et al. study to define fisheries conflict and fisheries cooperation as, “...an incident in which a fisheries resource is contested, disputed, the source of conflict or the source of cooperation, agreement, and support between a minimum of two human actors, at a discrete temporal moment, and in a discrete location. More than one actor dyad can be coded per conflict or cooperation event...” [1]. Reflected below are some of the key considerations that emerged from the third chapter when assessing fisheries conflict dynamics in a case study in Puerto Rico as well as some lessons learned when assessing fisheries conflict in one of the six case studies in Devlin et. al, the Somali region.

2.3.2 Fisheries conflict and climate change

A recent study illuminated that climate change impacts drive an increase in the risk of fisheries conflict, one example being significant shifts to fish populations following fish habitat disruption such as coral reef ecosystems undergoing more frequent and longer lasting “coral bleaching” events in combination with stressors such as nutrient run-off [4]. These concerns are reflected in Puerto Rico where fishers strongly believe declining stocks are caused primarily by pollution, habitat destruction and climate change [16,17]. In addition to these concerns, in 2017, Hurricane María, a category 5 hurricane, caused extensive damage to docks, ramps, coastal fish

shops and among other coastal infrastructure and many fishers lost their boats, fishing traps, and other gear, and resulted in substantial damage to the island's shallow water coral reefs [1,18,19]. The mishandling of federal fisheries aid after Hurricane María resulted in lawsuits and protests since fisheries aid was delayed for over three years. Noteworthy events related to regional fisheries governance contributed to evidence of weak governance capacity including, but not limited to, back-to-back replacements or resignations of Department of Natural and Environmental Resources (DNER) Secretaries; one of which was linked to an investigation related to corruption by the FBI in 2019. These events fueled widespread resentment by fishing collectives against DNER for the slow disbursement of fisheries aid [1,19].

Recent evidence from a Long-Term Ecological Research (LTER) study investigating ecosystem responses to climate change in the last 40 years (1980-2020), found that the tropical rainforest in Luquillo, located in northeast Puerto Rico, experienced more frequent and intense hurricanes which altered ecosystem processes by producing pulses of nitrate and potassium [20]. An expected increase in hurricane activity in the region, due to human induced climate change, would critically damage coral reef habitat, already weakened by bleaching events, as well as many economically and culturally important species [16]. Referencing fisheries conflict dynamics and events between DNER and fishers in the past decade as an indicator, it is anticipated that with an increase in hurricane activity in the region, more frequent and more intense conflicts have an increased potential to erupt in the coming years.

2.3.3 Fisheries conflict and sustainability

In the 1970s and 1980s, overfishing and the desire for marine conservation opened the way to new resolution approaches as part of the sustainability narrative [21]. Fisheries conflict research within the field of social-ecological sustainability has reflected a growing concern for human well-being, collaborative and participative management approaches have been adopted at many governance levels in the attempt to reduce natural resource conflicts, such as fisheries

conflicts [6,9,21]. To adequately work towards achieving the Sustainable Development Goals (SDGs) in the face of such challenges as climate change, it is important to explicitly position this larger body of work in proximity to the goals it sets out to contribute to. The most related links to this area of research are, SDG number 5, to achieve gender equality and to empower all women and girls, SDG number 14, life below water, and SDG number 16, to promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable, and inclusive institutions at all levels [22].

2.3.4 Fisheries conflict cross-study comparison

As we enter unknown territory with the compounding risks presented by climate change and work to create sustainability efforts adaptable to these dynamics, it is increasingly evident that comparisons between studies will be useful in determining how, where, and why fisheries conflicts emerge and how to proactively mitigate conflicts before they increase in intensity. According to a recent global assessment of fisheries conflict patterns using forty years of data from the international fishery conflict database, the frequency of fisheries conflict has increased since 1974, although there was a period of slightly lower reported incidents of conflict between approximately 1998–2007 [23]. From 1974-2016, intra-continental conflict composed 64.8% of all conflict events and was more common than inter-continental conflict, which made up 35.2% of all conflict events. The USA was involved in the most conflict followed by Canada, Japan, China and the EU. These high-conflict countries have been predominantly in conflict with countries located within the same continent [23]. In reviewing the literature for contemporary fisheries conflict studies, we noticed that studies typically focus on the country-level unit of analysis [15,23]. This has led to a significant gap in existing data and leaves much room for exploration in terms of analyzing fisheries conflict dynamics which occur at the state and territory level. Additionally, there are few cross-study comparisons when it comes to analyzing fisheries conflicts facing small-scale domestic fishers in different regions [6]. The primary

investigator of this dissertation has experience worked alongside the Secure Fisheries team analyzing fisheries conflict dynamics in the Horn of Africa region, notably the Somali region [14], and led an adapted effort analyzing fisheries conflict and cooperation dynamics in Puerto Rico, [1].

Reflected here are some of the lessons learned in comparing the two case studies of fisheries conflict in the Somali region and the small-island U.S. territory of Puerto Rico. The primary drivers of fisheries conflict in Somali waters from 1990-2010 were the presence of foreign fishers, grounds limitations, illegal fishing, weak governance, and piracy [14]. Many, but not all the fisheries conflicts in the Somali region were representative of the conflict between Somali fishers and foreign vessels that fish in Somalia's EEZ. Conflicts were over quickly but were often in response to longer term systemic problems such as resource depletion and illegal fishing. Comparatively the primary drivers of fisheries conflicts in Puerto Rican waters from 2010-2019 were maritime crime, an actual or perceived decline in fish populations, ecosystem change, cross national actors, and poverty [1]. Some of the most intense conflict events in Puerto Rico involved maritime crime as a driver and did involve foreign small fishing boats. Drug smuggling and other illegal goods smuggling were often involved in these events. Studies of drug-trafficking in the greater Latin American and Caribbean region tell us that threats such as drug cartel presence, including the risk of hijacking of fishing vessels, can contribute to forced recruitment of fishers [24]. One common and inescapably blaring thread between the two case studies is that better enforcement is not sufficient if governance is not also addressed.

2.3.5 Assessing the literature for fisheries cooperation theories and frameworks

Devlin et al. found that, in analyzing fisheries conflict in the Horn of Africa, one measure to prevent or resolve fisheries conflict is to link local knowledge of fisherfolk to technical and governance capacity at the national level so that federal policy makers and resource managers can anticipate the conditions that cause conflict to erupt [15]. Governance theory on the role of

institutions is helpful in understanding when conflict events start and the emergence of cooperation events [25,26]. Originally developed to understand the establishment of collective action institutions to manage common pool resources, the governance theory literature provides a cohesive framework which can be utilized to consider influences on the resource system by different social interactions and actor types [27,28]. This grouping of literature allows us to trace how these dynamics are translated into conflict or cooperation. The institutional literature further enables us to highlight the social interactions and the potential for cooperative outcomes over conflictual ones. Fisheries and coastal governance are defined as the following,

“Governance is a more complex structure and process. Here, government is not the only governor, and governance occurs not only nationally and internationally, but also at the local level or within a particular industry. Governance is the shared, collective effort of government, private business, civic organizations, communities, political parties, universities, the media, and the public. In this framework, governance is less top- down than it is bottom-up, and in many instances also horizontal, as when business enterprises within the same industry attempt to coordinate their actions. Governance can be more or less organized, formal and routine,” [29].

2.3.6 A bridge between fisheries cooperation and conflict moving forward

Collaboration environmental governance studies highlight that the processes of conflict and cooperation often work in tandem. One way to reconcile perspectives of cooperation and conflict involving natural resources is to focus attention on how actors are interacting and the reasons why (i.e. drivers) [30]. Due to the need to bring diverse sets of actors and stakeholders together in collaborative environmental governance, both conflict and cooperation are typically present, however the literature rarely studies these processes together [31].

This dissertation creates a framework which can be utilized to bridge a quantitative content analysis methodology to analyze fisheries cooperation and fisheries conflict dynamics simultaneously [1] with gender centric mixed methods practices to validate and supplement findings (**Chapter 4**). Applications for fisheries conflict and fisheries cooperation researchers, practitioners, managers, and all other stakeholders include:

1. Using the news media content analysis methodology from Villegas et al. to identify initial fisheries conflict and cooperation events given a specific temporal period (i.e.

2010-2019) with respective study site (s) actor types, intensities, drivers, spatial patterns, and social networks [1]

2. After identifying the patterns in the results from (1), look to the interview guide in Chapter 4 Appendix 4.1 and adapt to the fisheries management level regions of your area. Decide if there are any additional sub-questions that should be asked in the interviews. Based on the gender disaggregated data, identify women practitioners from the respective actor types resulting from the content analysis in (1).
3. Finally, compare the results from (1) and (2) to create a holistic reflection of the fisheries conflict and fisheries cooperation dynamics in the study site(s).

By using these tools, fisheries resource managers, researchers, and other fisheries resource stakeholders will have access to an all-encompassing blueprint that can make it easier to share lessons learned across fisheries sectors and across varying spatial and temporal scales.

2.4 Additional recommendations for future directions

2.4.1 Utilizing visual aids in conflict analysis

One recommendation we have after reviewing the existing fisheries conflict and fisheries cooperation literature is to lean into existing toolkits that aid in visualizing dynamics that are emerging. Engaging such tools provides the potential to allow for increased collaboration across actor types and sectors. One such visualization tool is the FishCollab ‘conflict mapping’ toolkit. The FishCollab toolkit is a participatory diagnostic tool designed to assist governments, communities, and non-government organizations (NGOs) in identifying opportunities, challenges, and management options to achieve sustainable coastal management and sustainable livelihoods [32]. Further, the toolkit identifies the direct and indirect parties to each conflict, contexts, strengths, underlying needs, and concerns with respect to the conflict issues

[32]. The purpose of the toolkit is to help stakeholders look for common interests and to identify "win-win" possibilities and opportunities to negotiate new solutions.

A recommendation that we have for users of this toolkit is to make adaptations to incorporate fisheries cooperation analysis alongside the recommended fisheries conflict analysis. In conducting fisheries cooperation analysis alongside fisheries conflict analysis, potential pathways for conflict mitigation and conflict resolution emerge. For example in Puerto Rico, the gap in direct cooperation between regional environmental managers and fishers, suggests an opportunity for stronger co-management agreements once institutional trust is strengthened [1]. There is potential for these agreements to be incentivized by existing pathways of cooperation between fishers and university actors and NGOs. Therefore, rather than start from scratch in attempting to look for common interests and potential collaboration pathways, fisheries managers and stakeholders can utilize fisheries cooperation analysis alongside fisheries conflict analysis to unveil next steps based on a structured holistic view on the context of their study site(s).

2.4.2 Prioritization of gender equity in future analysis

Women are involved in the capture, processing, and sale, as well as financial aspects of fisheries, yet many of these roles have been overlooked and continue to be under-acknowledged in fisheries management and policy development [33–35]. Fisheries conflict and fisheries cooperation research is no outlier to this unfortunate trend. However, there is hope in that recent studies have started to illuminate the crucial role women play in fisheries governance, for example, one study examines how Indigenous women responded during the crisis and conflict surrounding the Pacific herring (*Chupea pallasii*) on the Central Coast of British Columbia, Canada, and argue, “that these uniquely situated women played an essential role in creating and advancing the preconditions for a governance transformation” [5]. Further, existing inequalities to marginalized groups, such as women, within the small-scale fisheries sector have been

exacerbated by the pandemic [36]. There is no better time than now to acknowledge the contributions women make to fisheries; we urge researchers moving forward to disaggregate fisheries cooperation and fisheries conflict event analysis according to the methods carried out in the methodology presented in this dissertation by including a variable to capture presence or absence of women actors in such interactions [1,15]. Additionally, it is crucial that after the results from the content analysis methodology are concluded [1], facilitation of semi-structured interviews with women and men representing the actor types most frequently mentioned in conflict and cooperation events should be conducted. Semi-structured interviews help in both validating emerging patterns and surfacing hidden interactions that could not be detected via other media content analysis (i.e. news reports).

2.5 Conclusion

This research and the fisheries conflict and cooperation framework it developed and applied in the context of PR's SSF fisheries, serve as one small brick in building a foundation for fisheries cooperation and fisheries conflict analysis theory and application. For future research, there is still so much to explore in terms of analyzing fisheries cooperation and fisheries conflict dynamics which occur at the state and territory level. There are contributions and narratives from so many other inspirational women in the fisheries sector that remain overlooked and deserve to let their voices be heard and seen. We urge researchers moving forward to disaggregate fisheries cooperation and fisheries conflict event analysis according to the methods presented in this dissertation by including a variable to capture presence or absence of women actors in such interactions [1,15]. Since we started with a quote from Anzaldúa it is only fitting to end with one. To the women and men that are rising researchers, managers, leaders, writers, graduate students, and others in fisheries:

“Do work that matters. Vale la pena”

~ Gloria E Anzaldúa

2.6 References

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2.7 Tables

Table 2.1 Synthesis of Charles 1992, Warner 2000, and Bennett 2001 typologies of fisheries conflict [8]

	Conflict actors	Typology	Conflict causes	Potential conflict resolution
Charles 1992	All fisheries (i.e. national, industrial, local, etc.); Study focused on global North (Canada)	Fishery jurisdiction conflict; institutional issues; internal allocation; external allocation	Tensions between paradigms (conservation, rational, and community)	Policies that lie in intermediate space in the paradigm pyramid, specifically co-management scenarios
Warner 2000	Community members involved in fisheries management; Study focused on the South Pacific (Fiji and Papua New Guinea)	Intra micro-micro; inter micro-micro; micro- macro	Demographic change; natural resource competition; developmental pressures; structural injustices	No ideal policy for managing conflict, however key strategy is community-based consensus-building and mediation
Bennett et al. 2001	Tropical artisanal fishing communities: Study focused on global South (Ghana, Bangladesh, Turks and Caicos Islands)	Type I Who controls the fishery; Type II How the fishery is controlled; Type III Relations	Lack of transparency and information, perceived inequalities, and the institutional failure in addressing these	Increase institutional capacity, flexibility, adaptability; co-management

		between fishery users; Type IV Relations between fishers and other resource users; Type V Relations between fishers and non-fishery issues		
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Chapter 3. Cooperation and Conflict in the Small-Scale Fisheries of Puerto Rico

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3.1 Abstract

This study aimed to answer the calls to understand where, when, and how fisheries conflict and fisheries cooperation trends emerge in the small-scale fisheries systems for the small-island U.S. territory of Puerto Rico. Exploration of the dynamics between the date, location, drivers, and actors involved in conflict and cooperation interactions related to fisheries resources was achieved by creating a database via media content analysis and a qualitative social network analysis approach. During the timeframe of 2010-2019, a total of 35 fisheries conflicts and 133 fisheries cooperation events were identified. The primary drivers of all fisheries conflict events in Puerto Rico were maritime crime, an actual or perceived decline in fish populations, ecosystem change, cross national actors, poverty, marginalization, and strategic location of fisheries. The primary drivers of all fisheries cooperation events were an actual or perceived decline in fish populations and ecosystem change. Of all the cooperation events coded, nearly three quarters fell under meetings, third-party support, or negotiation requests. While half of the fisheries conflict events fell under fines, permit denials, or negotiations halted. Social network analysis revealed a gap in direct cooperation networks between regional environmental managers and fishers, suggesting an opportunity for stronger co-management agreements; there is potential for these agreements to be incentivized by existing links between fishers and university actors and NGOs.

3.2 Introduction

There is a need to understand fisheries conflict and cooperation in ways that encompass the complexities of the marine socio-ecological systems they are a part of. A challenge with addressing where, when, and how non-cooperative violent behaviors emerge in fisheries systems is the lack of available data. Applied social scientists in the Caribbean region refer to conflict as a constant hurdle to participation and governance [1]. This is true for Caribbean fisheries, which

are inherently small-scale and thus are conceptualized as integrated socio-ecological, complex adaptive systems [2–4]. They are deeply linked to the history and culture of local fishing communities and are strongly influenced by the regional economic trends [4]. This study aims to answer the calls to understand these global and regional problems using a new approach, with the creation of the Fisheries Conflict and Cooperation in Puerto Rico Database (FCC-PR-D) in conjunction with social network analysis, to document trends in conflict and cooperation for the small-island U.S. territory of Puerto Rico (PR). This new database adapts the intensity scale from the intrastate Upper Colorado Events Database (UCED) [5] (**Table 3.1**) and variables, including actor types, from the Fisheries Conflict Database Codebook [6] (**Table 3.2**) to examine conflict and cooperation on a continuous scale. We explore the dynamics between drivers and actors involved in conflict and cooperation interactions related to fisheries resources through media content analysis and a qualitative social network analysis approach.

Furthermore, the authors' objective is to help improve the sustainable management of marine socio-environmental systems in the Caribbean and provide a tool for the inception of pointed conflict prevention and management mechanisms by applying a new fisheries-management relevant approach, that has not been applied to marine resource management in the Caribbean. Explicit attention to conflict and cooperation dynamics and its drivers could potentially aid in conservation and community resilience efforts in the region by better informing policy and fisheries managers.

3.3 Background

3.3.1 Fisheries Conflict Typologies Context

Spijkers et al. notes one simplified hypothesis of fisheries conflict is the narrative of eco scarcity in which the scarcity of fisheries resources leads to an increase in competition, which in turn leads to conflict [7]. In contrast to this narrative, research in Southeast Asia has revealed complex and diverse drivers of conflict related to fisheries. Drivers such as education level, food security, crime, perceptions of resource health, and existing levels of other conflict were linked

to fisheries conflicts that ranged from social tensions to piracy and violence within fishing villages [8,9]. Pomeroy et al. found that conflict over fisheries is perpetuated by three top-level components: competition over fisheries, existing levels of conflict, and fisheries scarcity. Each top-level component is defined by a host of qualitative measures that can be quantified. For example, competition over fisheries is affected by the presence of both commercial and small-scale fishing fleets. Existing conflict may include user-group violence and crime against fishers. Fisheries scarcity is affected by poor resource governance [6,8]. Devlin et al. (2021) explored fisheries conflict in six case study nations around the Horn of Africa and East Africa region, finding that access to fishing grounds, illegal fishing, and the presence of foreign fishers were the three highest drivers of conflict in the region. This same analysis found that one key step in preventing or solving fisheries conflict is to link local knowledge of fisherfolk to technical and governance capacity at the national level so that federal policy makers and resource managers can anticipate the conditions that cause conflict to erupt [6].

3.3.2 Fisheries Cooperation and Social Network Analysis Context

Spijkers et. al. (2018) assessed global patterns of fisheries conflicts according to fisheries conflict typologies and called for a scale of conflict intensities that would enable analysis of conflict and cooperation across a gradient [10]. Studies of collaborative environmental governance tell us that processes of conflict and cooperation often work in tandem as two sides of the same coin and that one way to reconcile perspectives of cooperation and conflict involving natural resources is to focus attention on what the actors are doing and why [11]. Furthermore, there is a growing worldwide need to incorporate into the management of small-scale fisheries (SSF) nuanced understandings of fisheries conflict, such as precise definitions of typologies, its causes, a gradient of its intensities and a specification of the actors involved [7]. Researchers and resource managers in the wider Caribbean Basin have advocated for the usage of network

analysis to identify leaders and strengthen collective action among actors [1]. In systems with weak formal fisheries institutions, as is common in the Caribbean [4], the sustainability of SSF often depends on the strength of social capital and social cohesion of local communities [12]. One of the ways in which social networks are key for the effective governance is by untangling how aligned fisheries policies are with the resource user's social interactions and norms [13]. For example, social networks have supported the transition of Jamaican SSF towards co-management [14].

3.3.3 PR Socio-environmental Context

The Commonwealth of Puerto Rico (PR) is an archipelago surrounded by the Atlantic Ocean to the north and the Caribbean Sea to the south. The archipelago has an area of 9103.8 square kilometers and a coastline that extends for 500.5 km. Puerto Rico hosts diverse fisheries that local communities depend upon for subsistence in commercial and recreational fishing sectors [15,16]. PR is facing socio-environmental instabilities, associated with the island's deindustrialization, the 2008 world financial crisis, and deep austerity measures responding to its growing unsustainable debt [17]. Rising operational costs and marginal gains after the 2008 global recession have imperiled the viability of certain fisheries [18,19]. For example, the scuba diving fishery has taken more safety risks, in part due to economic pressures, while the trap fishery depends on capital-intensive technologies that translate to high operational costs [19]. Additionally, in 2017 Hurricane María, a category 5 hurricane, caused extensive damage to docks, ramps, coastal fish shops and among other coastal infrastructure and many fishers lost their boats, fishing traps, and other gear [20,21]. Hurricane María exposed the vulnerabilities created by ubiquitous socioeconomic inequality [22]. It also exacerbated the island's unemployment rates, poverty rate [23] and out-migration [24]. 2019 alone saw massive protests and the resignation of the island's governor. Although recent events have not been well studied, larger social processes are known to have had impacts on the well-being of coastal communities,

and on the fishing activities on which many depend on. For example, PR's de-industrialization contributed to shifts in fishing livelihoods [25], while failed fisheries development strategies has led to disillusioned and frustrated relationships with state policies [26]. Furthermore, the destruction of essential fish habitat through coastal development and urban sprawl has been an added factor contributing to stock declines [27]. Meanwhile, illegal economic activities are on this rise, including maritime crime [28]. For example, in 2018, 15 fishing vessels were linked to piracy and robbery incidents in the Latin American and Caribbean region, and in the Caribbean Lesser Antilles, 16 suspects were arrested for robberies on fishing vessels; there were 16 reported deaths, and 3 fishers were also reported missing [29].

3.3.4 PR Fisheries Management Context

PR's fisheries management is marked by complex institutional rules and a high degree of bureaucracy [30]. Fisheries regulations in PR have been met by resistance and skepticism from fishers [18], notably for seasonal closures and plans for marine protected areas [25,31], possibly driving fisheries conflicts. The fisheries of PR are small-scale or artisanal in nature, involving fishing households, tight-knit communities, and primarily local markets for both subsistence and commercial fishing [32]. Thus, community-based cooperation led by fishers has also been known to lead to desirable outcomes, such as the ending of military practices destroying coral reef ecosystems [33,34], and the creation of marine protected areas [35]. The role of cooperative social networks among Puerto Rican fishing communities has been highlighted as key to their viability, especially through the collective power of fishing associations, as well as fisher's adoption of ecosystem stewardship norms [16,36]. At the same time, fisher's associations and other informal cooperation networks are riddled with inter-personal and political conflicts that fragment communities and could hamper effective management at the local level [25]. While Griffith and Valdés-Pizzini (2002) have cited direct conflicts between fishing and the development and tourism sector in the past, there is a lack of studies prioritizing the conflict and

cooperation dynamic trends among fisheries stakeholders in contemporary data. This case study is uniquely positioned to evaluate methods that can identify and characterize conflict and cooperation in highly regulated, yet resistive and vulnerable, small-scale fisheries.

3.4 Methods

Researchers coded fisheries conflict and fisheries cooperation events and aggregates in Puerto Rico during 2010-2019, by reviewing Nexis Uni media reports, and categorized those events according to frequency, location, actors, intensity, and drivers of interactions. The resulting database was then analyzed via social network analysis.

3.4.1 FCC-PR-D Conceptualization

The Fisheries Conflict and Cooperation in Puerto Rico Database is a collection of contemporary reported incidents in which a fisheries resource is the source of conflict or cooperation. The researchers define a Fisheries Conflict or Cooperation Event (FCCE) as an incident in which a fisheries resource is contested, disputed, the source of conflict **or** the source of cooperation, agreement, and support between a minimum of two human actors, at a discrete temporal moment, and in a discrete location. More than one actor dyad can be coded per conflict or cooperation event.

A news report might describe fisheries conflict or fisheries cooperation in aggregate time scales. For these instances, the researchers define Fisheries Conflict or Cooperation Aggregate (FCCA) as an incident in which a news report contains information about a fisheries conflict **or** fisheries cooperation over a temporal range that may span multiple months or years and can occur throughout a larger region or in multiple locations. The protocol used to collect the fisheries conflict and cooperation data was adapted from the Fisheries Conflict Database Codebook, which draws largely from the Fish Wars Cycle [6,9,37].

The Fisheries Conflict and Cooperation in Puerto Rico Database (FCC-PR-D) builds on this approach in three distinct ways. The first major distinction is the expansion of the UCED

intensity scale to better capture the diversity of both fisheries conflict and cooperation events in PR's heterogeneous SSF system (**Table 3.1**). The second major distinction is the addition of other actor types (**Table 3.2**). Finally, rather than utilize the senatorial district levels that were used for initial data collection, the researchers utilized the Department of Natural and Environmental Resources (DNER) fisheries management regions for PR in the final spatial analysis to make findings relevant to fisheries management objectives and priorities. To ensure all events and aggregates that appeared along the coast were captured by the cataloging process, the researchers originally coded at the senatorial district level, then aggregated the FCCEs and FCCAs according to the DNER management regions. The management of fisheries resources in Puerto Rico are broken down into the four cardinal regions.

3.4.2 FCC-PR-D Data Collection and Database Compilation

We selected the Nexis Uni database for article collection. Nexis Uni contains over 15,000 news sources and has wide temporal and spatial coverage. Nexis Uni, formerly LexisNexis Academic, has been used in academic event-level conflict data collection [6,37]. A Boolean search string was utilized to systematically collect articles from Nexis Uni (**see Appendix 3.1**). We did not include words such as 'conflict,' 'dispute,' or 'contested' in the search string because this assumes the media reporter has already identified a conflict or used conflict-specific terms. Articles relevant to fisheries conflict or cooperation were catalogued and coded for the occurrence of actors, drivers, and intensity of FCCEs and FCCAs in Puerto Rico for a decade from January 1st-2010 to December 31st-2019. Both English and Spanish language articles were analyzed for the compilation of the database. Actors could be individuals (i.e., Domestic Fisher) or groups (i.e., Fishing Collective). Temporal moments and locations may be estimated, but for an FCCE or FCCA to be identified, the action must be reported to have occurred within the limits of a municipality or regional level in PR.

Prior to event-level coding, a random sample of 10% of the 200+ catalogued relevant articles were coded to ensure that all reported instances, intensities, and drivers of cooperation

and conflict over fisheries could be collected via the adapted coding procedure; coding responses were compared among all coders. Intensity of FCCEs and FCCAs were determined from a modified scale originally operationalized for scaling hydro-political events to a scale from intense conflict to intense cooperation in the compilation of the intrastate Upper Colorado Events Database (UCED) at Oregon State University [5]. Following a review of the literature about fisheries management in PR and cooperation and conflict in fisheries, the researchers identified variables that could potentially impact conflict and cooperation over fisheries resources in PR. Utilizing the information from this review, slight adjustments were made to the UCED scale to include specific fisheries resource relevant events (**Table 3.1**). Actor Types were coded according to the categories defined in the Fisheries Conflict Database Codebook (**Table 3.2**). For this study, the Actor Type “Other” was examined and additional actor type categories, according to actor name (i.e., University, NGO), were added to the analysis to disentangle what “Other” actor types were prevalent in FCCEs. The “Unaffiliated” actor type is indicative of an actor that was referred to as a community member or “the public” and was not associated in the news report with another actor type category. For example, news reports of Caribbean Fisheries Management Council meetings often referenced the public. “The public” were coded as actor type “Unaffiliated” since there was no additional information in the news report regarding the participants at the meeting. The “Private” actor type is indicative of organizations such as privately-owned corporations. Drivers of conflict and cooperation were coded according to the procedures outlined in the Fisheries Conflict Database Codebook [6,37]. Drivers in this study were identified only from information in the news articles. Multiple drivers can be coded for each FCCE (**Table 3.3**). After coding was completed, coding results from multiple coders were compared to ensure that events and aggregates were coded consistently.

3.4.3 Spatial Distribution Methods

The spatial distribution of both discrete and time-aggregated events across management regions was mapped in ArcMap 10.5 statistical software. A special was focus given to the

relationship between event intensity and the DNER fisheries management region it occurred in according to media reports. The focus on event intensity is key to understand where the worst conflicts and the more binding cooperation occur. For this purpose, events corresponding to zero intensity, such as announcements and no comment statements, were not mapped due to their neutral nature.

3.4.4 Social Network Analysis Methods

Networks were created from the cooperation and conflict relationships between the actor types coded from the news events. Actor types were represented as nodes, while the frequency of interactions between any one actor type was represented as edge thickness. Both networks were undirected since sender-recipient indicators of an interaction are not often clear from news reports. For news events where more than two actor types were mentioned, the importance of interactions was classified as either being primary (between main actors) or secondary (involving a third or more actor). Several measurements of network centrality, such as degree, closeness, betweenness, and eigenvector centrality were calculated to understand the network's structure. Using this data frame, network graphs were created using circle layouts and qualitative patterns were interpreted. Patterns of interest included which actors were most involved in cooperation or conflict in relation to their degree centrality (i.e., the number of ties it is connected to). To validate cooperation and conflict patterns among actors, network modularity was calculated by applying the walk trap (i.e. *cluster_walktrap*) community detection algorithm. This method uses random walks between nodes on a graph to detect communities. It assumes that the random number of steps needed to reach nodes outside a community should increase [38]. That is, walks are more likely to stay within the same community because there are only a few edges that lead outside a given community. All network analysis was performed in R statistical software using *statnet* and *igraph* packages.

3.5 Results

A total of 168 Fisheries Conflict and Cooperation Events were analyzed. During the timeframe 2013-2017 the frequency of cooperative events steadily declined, apart from an increase in 2018, before declining to the lowest number of events in 2019. Meanwhile, the frequency of conflict events fluctuated across the study period (**Figure 3.1 A**). The northern DNER region tallied up the highest frequency of discrete cooperation events (**Figure 3.1 B**). Additional spatial distribution patterns are highlighted below. Of the 133 cooperation events, 71% met characteristics placing them in an intensity 2, while of the 35 fisheries conflict events, 46% of events met the moderate/higher intensity characteristics of -3 (**Figure 3.2**).

3.5.1 Drivers

The primary drivers of all fisheries conflict in Puerto Rico were the variables Maritime Crime, Fish Populations, Ecosystem Change, Cross National, Poverty, Marginalization, and Strategic Location. Each of these were drivers in more than 25% of fisheries conflict events (**Figure 3.3 A**). The primary drivers of all fisheries cooperation events were an actual or perceived decline in Fish Populations and Ecosystem Change. These were drivers in more than 25% of fisheries cooperation events (**Figure 3.3 B**). Meanwhile, the most intense conflicts were driven by Maritime Crime, Foreign Fishing, Cross National, and Illegal Fishing. Intense cooperation was driven by Ecosystem Change and Fishing Grounds Limitations. An actual or perceived decline in fish populations had a high variability, driving both types of events, but on average was associated with cooperative events. (**Figure 3.4**).

3.5.2 Spatial Distribution

Cooperative events were reported more frequently than conflict events in all four regions, especially for those occurring in the north where the Caribbean Fisheries Management Council office is located. Median conflict event intensity scores were highest in the eastern region. The southern region tallied the highest median fisheries cooperation intensity out of all discrete events (**Figure 3.5 A**); Looking at longer timescales, months to years, median aggregate

conflict intensity scores were highest in the southern region; median aggregate cooperation intensity scores were highest in the eastern and western regions (**Figure 3.5 C and 3.5 D**).

3.5.3 Social Networks

When examining cooperation relationships, a total of 14 actor types were extracted from all news events (n=168) and categorized into sectors, leading to 32 unique types of interactions (edges) between them and a network density of 0.35. Likewise, 16 actor types were identified and categorized for 25 conflict interactions, leading to a lower density network (0.21).

Cooperation interactions between the federal government and the unaffiliated public were the most frequent dyads, followed by interactions between the federal government and domestic fishers (**Table 3.4**). Both the cooperation and conflict networks illustrate fishers as central and highly connected by frequent interactions involving their problems and collaborations (i.e., high degree of centrality) (**Figure 3.6**). The most frequent conflict events occurred between regional government and domestic fishers, as well as specific fishing collectives and fishing communities

3.6 Discussion

3.6.1 Temporal Fisheries Conflict and Cooperation Patterns

Fishing recovery efforts, after Hurricane María, both from PR's Department of Agriculture and NGO initiatives, did not reach fishers until 2018, partially explaining the rise in cooperative events we saw in 2018 (**Figure 3.1**). The handling of federal fisheries aid resulted in lawsuits, protests and a bureaucratic process delaying that aid for more than three years. This caused widespread indignation across the fisheries sector, adding to the public resentment towards the hurricane recovery and state governance. This manifested itself as political turmoil during the summer of 2019 in which unprecedented protests successfully lobbied for the resignation of the island's governor. Other events related to regional fisheries governance included reported ineffectiveness after the merging of DNER and Environmental Quality Board (EQB) in 2018 and the back-to-back replacements or resignations of DNER Secretaries – one of which was linked to a corruption investigation by the FBI in 2019. Contextualized to other crises, such as the impact

of numerous earthquakes along the southern coast in early 2020 and the recent COVID-19 health crisis lockdowns, we expect a larger shift in the intensity of both cooperation and conflict over fisheries resources in Puerto Rico as the lagged consequences of these stressors unfold.

3.6.2 Patterns of intensities/drivers

In our study, an actual or perceived decline in fish populations is more frequently associated with cooperative events, which is consistent with previous research finding that one of the adaptive capacity behaviors among fishers includes strengthening social bonds within the community [1,8,39,40]. We found that a perceived decline in fish populations also leads to some low-level intensity conflict, similar to a previous global analysis of fishing conflict [7]. In PR, decreases in fishing activity have been attributed by managers as consequences of aging of active fishers, conflicts among gear types and overfishing [18], yet fishers strongly believe dwindling stocks are caused primarily by pollution, habitat destruction and climate change [18,39,40]. Although these other drivers are increasingly recognized by managers (and are fundamental in the new island-based Fisheries Management Plan just approved by the Caribbean Fisheries Management Council (CFMC)) fishers repeatedly express that state fishing regulations need to be amended and enforced to tackle stressors beyond overfishing. In addition, fisher's perceptions of the performance of seasonal closures for spawning aggregations are mixed, with most believing that they are useful conservation measures but that they did not improve their livelihoods [41]. This discontent in the socio-environmental outcomes of regulations fosters the inherent conflict between fishers and states. When asked their perceptions of problems, most have stated socio-economic problems (i.e., operational costs) and conflicts with DNER regulations [18]. Our results suggest that this tension is overcome by the cooperation emerging from environmental awareness and motivation to conserve resources among PR commercial fishers.

We found that the most intense conflicts are driven by maritime crime, foreign fishing, cross national actors, and illegal fishing, as can be appreciated in (**Figure 3.4**). Conflict events

with maritime crime as a driver did involve foreign small fishing boats. These events mostly captured drug smuggling and other illegal goods smuggling. We know from studies of drug-trafficking in the greater Latin American and Caribbean region that coercion on the part of drug cartels, including threats and the hijacking of fishing vessels, can contribute to forced recruitment of fishers [42]. Negative economic shocks experienced by low-income small-scale fishers, such as the theft of outboard engines by petty criminals or the death of an income earner in the household, can foment them to enroll in drug trafficking [42]. This highlights the need to better understand and alleviate the drivers that Caribbean small-scale fishers face when choosing illegal smuggling as a complementary alternative livelihood, or as their primary source of income cloaked under fishing pretenses [42]. Our results highlight the role of maritime crime in driving fisheries conflicts in PR, suggesting a need for local policy actions that build trust and cooperative relations between law enforcement officials and fishing communities to deter fishers from resorting to illicit activities.

We found a larger proportion of cooperation than conflict events. Some of these events were intense and driven by Ecosystem Change and Fishing Grounds Limitations. Specifically, a majority of the intense cooperation events were representative of events such as the signing of the Caribbean Regional Ocean Partnership [43,44] and the collaboration which was mediated by Sea Grant between the Department of Agriculture and nine fishing cooperatives to fix infrastructure and build an aquaculture center [45]. Most cooperative events were low-intensity, due to the frequent mention of Caribbean Fisheries Management Council (CFMC) meetings in news reports. These often referenced the public, but at times there was no additional information in the reports regarding the types of participants present at the meeting. Despite the archive of public hearing and scoping meetings dating only back to 2013, it is apparent as early as June 25, 2014 that when fishers are present at the meetings, they vocalize that they are unhappy with the lack of opportunities available for their participation in the fisheries management process. During this time, there was already concern about the lack of involvement

of the fishers in the development of the allowable catch limit (ACL) and there is an apparent lack of communication of information to the fishers [46]. Although CFMC meetings were categorized as an intensity of 2 (cooperative), it is apparent through the meeting minutes that low-level conflict that was not captured in the media reports still occurred during the study period. Comparably, DNER fisheries stakeholder meetings were not captured by the news media at all.

3.6.3 Spatial Patterns

The Caribbean is a major transshipment zone for illicit drug traffickers and money launderers between South American source countries and the continental United States. Cocaine is the principal drug smuggled in the U.S. Caribbean and is smuggled almost exclusively through fast boats or fishing vessels. The eastern region in PR tallied the highest discrete fisheries conflict events, mainly due to the prevalence of drug smuggling along this coastline. Due to recent law enforcement successes in the Mona Passage west of Puerto Rico, traffickers send large cocaine loads directly to PR, often hopping across the British and U.S. Virgin Islands and entering through eastern PR [47]. Thus, fishers in this region are especially vulnerable to maritime crime. Discrete fisheries conflict events in the southern region were largely represented by coastal clean-ups led by local NGOs [48] and local fishing communities and regional government coordination in writing a coral reef protection agreement into law [49]. However, looking at longer timescales, aggregate conflict intensities were highest in the south and were represented by marginalization of fishers due to coastal development projects, human trafficking, and drug smuggling. Median aggregate (FCCA) cooperation intensity scores were highest in the eastern and western regions; cooperation in the west was represented by public scoping meetings led by CFMC and some permit approvals for DNER scientists and cooperation in the eastern region was largely driven by events such as an agreement between the USDA and domestic fishers to build an artificial reef that would restore a portion of the coast after an oil spill [50]. This distinct mismatch in the narratives of conflict and cooperation intensities in the DNER regions

at different temporal scales highlights the need for both discrete (FCCE) and aggregate (FCCA) analysis in order to get a more holistic account of the emergence of conflict and cooperation over fisheries in PR.

3.6.4 Insights from Social Networks

Our results illustrate the type of network data that can be derived from the approach utilized to create the FCC-PR-D. When applied to PR, it highlights the central role of fisher actors in conflict events, especially those involving the regional government and the interventions by the federal government (i.e., U.S. Coast Guard) and the police regarding foreign fishers. Notably, the conflict interactions between federal government and police with foreign fishers highlights the prevalence of events where drug smugglers were arrested in fishing boats. Expected patterns, such as the frequent conflict ties between domestic fishers and natural resource security forces (i.e., DNER security forces), conceptualize either the enforcement of fishing regulations or lack of it. Moreover, conflict ties between domestic fishers and the military reflect the legacy of fisher's struggles in the island municipality of Vieques, as well as drug smuggling interdictions by the US Coast Guard and Navy. News events where fishers spoke as collectives or were mentioned as a whole fishing community (in contrast to individual domestic fishers) had frequent antagonistic interactions with local governments. This pattern was validated through community detection (**see Appendix 3.2**). However, in previous recounts of fisheries conflicts in Puerto Rico, collective action was mostly directed at the state and federal levels, while cooperating with municipal administrations [25,51]. Although this still occurs, the local-level conflicts with municipalities captured through this approach evidence how collectives are also facilitating the needs of fishers (such as access to ramps and docks) from municipal actors by amplifying their voices through media. This validates the continued role of fishing collectives in facilitating fishers' political agenda despite the trend of weakening membership throughout the past decades [36,51].

The cooperative networks illustrate opportunities for more cross-sectoral collaboration and fisher participation in regional fisheries management. Although domestic fishers are still connected to six other sectors in the cooperation network, the frequency of interactions is not as often (i.e., width of links), with actors that are not the federal government. However, although domestic fishers are still central in the cooperative network, both the fishing collectives, and the fishing communities do not have frequent cooperative relations with the regional government, suggesting their lack of participation in these solution-oriented events that inherently involve them. That is, although the events are related to mitigating ocean problems that affect fishing, fishers in PR do not tend to cooperate directly with the DNER managers, but rather rely on collaborations with federal government institutions, universities, and NGOs. Indeed, there is a tendency for marine ecosystem-based management in PR to manifest itself as a decentralized network structure reliant on academic and environmental non-governmental organizations as influential brokers [52]. Our analysis reveals the gap in direct cooperation networks between regional environmental managers and fishers, suggesting an opportunity for stronger and more widespread co-management agreements once institutional trust is strengthened. With few governmental resources, the participation of fishers in management decision-making are being facilitated and incentivized by additional actors, such as academics, government officials and NGOs. This outcome aligns with how the social network analysis also captured that fishing associations and communities have frequent conflict with the local government, which highlights the need to strengthen participatory fisheries management [53].

3.6.5 Limitations

The cooperation and conflict interactions in this study should be interpreted as representations of real events through the lens of reporters and media organizations. It is likely details in news articles are biased when categorizing attitudes among actors and therefore care should be taken to only code broad sentiments. Media scholars define this bias in the news as

the content/coverage bias, which consists of favoring one side rather than providing equal treatment to both sides involved in a conflict [54]. Furthermore, this method captures only the events that are of interest to reporters or that domestic fishers call out on reporters for their amplification, and thus could exclude many local-level interpersonal conflicts and collaborations. Previous conflict studies that utilize media reported data have alluded to this selection bias, whereby media outlets choose to report on certain events but omit others. This can be the consequence of an outlet's audience not being interested in some events or a consequence of information about certain events not reaching a reporter [55].

Several examples of previously identified and ongoing fishing conflicts among different types of fishers were not captured by the news media and could explain the lesser amount of conflict news in proportion to cooperation events. For example, the spiny lobster (*Panulirus argus*) fishery is characterized by the deployment of traps as the primary gear use method, followed by a rapidly growing SCUBA diving sector [56,57]. Thus, the long-standing territorial conflict between trappers has arguably shifted or expanded to include conflicts among trappers and scuba divers in benthic habitats of the insular shelf where both gear types operate [18]. These tensions manifest between those compliant trap fishers versus those that use traps with illegal characteristics (i.e the size of mesh and escape doors). Notoriously for PR there are claims from trappers that SCUBA divers steal catch and vandalize traps [18,58]. However, these conflicts were not reported by the news media. Furthermore, an increased number of recreational fishers targeting the same species as commercial fishers and increased access to coastal infrastructure (i.e., boat ramps) has also resulted in conflicts [25]. These conflicts are believed to have been exacerbated by recent catch declines yet have not been reported by the news media [59]. Underreporting of fisheries conflicts could be driven by historical institutional distrust of fisheries agencies [40,60,61], media outlets, and contemporary Puerto Rican governance [62].

3.7 Conclusion

The cooperative trend observed in this study reinforces the perspective that an actual or perceived decline in fisheries resources is not simply a source of conflict but is also a driver of frequent cooperation. Evidence from this study supports the claim that cooperation and conflict are two types of social ties that may occur together [11]. Additionally, this case study of small-scale fisheries in Puerto Rico challenges the eco scarcity narrative that persists in the fisheries management literature by showing that other social factors, including institutional failure, may be a primary cause of fisheries conflict [63] and supports the notion that the current state of fisheries governance is inadequate to redress the increased risk of fisheries-related conflict [64]. In Puerto Rico, specifically, the aftermath of hurricanes, fiscal cuts to essential services and corruption scandals, has debilitated Puerto Rican fisheries governance and has been marked by the distrust of state institutions and a rise in community-based responses [21,65,66]. In the fisheries sector, this has manifested itself with widespread resentment and legal action by fishing collectives against DNER for the slow disbursement of fisheries aid, as well as a high reliance on community-based cooperation [21]. Most fishers in PR continue to have negative perceptions of fisheries governance, and don't believe decisions about fishing regulations are fair; despite this, fishers also believe that they and the government should cooperate to solve fisheries problems [61]. The social network analysis conducted in our study revealed a gap in direct cooperation networks between regional environmental managers and fishers, suggesting an opportunity for stronger co-management agreements once institutional trust is strengthened; there is potential for these agreements to be incentivized by existing links between fishers and university actors and NGOs. Our results highlight the role of maritime crime, specifically drug trafficking, in driving high intensity fisheries conflicts in PR. This suggests there is a need for local policy actions that build trust and cooperative relations

between law enforcement officials and fishing communities to deter fishers from resorting to such illicit activities.

Despite the limitations, high-level, cross-sectoral fisheries interactions derived from media content analysis provide contextual insights into the perception of actors and policy of institutions beyond harvesting by fishers. This approach is a systematic diagnostic tool able to build theoretical typologies of fisheries conflicts. A media-derived database can aid in the design of management interventions, as well as uncover further research priorities aiming to leverage conflict and cooperation relationships to facilitate fisheries participatory governance. With the COVID-19 pandemic limiting face-to-face data collection, it can prove useful as a diagnostic tool especially with limited travel opportunities. Further, this methodology can be used to compare amongst different regions and countries for systematic gathering of data to build fisheries conflict and cooperation theory, since these processes are two sides of the same coin [5,67]. This methodology is reproducible with training and can point fisheries resource managers to potential management priorities that have been previously neglected and deserve attention in upcoming agendas. Although we utilized Nexis Uni, this methodology can be used with other media sources such as local sources and social media. Once information is extracted from the source, the codebook can be utilized to replicate the process in other locations. Additionally, it can be readily complemented with interviews and other qualitative approaches to disentangle low-level or passive conflicts not reported by media outlets.

The approach used in this study can be an illuminating, low-budget method for interdisciplinary researchers to understand the contemporary social dynamics afflicting or strengthening the desirable outcomes in other data-poor SSF systems. Additionally, the implementation of cooperative initiatives, such as the SSF Guidelines, will require a mixture of governmental policy mechanisms and efforts by non-state actors, such as fishing cooperatives [4], and thus requires understanding current cross-sectorial conflict resolution partnerships. In

this vein, we highlight the key role of a holistic approach to better understand and explore the ever-evolving paradigm of fisheries conflict and cooperation among actors in SSF.

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3.9 Conflicts of Interest

Declarations of interest: none

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3.12 Figures

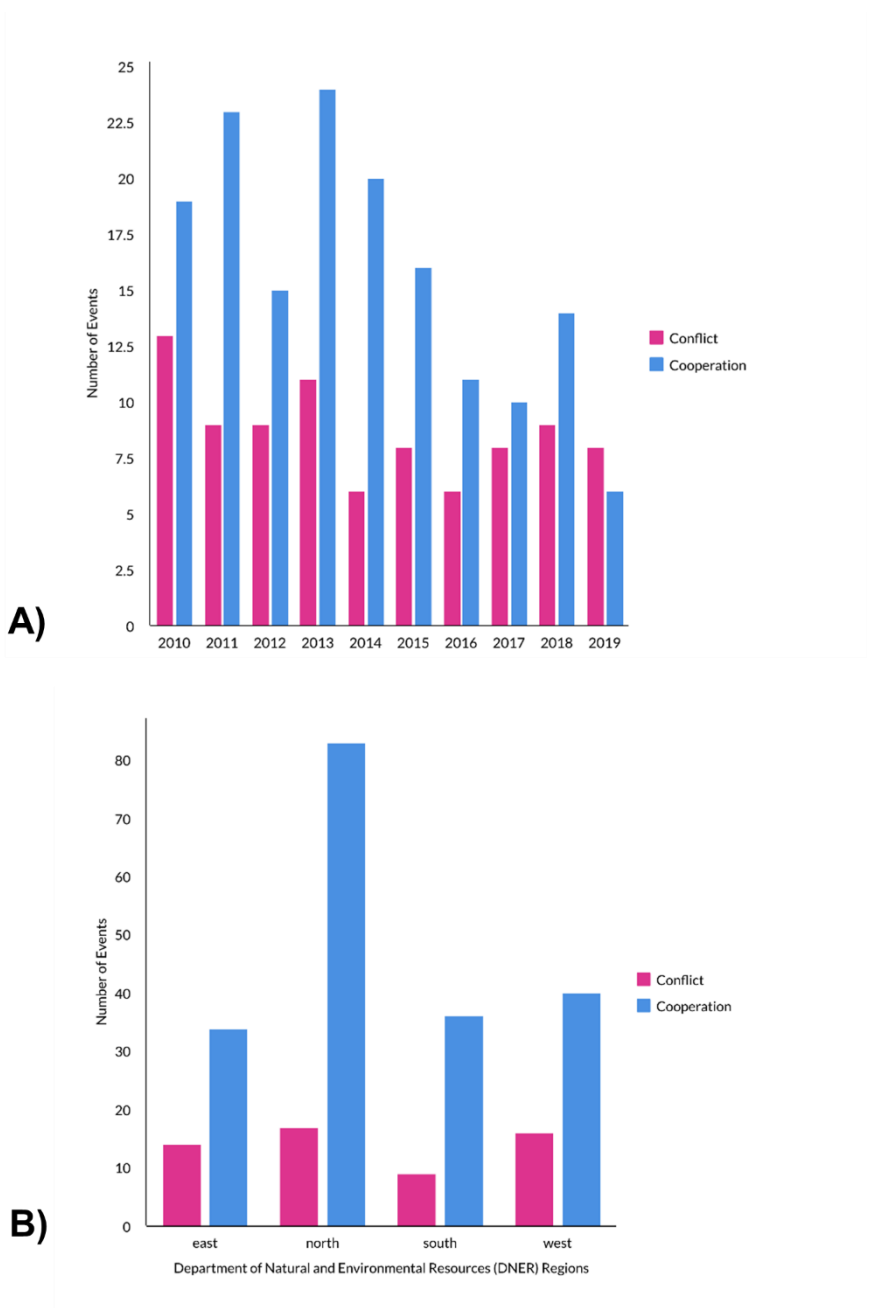


Figure 3.1 Spatio-temporal frequency of Fisheries Conflict and Cooperation Events in Puerto Rico. A) Temporal distribution (2010-2019). B) Spatial distribution across management regions. Fisheries Conflict events are depicted in pink. Fisheries Cooperation events are depicted in blue.

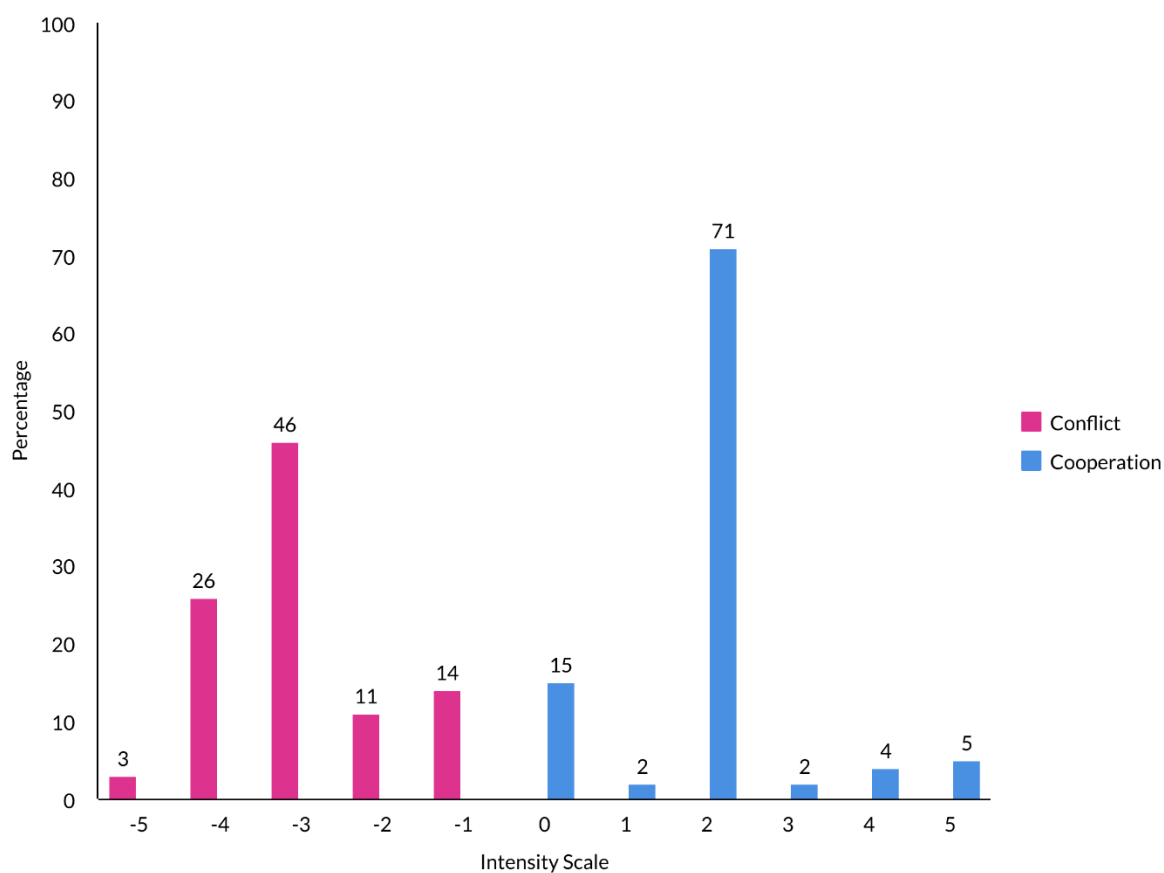


Figure 3.2 Percentage of Fisheries Conflict and Cooperation Events per intensity level. Percentages are listed above intensity level. Fisheries Conflict events are depicted in pink (n=35). Fisheries Cooperation events are depicted in blue (n =133).

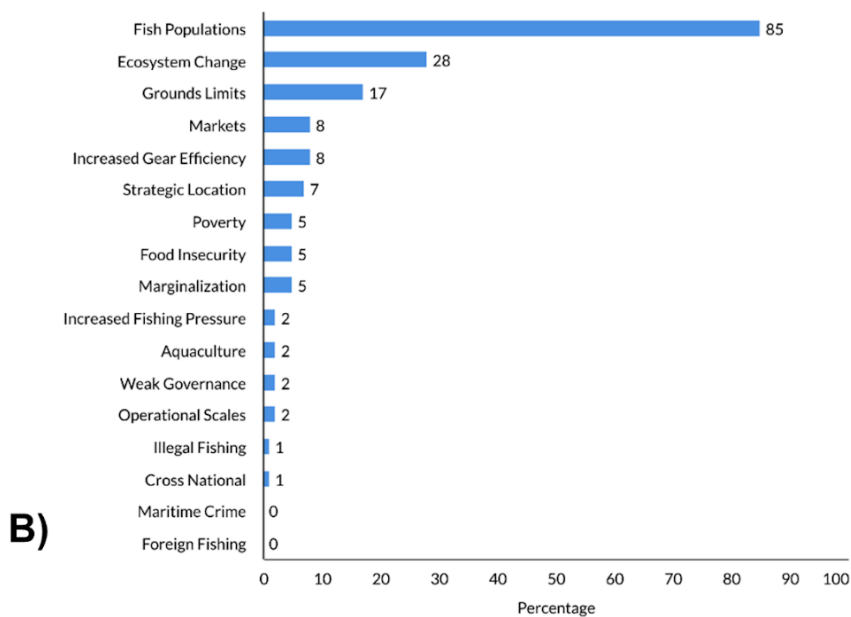
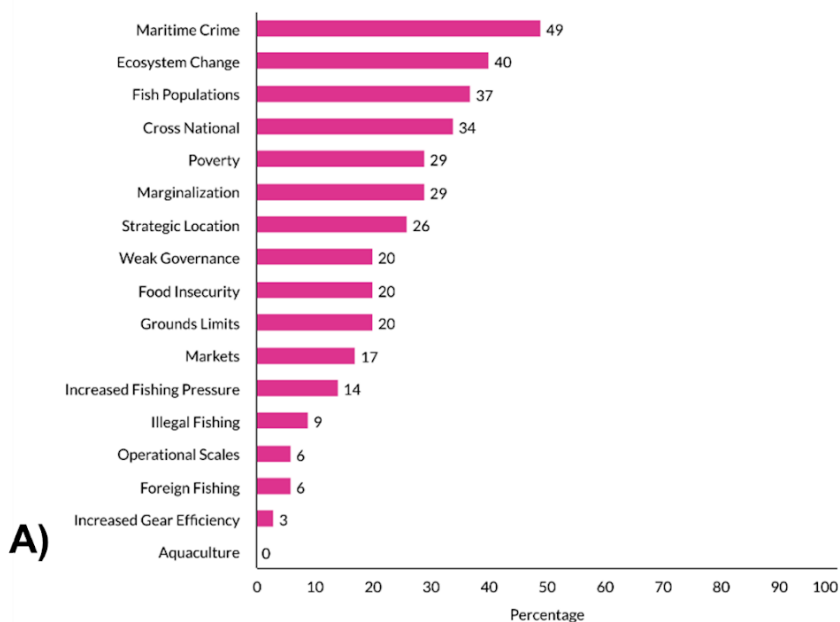


Figure 3.2 Percentage of Drivers in Fisheries Conflict and Cooperation Events. **(A)** Drivers of Fisheries Conflict Events in Puerto Rico (2010-2019) depicted in pink. **(B)** Drivers of Fisheries Cooperation Events in Puerto Rico (2010-2019) depicted in blue.

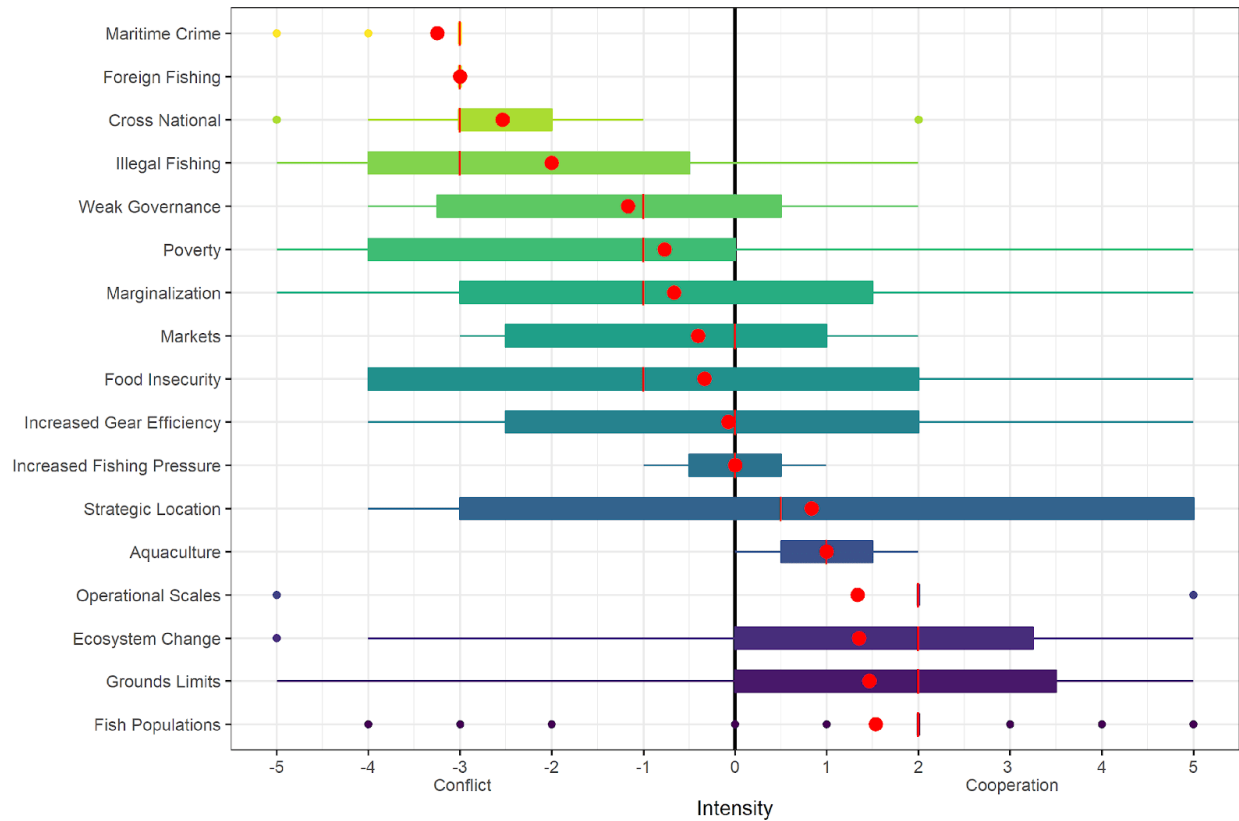


Figure 3.4 Boxplots illustrating the relationships between the intensities of conflict and cooperation events and their socio-environmental drivers. Red circles represent the means while red bars are medians. The width, or size of the box represents the interquartile range, or the middle 50% of the data, with the upper and lower limits of the box being the third and first quartile (75th and 25th percentile), respectively. The lines extending from the box (called whiskers) extend up to 1.5 times the interquartile range from the sides of the boxes. The outlier events are represented as points.

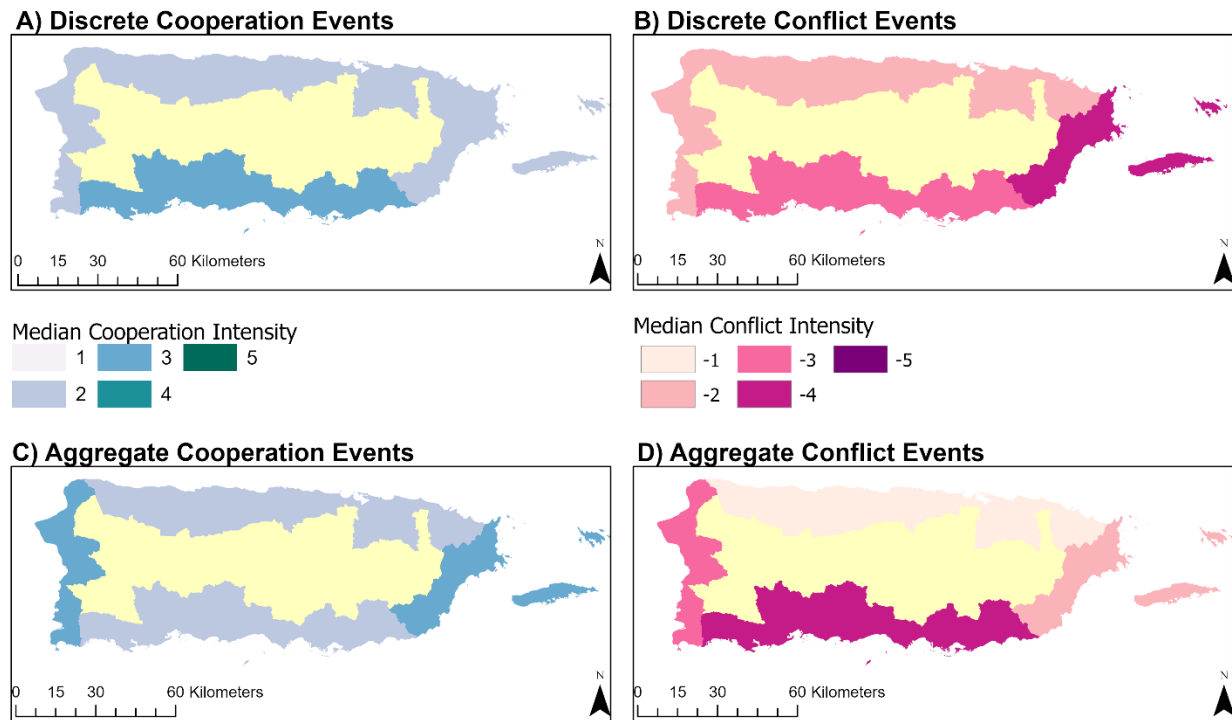


Figure 3.5 Spatial distribution of fisheries conflict and cooperation on median intensities on a scale from -5 to 5 utilizing the Department of Natural and Environmental Resources (DNER) management region boundaries. Zeros were excluded for the purpose of this figure (2010-2019). Fisheries Conflict Events are depicted in pink. Fisheries Cooperation Events are depicted in blue. **(A & B)** Temporally discrete events. **(C & D)** Temporally aggregated events.

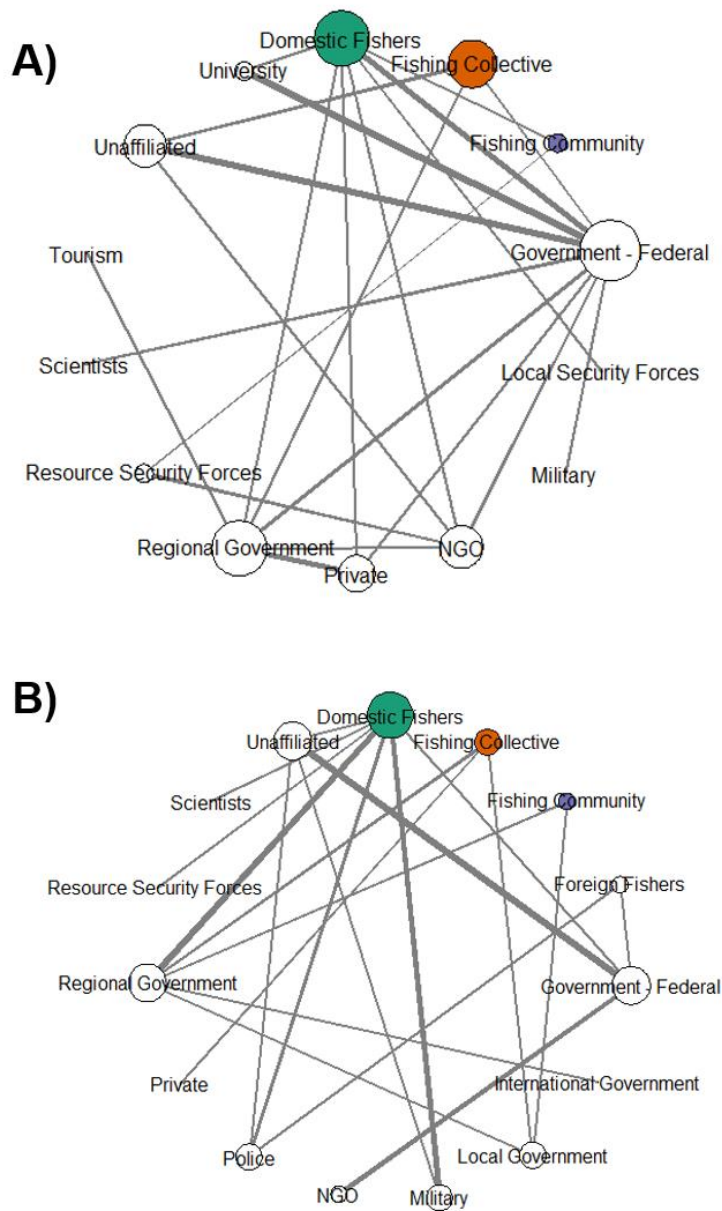


Figure 3.6 Networks of actors representing sectors involved in fishing conflict and cooperation news events. Nodes represent each actor type and links between them the frequency of interactions for all events. Nodes representing fishers are highlighted through color and sized according to their logged degree centrality. **(A)** Cooperation network, with a density of 0.35 consisting of 14 actor types and 32 types of ties. **(B)** Conflict network, with a density of 0.21, consisting of 16 actor types and 25 types of ties.

3.13 Tables

Table 3.1 Fisheries Conflict and Cooperation in Puerto Rico Intensity Scale

FCC-PR-D	Intensity	UCED
Small scale acts of violence, protests, vandalism	-5	Small scale acts of violence, protests, vandalism
Litigations, appeals of administrative actions, *arrests	-4	Litigations, appeals of administrative actions
Fines, proposal and permit denials, halting negotiations, *significant fisheries livelihood loss	-3	Fines, proposal and permit denials, halting negotiations
Petitions, withdrawal of third-party support	-2	Petitions, withdrawal of third-party support
Delays, report reviews, voicing opposition, editorials	-1	Delays, report reviews, voicing opposition, editorials
Judicial rulings, no comment statements, announcements	0	Judicial rulings, no comment statements, announcements
Voicing opinions of approval, court-forced negotiations, editorials, *fisheries ecosystem clean-ups (including mangroves)	1	Voicing opinions of approval, court-forced negotiations, editorials
Meetings, third-party support, negotiation requests	2	Meetings, third-party support, negotiation requests
Permit approvals, fixing violations, negotiations begin, *tangible business arrangements involving fishers	3	Permit approvals, fixing violations, negotiations begin
Lawsuit settlements, regulation approval, management transfers	4	Lawsuit settlements, regulation approval, management transfers
State bill passage, compacts or official agreements	5	State bill passage, compacts or official agreements

*Indicate slight modifications to the Upper Colorado Events Database (UCED) intensity scale [5].

Table 3.2 Fisheries Conflict and Cooperation Event Actor Types

Actor Type
Domestic Fishers
Foreign Fishers
Fishing Community
Security Forces – Military
Security Forces – Police
Security Forces – International
Security Forces – Resource
Security Forces – Local
Government – Local
Government – Regional
Government – Federal
Government – International
Fishing Collective
Fish Processors/Traders
Tourism
Rebels - Organized
Rebels – Other
Bandits
Other *NGO, University, Scientists, Private Sector, Unaffiliated

*Indicates the Other Actor Type categories that were added for the (FCC-PR-D). The original Actor Types are directly from the Fisheries Conflict Database Codebook [6].

Table 3.3 Drivers of Fisheries Conflict and Cooperation

Driver	Description
Weak Governance	Corruption, weak enforcement, weak institutional capacity, a lack of public participation, inadequate information
Fish Populations	An actual or perceived decline in fish populations
Ecosystem Change	Changes to the natural ecosystem, excluding the health of fish populations
Cross National	Actor dyad involves a minimum of two nationalities
Poverty	Limited livelihood options, lack of public health services, or a lack of public education services
Food Insecurity	A lack of access to a reliable source of sufficient and nutritious food (both fisheries and non-fisheries food)
Marginalization	Actors targeted for their social, economic, ethnic, tribal, gender, or political identity
Grounds Limits	Limitations on access to fishing grounds
Operational Scales	Competition between actors that operate at a different scale of fishing
Foreign fishing	The presence of foreign fishers in domestic waters
Markets	The supply or demand from transnational markets
Increased Gear Efficiency	Destructive fishing practices that collect fish rapidly in high volumes (illegal), highly efficient gear types (legal), or technological advances aimed at increasing catch
Increased Fishing Pressure	Increased domestic market demand for seafood or an increased number of fishers at a water body
Maritime Crime	Piracy, kidnap for ransom, theft of gear or fish resources, *illegal drug and wildlife trafficking
Illegal Fishing	Fishing in violation of local laws, including with banned gear, for endangered species, in a restricted location or without formally issued licenses
Strategic Location	The strategic importance of a fishery landing location
Aquaculture	Aquaculture operations such as the farming of fish, crustaceans, mollusks, aquatic plants, and algae

*Indicates additional maritime crimes that were added for the (FCC-PR-D). The original drivers are from the Fisheries Conflict Database Codebook [6].

Table 3.4 Frequency of Fisheries Conflict and Cooperation Actor dyads

Actor Type A	Actor Type B	Conflict	Cooperation	Total
Government - Federal	Unaffiliated	5	78	83
Government - Regional	Domestic Fishers	5	3	8
Domestic Fishers	Security Forces - Military	4	0	4
Government - Federal	NGO	4	4	8
Domestic Fishers	Security Forces - Police	2	0	2
Fishing Collective	Government - Regional	2	0	2
Security Forces - Military	Unaffiliated	2	0	2
Domestic Fishers	Domestic Fishers	1	0	1
Domestic Fishers	Government - Federal	1	49	50
Domestic Fishers	Scientists	1	0	1
Domestic Fishers	Security Forces - Resource	1	0	1
Domestic Fishers	Unaffiliated	1	0	1
Fishing Collective	Government - Local	1	0	1
Fishing Collective	Private	1	0	1
Fishing Community	Government - Local	1	0	1
Fishing Community	Government - Regional	1	0	1
Foreign Fishers	Government - Federal	1	0	1
Foreign Fishers	Security Forces - Police	1	0	1
Government - Federal	Government - Federal	1	4	5
Government - International	Government - Regional	1	0	1
Government - Local	Government - Regional	1	0	1
Government - Regional	Government - Regional	1	3	4
Security Forces - Police	Unaffiliated	1	0	1
Government - Regional	Government - Federal	0	8	8
Fishing Collective	Unaffiliated	0	5	5
Government - Federal	Private	0	4	4
Fishing Collective	Government - Regional	0	3	3
Government - Federal	Scientists	0	3	3

NGO	Unaffiliated	0	3	3
Domestic Fishers	NGO	0	2	2
Fishing Collective	Government - Federal	0	2	2
Government - Regional	NGO	0	2	2
Government - Regional	Private	0	2	2
NGO	Security Forces - Resource	0	2	2
Domestic Fishers	Fishing Community	0	1	1
Domestic Fishers	Private	0	1	1
Domestic Fishers	Security Forces - Local	0	1	1
Fishing Community	Security Forces - Resource	0	1	1
Government - Federal	University	0	1	1
NGO	NGO	0	1	1
Security - Military	Government - Federal	0	1	1
Tourism	Government - Regional	0	1	1
University	Domestic Fishers	0	1	1
	Total	40	186	226

¹Values indicate frequency of events with actor dyad for cooperation and conflict that involved the corresponding actor type. More than one actor dyad can be coded per conflict or cooperation event.

3.14 Appendix

Appendix 3.1 Queries to collect relevant news articles were conducted in both Spanish and English since these are the primary languages spoken in Puerto Rico.

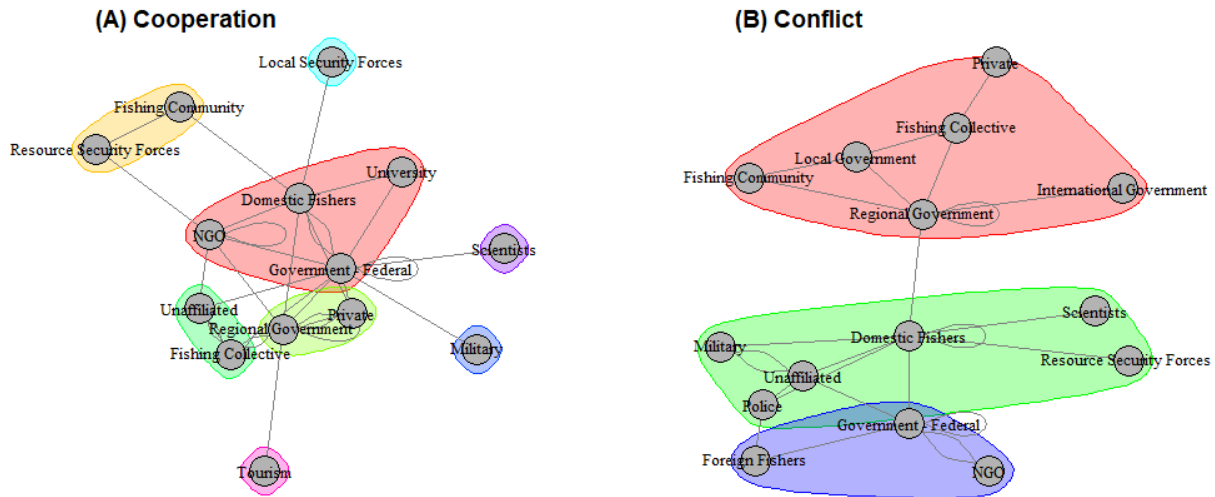
Queries included the following search terms:

English query:

"san juan" OR " arecibo " OR " mayagüez" "aguadilla" OR "ponce" OR "humacao" AND "exclusive economic zone" OR "territorial waters" OR "contiguous zone" OR "continental shelf" OR "high seas" OR (coast OR coastline OR coastal OR beach OR island) AND (fish OR fishery OR fisheries OR fisherman OR fishermen OR fisherfolk OR aquaculture OR trawl OR seine)

Spanish query:

"san juan" OR " arecibo " OR " mayagüez" OR "aguadilla" OR "ponce" OR "humacao" AND " zona económica exclusiva " OR "aguas territoriales" OR "zona contigua" OR "placa continental" OR "alta mar" OR (costa OR línea costera OR costera OR costero OR playa OR isla) AND (pez OR pescador OR pescado OR langosta OR carrucho OR pescadores OR acuicultura OR trasmallo OR rastreo OR chichorro)



Appendix 3.2 Community detection of sectorial actors using the Walktrap algorithm to validate patterns identified qualitatively.

The graph uses the Fruchterman-Reingold layout for visual clarity, and thus the distance between nodes does not equal the strength of the relationship. **(A)** Cooperation network with a modularity of 0.15, divided into 8 sub-groups distinctively colored. Notably, domestic fishers and federal government are part of the same cooperative community. **(B)** Conflict network with a modularity of 0.43, divided into three major subgroups. Notably, organized fishers (represented by fishing communities and collectives) are in the same conflict group as local and regional government. Meanwhile, individual domestic fishers are in more frequent conflict with government security forces.

**Chapter 4. Women in Small-scale Fisheries (SSF) Cooperation
and Conflict Case Study in Southwest Puerto Rico**

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Keywords: Women, Fisheries Conflict, Fisheries Cooperation, Small-scale fisheries, Puerto Rico

4.1 Abstract

This study aimed to answer the question: What role have women played in fisheries cooperation and conflict in the Southwest region of Puerto Rico from 2010- March 2020? Virtual semi-structured interviews were conducted in March 2020 with several women situated in a variety of roles in the small-scale fisheries sector in the Southwest region of Puerto Rico. The interview guide was adapted from the coding methodology for Villegas et al. [1]. Interviews were transcribed and qualitatively coded using NVivo. Of the three interviews analyzed, 20 fisheries conflict events and 17 fisheries cooperation events were extracted. The three primary drivers of fisheries conflict described in the interviews were the variables limitations on access to fishing grounds, weak governance, and an actual or perceived decline in fish populations. The three primary drivers of all fisheries cooperation events were the supply or demand from markets, marginalization, and increased gear efficiency. Women in Puerto Rico make up a small percentage of the commercial fishing sector, however the influence they have in shaping cooperation and conflict dynamics is evident. Despite their efforts often going unacknowledged within the literature, the women in SW PR serve in many different roles in the fisheries sector including subsistence fishing (oysters and snappers), science communication, and governmental positions. Women are key actors and leaders in cooperation amongst other fisher women, fishermen, and local government figures in the region.

4.2 Introduction

In 2011 the University of Puerto Rico Sea Grant Program published a volume of Fuede y Verguilla, “La Mujer en la pesca,” It concludes with a picture of a some young girls and the question “*Serán ellas el futuro de la pesca?*” [2]. This hopeful question translates to “Will they be the future of fishing?”. Since 2011, however, there has been no published research specifically focused on women’s roles in the small-scale fisheries in Puerto Rico. The most recent publication highlighting women’s roles in Puerto Rican fisheries of any scale appears to be from 2004, and fond that women’s participation is very limited in Puerto Rican fisheries. Women

made up less than 1% of the 2003 trap fisher population; women generally engage in activities such as gear maintenance and repair, fishery product sales and marketing, and accounting and other paperwork [3]. The pattern of neglecting to include women's contributions in Puerto Rican fisheries remains, however, according to interviewer respondents, there has been a recent push to emphasize the important role that women play in Puerto Rican fisheries. Additionally, there are plans to develop more in-depth interviews by a woman academic at University Puerto Rico Sea Grant to gain a better understanding of fisherwomen roles in the small-scale fisheries island-wide in Puerto Rico; however, the state of this work as of 2021 is in development (R2, 2020). This study is the first contemporary work to specifically highlight women's roles in fisheries conflict and cooperation in Puerto Rico.

The roles and responsibilities that women hold within the small-scale fisheries sector are largely underappreciated and deserve to be acknowledged. Continuously, non-inclusive statistics based on fisheries catch and production data fail to reflect the actual participation of women in fisheries, resulting in a quantitative data gap [4–6]. A 2020, study surfaced that women account for an annual catch of ~2.9 million tons of seafood a year and an estimated 2.1 million women participate in small-scale fisheries globally [7]. The importance of recognizing the ecological knowledge that women carry within these systems was also highlighted. The study further argued that:

“...broad global initiatives such as the Sustainable Development Goals (SDGs) have the potential to influence policies and programs at a national and local level that respond to the broad range of challenges at the human-environment interface, including fisheries. SDG 5, to achieve gender equality and to empower all women and girls, and SDG 14, life below water, provide considerable guidance through detailed targets on how to advance each of these goals. However, advancing these goals requires indicators for taking stock, measuring gaps, and assessing progress. The collection of sex-disaggregated data for the fisheries sector is critical to the process of developing policies and programs that aim to sustainably and equitably manage our oceans...” [7]

In tandem with SDG 5 and SDG 14, is SDG 16, to promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable, and inclusive institutions at all levels. One of the indicators of SDG 16 is, to

significantly reduce all forms of violence and related death rates everywhere. Reducing all forms of violence requires an understanding of a base line of what the current rate, percentage, or counts of all types of violence are, this can take the form of conflict analysis similar to what is presented in [1]. Furthermore, if we are going to truly hold institutions accountable to promoting peaceful and inclusive societies and the access to justice *for all*, it should come as no surprise that women need to be included in the analysis helping us understand if we are reducing all forms of violence.

There have been calls to better understand the drivers, actors, and dynamics which characterize cooperation and conflict surrounding fisheries systems and resource in the Caribbean [1,8]. Fisheries conflicts have received little regional attention in Latin America and the Caribbean. Caribbean small-scale fisheries are complex adaptive systems, conceptualized as social-ecological systems, with many layers and moving parts [9,10]. More generally, there have been few fisheries conflict studies which focus on the role that women play in fisheries conflict and cooperation dynamics [11]. A recent study found that of the 168 fisheries conflict and cooperation events identified in Puerto Rico, 38% of these events included at least one woman actor[1].

According to experts in Puerto Rico, social data is the least well known by traditional fisheries managers and is lagging the most in terms of database development and research investment. It has been argued that social scientific data is at least as important as fish biology data for management purposes [12] . Despite this urgent need, there is very little contemporary data about the social, historical, cultural, and economic context of fishing is readily available to be used, in fishery management actions. A synchronized comprehension of gender roles and contributions by women is urgent and critical to manage SSF and move towards better coastal management [13,14].

This study uses a targeted mixed methods approach to interrogate the role of women in in Puerto Rico's small-scale fisheries in general and in fisheries resource cooperation and

conflict specifically. It uses women's voices to begin fill a generational chasm in our understanding of these roles [15] . We hope to help reposition women and their voice at the forefront of policy recommendations to achieve Sustainable Development Goals relevant to the intersection of gender equality, empowerment, and peaceful and inclusive institutions at all levels in small scale fisheries in Puerto Rico.

4.3 Background/Context on Community

Puerto Rico's U.S. territory status often situates the island to be marginalized from international efforts at fisheries peace and conflict studies while also being overlooked from certain state-level support systems in the U.S. Puerto Rico is more reliant on ocean-related activity than most U.S. states. The island is home to 3.2 million people and has some 700 miles of coastline that includes mangroves, wetlands, coral reefs, beaches, and coastal forests. Puerto Rico has one of the most diverse and competitive economies in the Caribbean and Latin American region [16].

Cabo Rojo, a municipality in Puerto Rico is dependent on fishing, with the highest annual landings and the most productive fishers; over one thousand tons were landed valued at over \$5.2 million from 1999 to 2003, ranking first among all municipalities [17] . Cabo Rojo has seven landing centers: four to five in Puerto Real, two in Boquerón, and one in El Combate [17] (**Fig. 3.4**). Although engagement varies according to region, commercial fishers tend to belong to a Villa Pesquera, where they have lockers for their gear, seafood markets, slip space, piers, and other fishing infrastructure [18].

4.4 Materials and Methods

4.4.1 Data Collection

The primary investigator conducted semi-structured interviews with women engaged in the fisheries sector in the southwest region of Puerto Rico. The interview participants reside respectively in Cabo Rojo, Puerto Real, and Boquerón. The semi-structured interview guide used in this study was adapted from the coding methodology previously developed by the researchers

and others [1]. The coding methodology categorizes cooperation and conflict events according to frequency, location, intensity (**Table 4.1**), drivers of interactions (**Table 4.2**), and actors (**Table 4.3**). The methodology defines a Fisheries Conflict or Cooperation Event (FCCE) as an incident in which a fisheries resource is contested, disputed, the source of conflict **or** the source of cooperation, agreement, and support between a minimum of two human actors, at a discrete temporal moment, and in a discrete location [1]. Both English and Spanish were used in this guide. All methods were approved by the Oregon State University Institutional Review Board (IRB)¹.

Fifteen fisheries sector experts were contacted and five responded. The Snowball Sampling Method (SSM) was utilized to identify and recruit participants for this study. This is a method for finding research participants where one participant gives the researcher a name of another potential participant, that participant provides another name and so on. So that the sample group grows like a rolling snowball [19,20]. One expert did not follow-up with the actual interview although initial phone contact was made via text, and one final participant identified as a male. Three female participant interviews lasted for between 40min-90min and were recorded and transcribed for subsequent analysis. Interviews were conducted remotely via Zoom (Zoom Video Communications Inc., San Jose, California) or via phone call. As travel restrictions eased in the second half of 2021, the 2020 virtual interviews were validated in September 2021 by the primary investigator using in-person interviews with two of the interview participants in Puerto Rico. These in-person interviews were conducted on the west coast of Puerto Rico. The third participant could not be contacted for an in-person follow-up interview.

¹ Compliance with Ethical Standards Information: IRB Number: IRB-2020-0548 Approved: March 13th, 2020
Expiration Date: 3/11/2025

The occupations of the interview participants varied, with each woman participating in different fields within the fisheries sector. One woman is a Council Member on a Fishing Management Council. Another participant has a background in accounting, and she identifies as a Fisherwoman. The final participant is a member of the Outreach and Education Committee for a Fishing Management Council and is affiliated with the University of Puerto Rico (UPR). Although the sample size for was significantly smaller than anticipated, the number of documented women participants in the fisheries sector of Puerto Rico compared to male counterparts is small. Latest publicly available data of the percentage of women active in fisheries comes from Valle-Esquivel et al. (2004), women made up less than 1% of the 2003 trap fisher population, at the time, 1163 fishers were operating in Puerto Rico translating into 11 women were fishers in Puerto Rico in 2003 [3]. On average, since 2010, there are approximately 15-20 documented women involved with fisheries in Puerto Rico, whether that be in fisheries management or directly fishing & operating in the fisheries. The number 15-20 was estimated from semi-structured interview responses and follow-up emails where a list of names were provided at different points in time of the 15 women contacted for initial interviews. Taking this into account a sample of approximately 15-20% of the population of women that are documented as directly involved in fisheries in Puerto Rico actively participated in this study.

4.4.2 Data Analysis

The primary investigator transcribed the audio recordings into password protected documents. The interview participants were sent a digital copy of their responses and asked to verify if they would like anything added or omitted from their individual transcripts. Additionally, the primary investigator confirmed during the in-person follow-up interviews if they had anything additional, that they would like to add or omit. Audio responses were then deleted from the device. To protect interviewee privacy, codes starting with the letter “R” standing for research participant followed by a random number were assigned to each interviewee for identification purposes (i.e. R3). The interview transcripts were coded in two

rounds to identify themes and patterns in the data. The first round used an open coding approach to classify segments of text with themes by looking for phrases that were used repeatedly. Additionally, after identifying general themes and patterns, the software program NVivo Qualitative Analysis Software (QRS International, Burlington, Massachusetts, USA) and the coding process documented in [1],” was utilized as a guide to further classify segments of the text according to actors involved with cooperation and conflict events, assign an intensity level to the cooperation and conflict events or aggregate events (events lasting multiple years), and identify drivers of the events identified in the interviews.

4.5 Results and Discussion

A total of 37 Fisheries Conflict and Cooperation Events were identified from the interview transcripts. Of the 17 cooperation events, characteristics placed them in an intensity of -5, -4, -2, -3, or -1 (least common to most common). Of the 20 conflict events, characteristics placed them in an intensity of 4, 2, or 3 (least common to most common) (**Fig. 4.1**). Out of the 17 possible drivers, three were identified for the cooperation events and ten were identified for the conflict events (**Fig. 4.2**). Out of the 23 possible actor types, seven were identified for the cooperation events and seven were identified for the conflict events (**Fig. 4.3**).

4.5.1 Intensities

In respect to the 17 cooperation events, 27% met characteristics placing them in an intensity of moderate/higher intensity of 3, most of the events fell into the tangible business arrangements involving fishers or fish processors and fish traders category. In reference to the 20 fisheries conflict events, 30% of the events met the moderate/higher intensity characteristics of – 1, most of the events referred to voicing opposition with DNER (Fig. 2).

4.5.2 Drivers

The three primary drivers of fisheries conflict described in the interviews were the variables Grounds Limits, Weak Governance, and Fish Populations. Each of these were drivers in more than 10% of fisheries conflict events (**Figure 4.2 A**). The three primary drivers of all fisheries

cooperation events were changes in Markets, Marginalization, and Increased Efficiency. These were the only drivers mentioned in fisheries cooperation events (**Figure 4.2 B**).

4.5.3 Actor Types

Seven actor types were extracted from all events (n = 37). Likewise, seven actor types were identified and categorized for conflict interactions. The most frequent conflict events occurred between Domestic Fishers and Security Forces – Resource (**Fig. 4.3 A**). Both the cooperation and conflict events illustrate fishers as key actor types. Cooperation interactions with Domestic Fishers, Government – Local, Fish Processors or Traders, and Fishing Community were the most frequent actor types (**Fig. 4.3 B**).

4.5.3.1 Women and Fisheries Conflict with DNER

Conflict between the *Departamento De Recursos Naturales Y Ambientales (DRNA)* (also known as the Department of Natural and Environmental Resources (DNER)) and domestic fishers in Puerto Rico has been persistent for the last decade. Conflicts included the following: A) frequent DRNA position turnover, B) catch regulations and rules being enforced with very little community buy in and perceived lack of understanding by officials of the nature of Puerto Rican fisheries compared to U.S. state fisheries, C) a multiple years lag in the fishing license approval process for queen snapper, and D) perceptions of DRNA misallocation of funding and lag in distribution of fisheries recovery funds after 2017's Hurricane Maria.

- A) *“And Recursos Naturales (DRNA) is very slow in their actions. Right now in the last year, there have been three different (Recursos Naturales officers) because they come and go and there is not one that can say, “he knows what he’s doing or she knows what she’s doing,” because they’ve never been on the boat and they have never been close to nobody in the area on the outside (of the department),” (Interview R3, 2020).*
- B) *“12 years ago, they made the closing of the conch, they wanted to do it during the summer, and that’s the peak of when people go out to fish. And with the meetings and the pressure from the fishermen, they changed it and they gave another month and extended to August because they wanted to close June and July, and this is the peak, and the people pressured them, they were very pressured, and they stuck to August. But usually, they ehh I don’t know. Because sometimes they try to rule with the rules of the state, and we are different because first we are an island and it is very different because in the states it is very commercial boats, big boats, not like us we have small*

boats. And we are different in that way and sometimes they make these rules without thinking that we are different,” (Interview R3, 2020).

- C) *“The snapper is closed from October, November, and December. And if you don’t have the license, you can’t catch the cartucho de marionaba. That’s why I was talking to the Recursos Naturales (DRNA) because they need to give us that license or we can’t fish. My fiancé his body is old because he has been fishing for 13 years using scuba, and the body doesn’t do well, he’s tired. He’s been here waiting for 6 years to get the license. So, it has been 6 years since he has not been allowed to catch the snapper (cartucho). And we had a meeting last year, and the guy told me, no, no, no he doesn’t have it, and I say come on, he has it. I told him let me know how much you have down, and I can tell you much I reported. And he said, no, no, no he doesn’t have it. And then I call him every month, and in February, he said, “oh, I’m so sorry, I have been doing a mistake.” And I said what?! A mistake?! That took so long!”* (Interview R3, 2020).
- D) *“I don’t know if you know about the money after Maria? (Hurricane Maria) There is a big fight there, they also went to the DRNA, because they were fighting for the money, and they only received 300 dollars, out of 9 million dollars, only 300 dollars each fisherman. There are a lot of fishermen that lost between \$5000-\$10000, they lost their boats their houses, and only 300 dollars. And now we have the pandemic, the pandemic, and, also we have the earthquakes. The earthquakes are in the Southside of the island, so those fishermen, some of them have the experience that they feel that the government has left them and they are not helping them. The fishermen they fight with the DRNA, all the time. Because that is the agency that puts the rules for them and they feel that the Department doesn’t do their job with them, they don’t protect them, the fishermen”* (Interview R2, 2020).

4.5.3.2 Women and Marginalization in Fisheries

Two of the interview participants reflected on reasons how and why women have historically experienced marginalization from the fishing sector in Puerto Rico:

“Practically, in the first generation it was bad luck for the boat if you have a woman in the boat and that was the first generation, and later it was just because of respect, if you have a woman in the boat, like in your small boats, you don’t have the facilities, to go to the bathroom or something, so they think it’s not respectful to have the woman in there because then she has to be looking for other ways. We can meet them at the parking lot. Because when they land the fish, we can clean the fish, we can sell the fish, we can do everything with the fish, but we can’t be fishing more than them. Only if you are the owner of a boat, you can have another woman fishing with you and in this area, we don’t have women fishing together. We have recreational fishing with women, but commercially, practically, all the women that are fishing now is because they fish with their brother or their husband. And that’s it.” (R1 Interview, 2020).

Similar to Puerto Rico, in Mexico, women are widely absent from the fishing sector census due to their low access to boat ownership, permits, or concessions [4,6]. Another participant noted

that fishermen have had to learn how to dive because they have had to go deeper for the fish. She reflected that she hasn't met a woman in fisheries that dives. It is a possibility that women have been excluded from this fishing practice, although the reason is unknown whether it be financial or if there is a lack in access to resources for diving resources in the region.

"And every day, here in Puerto Rico, is harder for the fishermen because of the overfishing, the pollution, and climate change they have to go more deeper for the fish and you have to know how to dive, and it can be dangerous. And I haven't met a woman in fisheries and dives." (R2 Interview, 2020).

4.5.3.3 Fisheries Cooperation with Fisherwomen and Families

"And we cooperate with each other always. That's part of what's great about being a woman. Because we live in the machismo, mucho machismo Puerto Rico; we are very strong, but they mistake our women in the industry. They don't see that we are there, at the beginning, they are like if you really can do it? But when they know we can do it, they are like okay, and they treat us like equals," (Interview R3, 2020).

A theme that emerged was that machismo is prevalent in the fishing community and still maintains a barrier for women's full incorporation into the fisheries sector in Puerto Rico. According to Tamar Diana Wilson, *"Machismo is the belief that women should be subordinate to the needs and desires of their male partners, taking care of them, providing them pleasure (either as wives or partners or as approached in predatory fashion by men who would not consider marrying them), and bearing their children, and it is not limited to Latin American societies,"* (Wilson, 2014: 4).

Although machismo is present, despite these and many other barriers, women act as agents of transformation in the management of fisheries in Puerto Rico. All three interview participants mentioned two notable women that cooperate and work together and rely on the oysters in the mangroves for income (**Fig 4.5**). Mangroves have often been cited in other regions such as the Philippines and West Africa as primary areas for women empowerment and participation in fisheries. For example, women in Honda Bay value and use intertidal and nearshore species of crustaceans for subsistence purposes, these species thrive in mangrove ecosystems [22]. More recent studies have found that women in the Philippines tend to dominate in these nearshore

ecosystems by engaging in nearshore gleaning and these practices play critical roles in household food security [23]. Additionally, oyster harvesting in the Densu Delta, in West Africa is traditionally led by women; in Casamance, Senegal female oyster farmers have organized themselves to achieve financial independence and better fulfil the need of their families, despite ongoing conflicts and hardships [24].

“Here they have oysters and they are 2 of them to pick the oysters in the mangroves and they sell them here at the table in Boqueron at the table and they sell them. One of them catches them and the other sells them at the table there in Boqueron. yeah they make a lot of money because the thing is that they drive a little boat, they don’t need a big boat. And the expenses are maybe \$5 for gasoline and go to the water and they took it because they are on the roots of the mangroves, the oysters. And they are free. They don’t need bait, just a knife and a bucket and that’s it. And clean them and put them on the table and put some lime and cut them and they sell it because this area. Boquerón is the area of the oysters. There are no oysters in other areas, maybe a little, but not as much as here, because here it is an area like a lagoon that they grow very fast. And they go every weekend. They open every weekend. In the summer they open every day,” (Interview R3, 2020).

Additionally, two of the interview participants mentioned the importance of passing down fishing traditions from generation to generation. This passing down of knowledge is truly where and how more women are becoming more involved in the fisheries sector as a family business.

“There is another family here in Puerto Real. That I love because there are a lot of women there. And 3 or 4 generations. The one in charge is the youngest. And the grandfather was a fisherman, and her grandmother was a fisherwoman. So now she is in charge of cleaning the fish and they cook, and they sell cooked fish. And another woman, her father is a fisherman, her brothers and uncles are fishermen, and she is the only girl in the family and her husband is a fisherman and they fish also for snappers,” (Interview R2, 2020).

4.5.3.4 Limitations and further research

The study was initiated and received IRB approval during the initial phases of the COVID-19 pandemic in March 2020. Due to the COVID-19 pandemic and associated travel restrictions, the extent of interview follow-up and in-person interviews was restricted. Additionally, the primary investigator is conversational in Spanish, but not fluent in Spanish and this restricted the extent to which she could build relationships with a some of the women in fisheries (for example, the women that collect and sell the oysters) that speak primarily Spanish.

Further research is needed to develop a more nuanced gender analysis and documentation of women's roles in all four fisheries management regions in Puerto Rico (North, South, East, and West). These explorations should also include mental health and community resources that are available to support the overall wellbeing of fishing communities and what additional resources are needed moving forward for them to thrive [25]. There appears to be a separate need for interpersonal relationship support and guidance to the fishermen and fishermen wives/significant others with respect to substance misuse/abuse especially as it pertains to diving practices.

4.6 Conclusion

This study provides a glimpse into the roles that women lead in fisheries conflict and cooperation events in Southwest Puerto Rico. In summary, women in Puerto Rico make up a small percentage of the commercial fishing sector, however the influence they have in shaping cooperation and conflict dynamics is evident. Despite their efforts often going unacknowledged within the literature, the women in SW PR serve in many different roles in the fisheries sector including subsistence fishing (oysters and snappers), science communication, and governmental positions. They represent key connections and leaders in cooperation amongst other fisher women, fishermen, and local government figures in the region. Additionally, the women that were interviewed did not necessarily think of conflict as a negative thing, they mentioned having pride in the way women use their voices to advocate for the fishing community especially when it comes to addressing injustices against fishers carried out by the DNER. In terms of creating more equitable fisheries management practices, we recommend that DNER in partnership with fishermen and fisherwomen and the University of Puerto Rico Sea Grant implement strategies such as gender-specific policy that aims at encouraging participation of women in fish farming, processing and marketing through encouraging mobilization of communities, and promoting the training of more men and women in fishing techniques (especially SCUBA diving), and business management [26].

While there is still so much to learn about the role that women play in the small-scale fisheries of Puerto Rico, we are inspired by the women that participated in this study to keep continuing the journey of learning and maintain relationships with the interview participants, colleagues in Puerto Rico, and especially programs such as UPR Sea Grant to see what the future holds. We began with a question from 2011: question “*Serán ellas el futuro de la pesca?*” Will they be the future of fishing? We cannot answer that decade old question yet, in part because women’s voices are absent from fisheries management discourse in Puerto Rico and their participation in fisheries remains largely hidden to those outside the social construction of small-scale fisheries in Puerto Rico. We can though end with the voice of the women themselves acknowledging a visible shift in the recognition they are beginning to receive:

“Since 2016, The Caribbean Fisheries Management Council made a calendar of the year about Women in fisheries, and they started looking for that information about what are the women in Puerto Rico and Virgin Islands and how are they working in the fisheries. So we started developing collaboration from woman to woman, because we started to know each other, okay you work in the fish market, and okay the other one, you are a fisherwoman and you fish and go out and fish for red snapper with your husband, so we started to talk together, because usually we don’t know about other women in fisheries at least here in my area, there are only three women that work in the fish market. Aside from me, one is the daughter of the owner. So, she is the daughter, and she runs a fish market now that, her father is getting old, and she stayed with the fish market and the other one is the partner of the owner of Bahia Puerto Real, she is the one that was born in the business. Now they see that the women take care of the sales and merchandise of the fish. I think everything has changed since 2015/2016,” (Interview R1, 2020).

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4.8 Figures

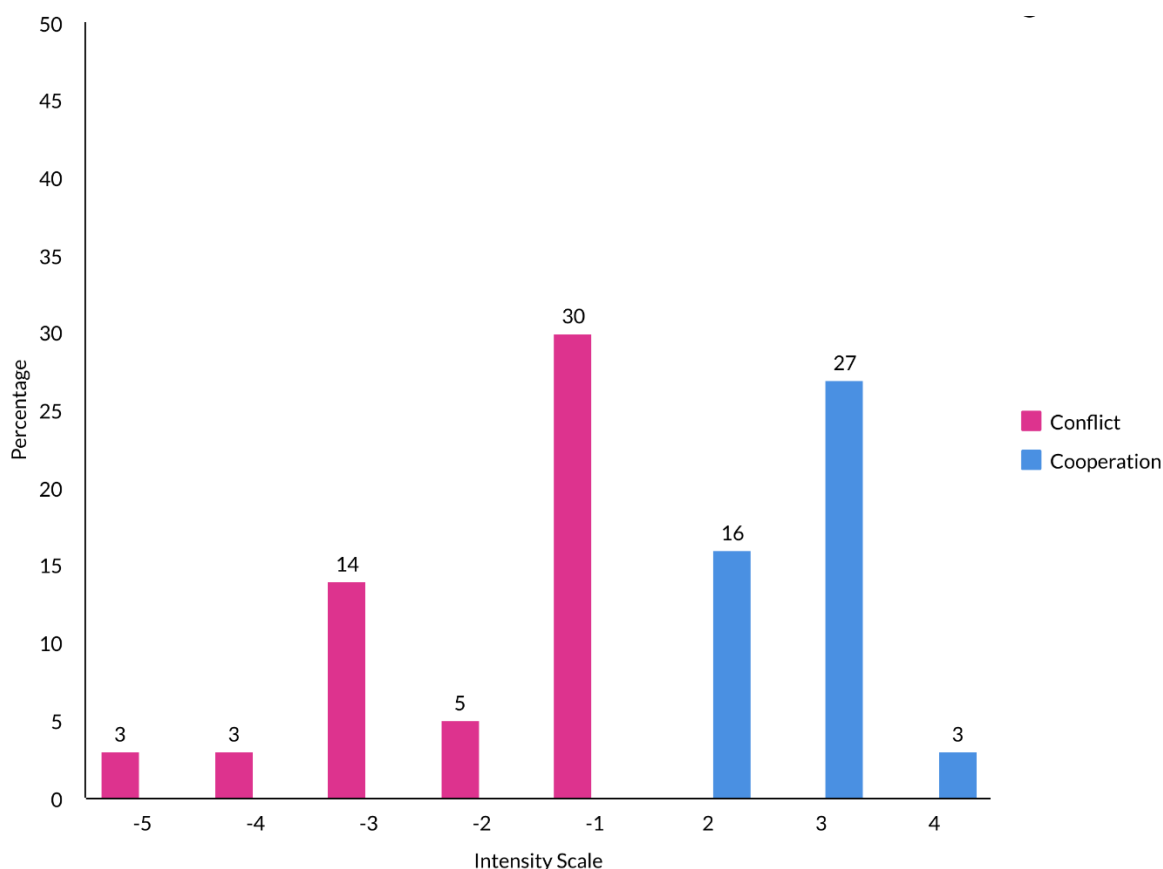
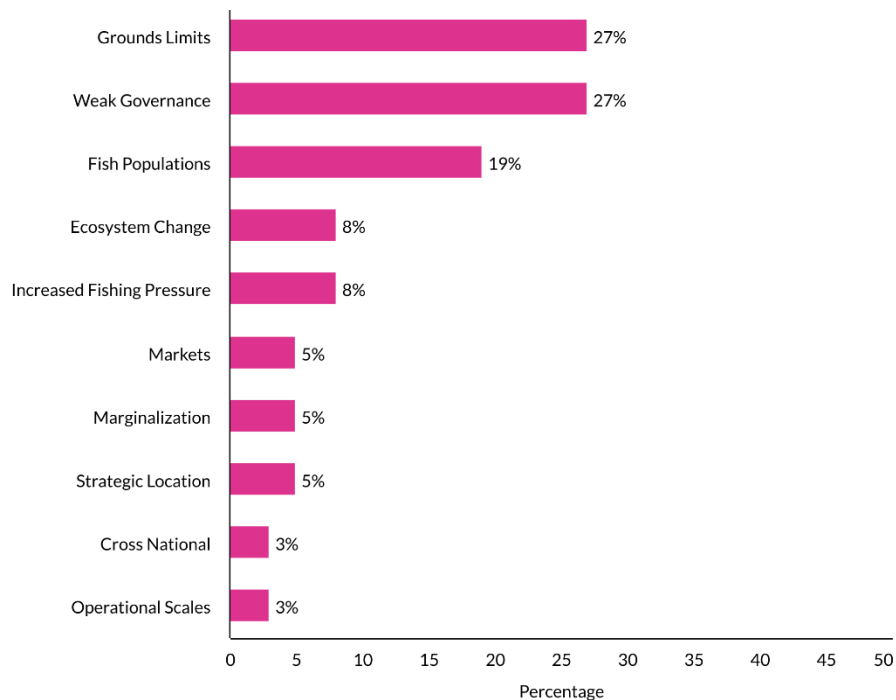


Figure 4. 1. Percentage of Fisheries Conflict and Cooperation Events per intensity level extracted from semi-structured interviews (n=3) with women actors involved in the small-scale fisheries in southwest Puerto Rico. Percentages are labeled above respective intensity level. Fisheries Conflict Events are depicted in pink (n = 20). Fisheries Cooperation Events are depicted in blue (n = 17). There are additional intensity levels on the intensity scale (**Table 4.1**) that did not match with events described in the interviews.

A)



B)

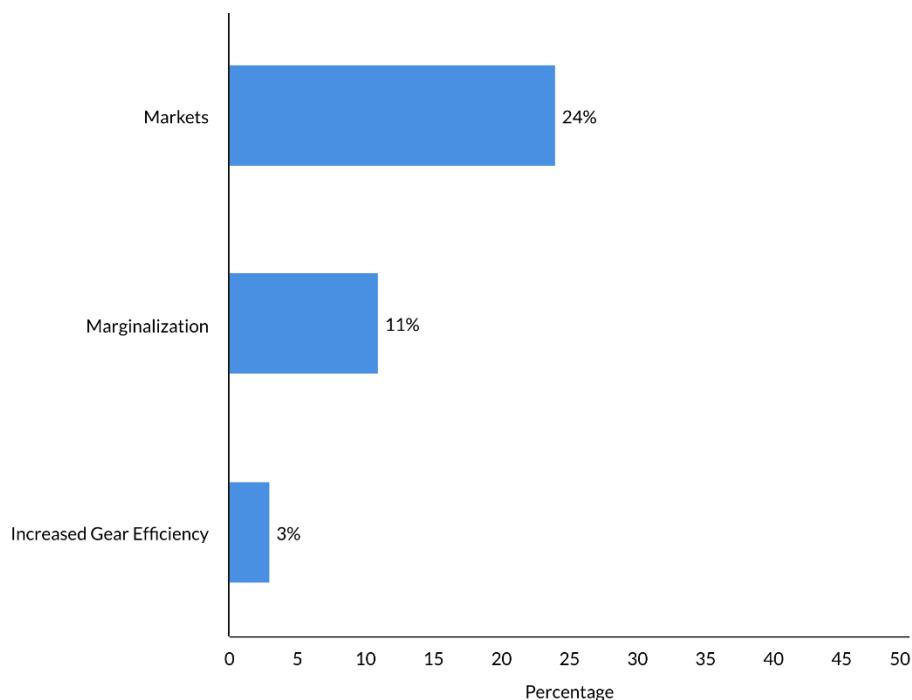
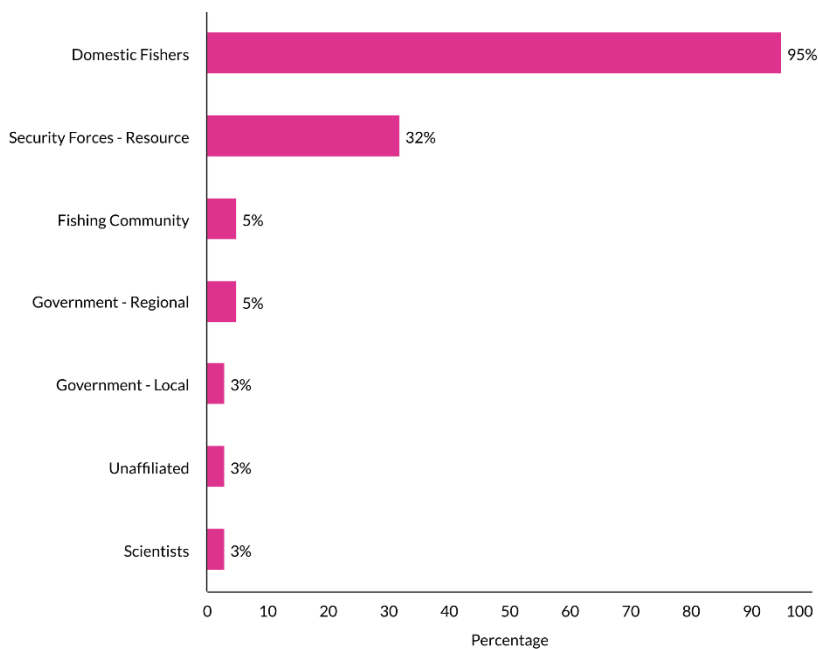


Figure 4.2. Percentage of Drivers in Fisheries Conflict and Cooperation Events extracted from semi-structured interviews (n=3) with women actors involved in the small-scale fisheries in southwest Puerto Rico. (A) Drivers of Fisheries Conflict Events in Puerto Rico depicted in pink. (B) Drivers of Fisheries Cooperation Events in Puerto Rico depicted in blue. There are additional drivers (**Table 4.2**) that did not match with events described in the interviews.

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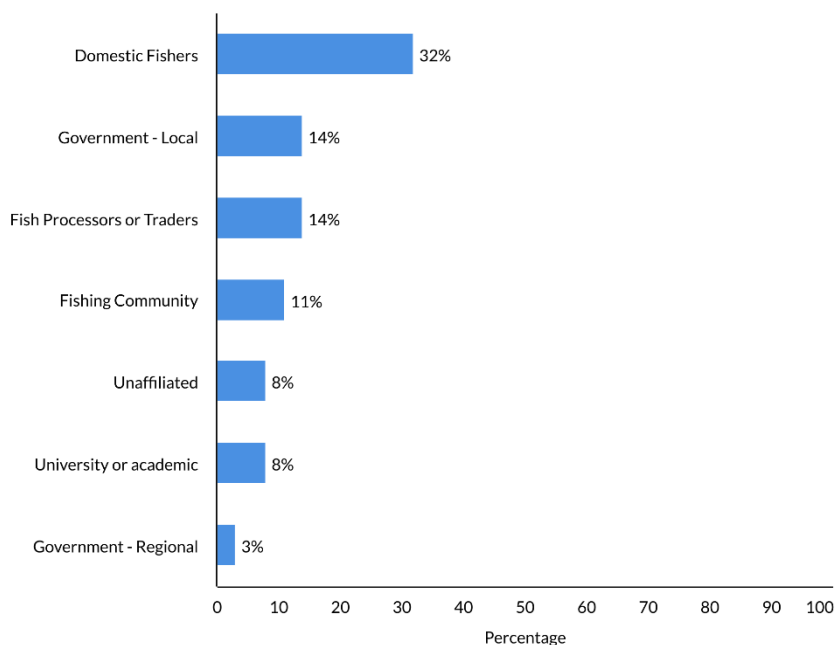


Figure 4.3 Percentage of Actor Types in Fisheries Conflict and Cooperation Events. (A) Actors of Fisheries Conflict Events in Puerto Rico depicted in pink. (B) Actors of Fisheries Cooperation Events in Puerto Rico depicted in blue. There are additional actor types (**Table 4**) that did not match with events described in the interviews.

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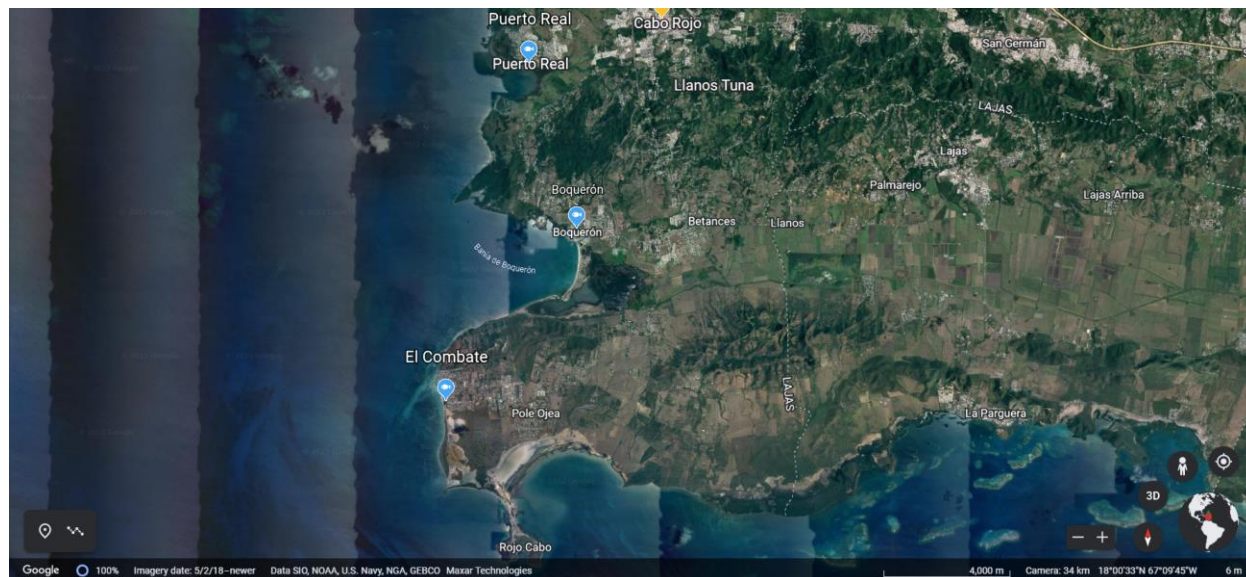


Figure 4.4 Google Maps, 2022. *Cabo Rojo Landing Sites*, 1:4000. Google Maps [online] [Accessed 23 August 2022]. The primary landing sites in Cabo Rojo are represented with blue fish icons, in Puerto Real, Boquerón, and El Combate.



Figure 4.5 Photograph of Oysters from El Poblado de Boquerón. Photo Credit: Ciera Villegas.

4.9 Tables

Table 4.1. Fisheries Conflict and Cooperation in Puerto Rico Intensity Scale

FCC-PR-D	Intensity	UCED
Small scale acts of violence, protests, vandalism	-5	Small scale acts of violence, protests, vandalism
Litigations, appeals of administrative actions, *arrests	-4	Litigations, appeals of administrative actions
Fines, proposal and permit denials, halting negotiations, *significant fisheries livelihood loss	-3	Fines, proposal and permit denials, halting negotiations
Petitions, withdrawal of third-party support	-2	Petitions, withdrawal of third-party support
Delays, report reviews, voicing opposition, editorials	-1	Delays, report reviews, voicing opposition, editorials
Judicial rulings, no comment statements, announcements	0	Judicial rulings, no comment statements, announcements
Voicing opinions of approval, court-forced negotiations, editorials, *fisheries ecosystem clean-ups (including mangroves)	1	Voicing opinions of approval, court-forced negotiations, editorials
Meetings, third-party support, negotiation requests	2	Meetings, third-party support, negotiation requests
Permit approvals, fixing violations, negotiations begin, *tangible business arrangements involving fishers	3	Permit approvals, fixing violations, negotiations begin
Lawsuit settlements, regulation approval, management transfers	4	Lawsuit settlements, regulation approval, management transfers
State bill passage, compacts or official agreements	5	State bill passage, compacts or official agreements

*Indicate slight modifications to the Upper Colorado Events Database (UCED) intensity scale

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Table 4.2 Drivers of Fisheries Conflict and Cooperation

Driver	Description
Weak Governance	Corruption, weak enforcement, weak institutional capacity, a lack of public participation, inadequate information
Fish Populations	An actual or perceived decline in fish populations
Ecosystem Change	Changes to the natural ecosystem, excluding the health of fish populations
Cross National	Actor dyad involves a minimum of two nationalities
Poverty	Limited livelihood options, lack of public health services, or a lack of public education services
Food Insecurity	A lack of access to a reliable source of sufficient and nutritious food (both fisheries and non-fisheries food)
Marginalization	Actors targeted for their social, economic, ethnic, tribal, gender, or political identity
Grounds Limits	Limitations on access to fishing grounds
Operational Scales	Competition between actors that operate at a different scale of fishing
Foreign fishing	The presence of foreign fishers in domestic waters
Markets	The supply or demand from transnational markets
Increased Gear Efficiency	Destructive fishing practices that collect fish rapidly in high volumes (illegal), highly efficient gear types (legal), or technological advances aimed at increasing catch
Increased Fishing Pressure	Increased domestic market demand for seafood or an increased number of fishers at a water body
Maritime Crime	Piracy, kidnap for ransom, theft of gear or fish resources, *illegal drug and wildlife trafficking
Illegal Fishing	Fishing in violation of local laws, including with banned gear, for endangered species, in a restricted location or without formally issued licenses
Strategic Location	The strategic importance of a fishery landing location
Aquaculture	Aquaculture operations such as the farming of fish, crustaceans, mollusks, aquatic plants, and algae

*Indicates additional maritime crimes that were added for the (FCC-PR-D). The original drivers are from the Fisheries Conflict Database Codebook [6].

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772 *Table 4.3. Fisheries Conflict and Cooperation Event Actor Types*

Actor Type	
	Domestic Fishers
	Foreign Fishers
	Fishing Community
	Security Forces – Military
	Security Forces – Police
	Security Forces – International
	Security Forces – Resource
	Security Forces – Local
	Government – Local
	Government – Regional
	Government – Federal
	Government – International
	Fishing Collective
	Fish Processors/Traders
	Tourism
	Rebels - Organized
	Rebels – Other
	Bandits
	Other *NGO, University, Scientists, Private Sector, Unaffiliated

*indicates the Other Actor Type categories that were created [1]

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4.10 Appendix

Appendix 4.1. Semi-structured interview question guide.

Following the introduction, I asked seven blocks of guiding questions.

Primary Questions	Prompts
Q1. First, can you describe your role in relation to fisheries resources in Puerto Rico? For how long have you held this position?	First, can you describe your role in relation to fishing and seafood in Puerto Rico? For how long have you held this position?
Q2. What conflicts over fisheries resources do you see in general?	<p>SQ1: Do people argue or fight over fish and seafood? Can you give me examples?</p> <p>SQ2: What is the nature of the conflict (i.e. verbal, physical action taken (arrests, confiscations), violent)?</p> <p>SQ3: Where and when did you see these conflicts? Can you tell me where on the map?</p> <p>SQ4: Who is involved with these conflicts?</p> <p>SQ5: What are the reasons for these conflicts (do this for each event mentioned)?</p>
Q3. How are women involved in conflicts over fisheries resources?	<p>SQ1: What roles do women play in fishing and seafood?</p> <p>SQ2: What roles do women play in fishing and seafood conflict?</p> <p>SQ3: Is it acceptable for women to use violence in resolving these conflicts?</p> <p>SQ4: What impact does this conflict over fisheries resources have on women?</p> <p>SQ5: Do women have to take on different roles as a result of this conflict over fisheries resources?</p> <p>SQ6: What specific fisheries resource conflict, if it is resolved, will make the biggest difference to bringing peace to your community?</p>
Q4: Have Maria and the recent earthquakes escalated fisheries conflict?	

	SQ1: If so, can you provide me with examples?
Q5. What cooperative events over fisheries resources do you see in general?	
	<p>SQ1: Do people agree or cooperate over fish and seafood? Can you give me examples?</p> <p>SQ2: What is the nature of the cooperation (i.e. verbal, physical action taken, formal agreement)?</p> <p>SQ3: Where and when did you see this cooperation? Can you tell me where on the map?</p> <p>SQ4: Who is involved with this cooperation?</p> <p>SQ5: What are the reasons for the cooperation (do this for each event mentioned)?</p>
Q6: How are women involved in cooperation over fisheries resources?	
	<p>SQ1: What roles do they play?</p> <p>SQ2: What is expected from women when there is cooperation over fish or seafood?</p> <p>SQ3: What impact does this cooperation over fisheries resources have on women?</p> <p>SQ4: Do women have to take on different roles as a result of this cooperation over fisheries resources?</p> <p>SQ5: What specific fisheries resource cooperation will make the biggest difference to bringing peace to your community?</p>
Q7: Have Maria and the recent earthquakes escalated cooperation over fisheries resources?	
	SQ1: If so, can you provide me with examples?

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Chapter 5. General Summary

5.1 Chapter summaries

This dissertation provides a single framework to analyze fisheries cooperation and conflict dynamics. In Chapter 2, a synthesis is presented of literature on fisheries conflict, literature on fisheries cooperation, and provides a bridge between the two using the framework developed for this dissertation. The framework utilizes the coding methodology in chapter 3 and the semi-structured interview guide in chapter 4. Additional brief recommendations are provided in terms of adapting toolkits such as the FishCollab ‘conflict mapping’ toolkit [50] can be utilized to bridge a quantitative content analysis methodology to analyze fisheries cooperation and fisheries conflict dynamics simultaneously [3] with gender centric mixed methods practices to validate and supplement findings. By using these tools, fisheries resource managers, researchers, and other fisheries resource stakeholders will have access to an all-encompassing blueprint that can make it easier to share lessons learned across fisheries sectors and across varying spatial and temporal scales. Finally, researchers are urged moving forward to disaggregate fisheries cooperation and fisheries conflict event analysis according to the methods presented in this dissertation by including a variable to capture presence or absence of women actors in such interactions [3,5].

Chapter 3 presents the operationalized and published framework via the creation of a database composed from Nexi Uni extracted media content analysis and a qualitative social network analysis approach which explored the dynamics between the date, location, drivers, and actors involved in conflict and cooperation interactions related to small-scale fisheries resources in Puerto Rico. During the timeframe of 2010-2019, a total of 35 fisheries conflicts and 133 fisheries cooperation events were identified. The primary drivers of all fisheries conflict events in Puerto Rico were maritime crime, an actual or perceived decline in fish populations, ecosystem change, cross national actors, poverty, marginalization, and strategic location of

fisheries. The primary drivers of all fisheries cooperation events were an actual or perceived decline in fish populations and ecosystem change. Of all the cooperation events coded, nearly three quarters fell under meetings, third-party support, or negotiation requests. While half of the fisheries conflict events fell under fines, permit denials, or negotiations halted. Social network analysis revealed a gap in direct cooperation networks between regional environmental managers and fishers, suggesting an opportunity for stronger co-management agreements; there is potential for these agreements to be incentivized by existing links between fishers and university actors and NGOs. The study found that of the 168 fisheries conflict and cooperation events identified in Puerto Rico, 38% of these events included at least one woman actor[4].

Finally, in chapter 4, the coding methodology utilized in chapter 3 was adapted to create a semi-structured interview guide. What role have women played in fisheries cooperation and conflict in the Southwest region of Puerto Rico from 2010- March 2020? Virtual semi-structured interviews were conducted in March 2020 with several women situated in a variety of roles in the small-scale fisheries sector in the Southwest region of Puerto Rico. The interview guide was adapted from the coding methodology for Villegas et al. [4]. Interviews were transcribed and qualitatively coded using NVivo. Of the three interviews analyzed, 20 fisheries conflict events and 17 fisheries cooperation events were extracted. The three primary drivers of fisheries conflict described in the interviews were the variables limitations on access to fishing grounds, weak governance, and an actual or perceived decline in fish populations. The three primary drivers of all fisheries cooperation events were the supply or demand from markets, marginalization, and increased gear efficiency. Despite their efforts often going unacknowledged within the literature, the women in SW PR serve in many different roles in the fisheries sector including subsistence fishing (oysters and snappers), science communication, and governmental positions. Women are key actors and leaders in cooperation amongst other fisher women, fishermen, and local government figures in the region. In order to create more equitable fisheries management practices in Puerto Rico, this chapter recommends that DNER in

partnership with fishermen and fisherwomen and the University of Puerto Rico Sea Grant implement strategies such as gender-specific policy that aims at encouraging participation of women in fish farming, processing and marketing through encouraging mobilization of communities, and promoting the training of more men and women in fishing techniques (especially SCUBA diving), and business management.

5.2 Conclusion

In conclusion, this dissertation provides a framework to study fisheries cooperation and fisheries conflict in conjunction with women's roles in these dynamics. For future research, there is still so much to learn about the role that women play in the small-scale fisheries of Puerto Rico, I was deeply inspired by the women that participated in this study to keep continuing the journey of learning and maintain relationships with the interview participants, colleagues in Puerto Rico, and especially programs such as UPR Sea Grant to see what the future holds. A potential next step could be a more nuanced gender analysis and detailed documentation of women's roles in all four fisheries management regions in Puerto Rico (North, South, East, and West). Additionally, there is still so much to explore in terms of analyzing fisheries cooperation and fisheries conflict dynamics which occur at the territory level. There are many different pathways to explore which were not explored for the purpose of this dissertation. Colonization's impact or involvement in fisheries conflict and cooperation dynamics over time has not been thoroughly studied to date and this could be an interesting pathway to further explore these dynamics.

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