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# Managing small-scale fisheries in Colombia



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## Abstract

The small-scale fishermen of Colombia face a wide range of problems and conflicts. While many problems are shared among individuals from both the Atlantic and the Pacific coasts (bi-coastal), others are unique to a subset of the communities, only occur on one of the coasts (uni-coastal) or in an individual locality. To come to grips with the major problems for these fisheries requires establishing a fisheries management strategy that can prioritize solutions at different levels: national, coastal, and local. This study describes the solutions identified by three sets of stakeholders: fishermen, local leaders and fisheries experts, to improve small-scale fisheries management in Colombia. Some cross-cutting solutions were recommended by all three sets of stakeholders. In other cases, only two of the three stakeholder groups agreed on certain proposals, and some isolated solutions were found in only one type of stakeholder. All three sets of stakeholders recommended that the government put in place fundamental regulatory framework for small-scale fisheries including support for alternative employment opportunities to reduce fishing pressure on the resources. Some but not all groups supported specific measures, such as gear restrictions, closed areas and closed seasons. There was also a clear need to distinguish those truly engaged in fishing as their livelihood from opportunists moving in and out of the sector. Specific recommendations are here presented to reform and restructure governance through co-management, and to develop a consensus among the main government and user stakeholders.

**Keywords:** Colombia, Small scale fisheries, Co-management, Fishery solutions

## Introduction

Small-scale tropical fisheries studies in the last few decades have strongly benefitted from a multidisciplinary approach that includes ecological, economic, sociological, technological and governance information (Christy 1997; Preikshot and Pauly 1998). Many fisheries frameworks and governance models around the world are based on a combination of government and community efforts. These models could be used as points of departure for discussions with important stakeholders in Colombian small-scale fisheries.

A growing global literature describes lessons learned from implementing small-scale fisheries management (Berkes 2004, 2010; Brown and Pomeroy 1999; Chuenpagdaee and Jentoft 2007; Cinner et al. 2012; FAO 2006; Francis et al. 2007; Garcia and Cochrane 2005; Lam and Pauly 2010; Lebel et al. 2006; Olsson et al. 2004, 2006; Pomeroy et al. 2004; Salas et al. 2011; Tyler 2006). Understanding social interactions within the context of fishing, and the dynamic among fishermen within and among

fishing communities (St. Martin et al. 2007) are essential in order to develop effective management strategies.

Moreover, the theoretical context for co-management of small-scale fisheries is an ongoing debate among academics and fisheries management practitioners, especially in the context of social-ecological systems (Berkes et al. 2001; Ostrom 1990, 2009; Pomeroy et al. 2004, 2011). Weak governance is one of the main causes of the present poor condition of fisheries and is characterized by (but are not limited to) corruption, lack of stakeholder participation, political will and capacity, weak institutional capacity and capabilities, poor enforcement, and inadequate information (CRC et al. 2006). Small-scale fisheries are extremely diverse, complex and dynamic (Berkes et al. 2001). They operate at many different scales and with many different stakeholders. These characteristics make the challenges and concerns that confront small-scale fisheries governance more difficult. Given the range of actors in small-scale fisheries, with their varying perceptions, agendas and power, there is a need to develop a governance system that can include multiple stakeholders (Bavinck et al. 2005). How best to tap their various interests, agendas and capacities remain a challenge.

In the case of Colombia, small-scale fishermen have not been fully recognized as key stakeholders in the fisheries management process (Cuello and Duarte 2010; García 2010; Saavedra-Díaz et al. 2015a). It is critically important to involve communities in co-management practices in order for management to be fully effective and to reduce the propensity for overexploitation. In the Caribbean and Latin America, examples of co-management exist in Mexico, Belize, Brazil, Peru and Chile. Due to the high diversity of the fisheries in these areas, as well as poverty, violence, forced displacement, among other situations, many co-management practices need to be implemented in concert in order to be effective. Also, decision makers need to recognize the importance of supporting management decisions with local knowledge (Begossi and Brown 2003). Recently, fisheries co-management was successfully implemented in Chile by dividing responsibilities for the Management Area System between government agencies and small-scale fishers' organizations (Marin and Berkes 2010). This success raised consciousness among fishermen. It avoided the tragedy of the commons by building rapport between the state and fishermen, raising ecological and management awareness, and promoting teamwork between fishermen and scientists (Schumman 2007). The research presented here explores possible cross-cutting solutions of this kind for the particular realities of the under-researched small-scale fisheries of Colombia.

Government institutions and agencies in Colombia have attempted to organize the fisheries sector and articulate policy through the publication of different sets of national documents. However, a disarticulated institutional framework and a thicket of contradictory policies highlight the fragmented nature of Colombian fisheries management. Unfortunately, national planning documents such as the "Colombian Vision 2019" have set unrealistic goals for increases by 30 % in fisheries captures for 2019 (ECOVERSA 2007). Development goals such as this misunderstand the current status of both fishery resources and the management system and have not directly involved local communities in the development and implementation of policy to achieve sustainable fisheries (Hart 2003; McCay and Jentoft 1996; Schumman 2007). The Colombian legal framework that regulates fishery resources at the national level is the Code of Renewable Natural Resources and Protected Environment, created by the Decree/law 2811 of 1974 and Law

13 that created the General Statute for Fisheries in 1990. The Rural Development and Agriculture Ministry- through the Fishery and Aquaculture National Authority - is in charge at the national level of the Marine Small-Scale Fishery sector since 2011. However, over the last decade five different institutions have been in charge of fisheries. Such institutional instability at the national level has been one of the major challenges for successful management of the small-scale fishery sector.

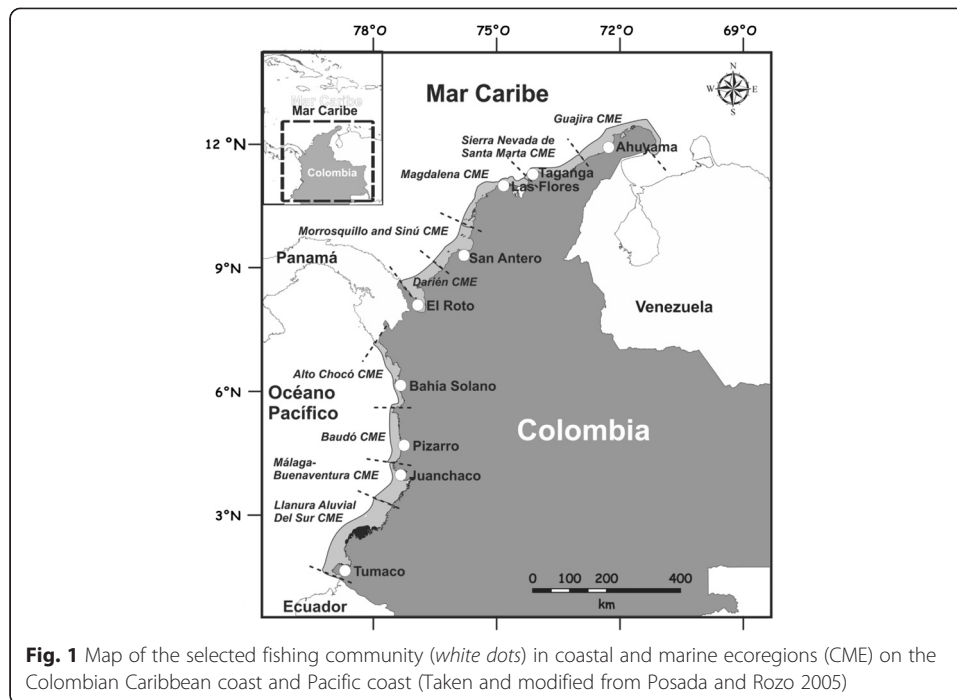
Another challenge to overcome is the difference of social perceptions among stakeholders –i.e., fishermen, local leaders, and fishing experts and their existing relationships within marine ecoregions. According to Saavedra-Díaz et al. (2015b), fishermen perceive destructive fishing methods as the most significant problem with the highest percentage response among all respondents (70 % in the Caribbean coast and 79 % in the Pacific), followed by the lack of regulation enforcement (60 % in Caribbean and 47 % in Pacific) and pollution and industrial contamination. Local leaders identified the low quality of life of fishermen including the lack of public services, lack of potable water and lack of education focused on environmental awareness. They also noted a weakness of fisher's organizations and leadership. In contrast, the majority of fisheries experts believed that the small-scale fishery sector has been largely ignored by governmental actions. The fisheries experts identified the instability of regulatory authorities and lack of control measures, oversight and monitoring by the agencies in charge of artisanal fishery activity due to lack of personnel, and the lack of infrastructure or equipment to facilitate this work. While many problems occur on both coasts, other problems are coastally unique, and further, some affect only a small portion of fishing communities. In consequence, there is a need to establish a fisheries management strategy that can prioritize solutions at different levels: national, coastal, and local.

Using results from the same survey discussed in Saavedra-Díaz et al. (2015b), the objective of this paper is to discuss the solutions identified by fishermen, local leaders and fisheries experts for improving small-scale fisheries management in Colombia. In addition, we present specific recommendations on a framework for small-scale fisheries governance in Colombia.

## **Methods**

### **Study area**

The Colombian coastline is divided between the Caribbean and the Pacific. The Caribbean coastline is 1642 km in length and the Pacific coastline is 2188 km in length. The Caribbean coast has a population of 2,919,348, while the Pacific coast has a population of 543,594 (Posada and Rozo 2005). Colombia has 12 political and administrative coastal states, eight on the Caribbean coast and four on the Pacific coast. Different from the states, coastal and marine environmental divisions separate the Colombian coast into six Coastal and Marine Ecoregions (CME) on the Caribbean and four CMEs on the Pacific coast (Fig. 1), plus four Insular Ecoregions on both oceans. CMEs are distinguished by different environmental characteristics such as geo-morphology, hydrography, sedimentology, and coastal and marine ecosystems (Posada and Rozo 2005). Nevertheless, state and CME boundaries are relatively similar, in some cases nearly overlapping. Since the present study focuses on environmental conditions, CMEs provide spatial orientation. Although the Caribbean and Pacific Insular Eco-regions



(San Andrés and Providence Archipelago, San Bernardo, Malpelo and Gorgona Islands) are not included this study they should be included in future efforts to improve Colombian fisheries management overall.

The following parameters were employed in identifying one “typical” community in each CME: (1) it was not located in a marine protected area or on an island; (2) it was historically recognized as a fishing community; (3) it relied on fishing as a primary economic or subsistence activity; (4) there existed some level of fisher’s organization (formal); (5) the community was involved previously in research projects; (6) there was a low incidence of violence or drug trafficking (for safety); and (7) it had been considered by Fishery experts.

Caribbean coast fishing communities selected in each coastal and marine ecoregion (CME) for this study (Fig. 1) include *Ahuyama* in the Guajira CME, *Taganga* in the Sierra Nevada de Santa Marta CME, *Las Flores* in the Magdalena CME, *San Antero* in the Morrosquillo and Sinú CME and *El Roto* in the Darién CME. Pacific coast fishing communities selected in each CME are *Bahía Solano* in the Alto Chocó CME, *Pizarro* in the Baudó CME, *Juanchaco* in the Málaga-Buenaventura CME, and *Tumaco* in the Llanura Aluvial del Sur CME.

#### Data sources

The fishermen, local leaders and fisheries experts were interviewed concerning their solutions to the identified problems that are affecting the small-scale fisheries communities and the marine fisheries resources they depend upon for food and livelihood. In addition, fishermen at community meetings were asked questions about their interest in, readiness for and how to move toward fisheries co-management. Fishermen are defined here as coastal marine small-scale fishermen or fisherwomen, including a great

variety of racial and ethnic groups and are directly involved in fishing activities. Local leaders include presidents of local fishing associations or persons recognized as influential members of the fishing community including traditional authorities who fishers look to for leadership and who bring a broader perspective than just of a single fisherman. Finally, fisheries experts are scientists and technicians from Colombian fisheries institutions and administration with expertise and experience working with fishing communities, fishermen and marine resources. Semi-structured interviews of 309 people were conducted. Table 1 shows the number of interviews undertaken for the Caribbean and Pacific coasts per stakeholder group per community.

Fieldwork performed in the fishing communities took place from August 2008 to August 2009 and lasted approximately one month within each community. To collect the fishermen and local leaders' perceptions about fisheries management solutions, a representative sample of leaders and fishermen in each small-scale fishing community were chosen (Table 1). The great variety of the fishing communities imposed important methodological limitations. For instance, fishing communities vary in population from villages such as *El Roto* with 50 Fishermen, to municipalities such as *Tumaco* with 4000 fishermen. In high population fishing communities such as *San Antero* on the Caribbean and *Tumaco* on the Pacific community leaders identified neighborhoods populated mainly by fishermen, for whom fishing activity and proximity to landing places determine where they live. Some municipal fishing communities also cover a much larger area than others (*Tumaco* extends over 167 counties). Therefore, the number of *Tumaco* fishermen involved in the study was low compared to the total number of fishermen in the community, and most came from the municipal center so that peripheral areas were under-represented.

Small communities with fishing populations of around 200 were simpler to sample. The lead author lived approximately three weeks to one month in each community and developed a greater understanding of the situation those fishermen faced. Recognizing these limitations is important in understanding the results of this research.

Community leaders were interviewed first upon arrival at each community. Local leaders identified the principal fishing gears used locally and explained the general

**Table 1** Number of semi-structured interviews and number of fishermen performed in each stakeholder group on each community and eco-region on each coastal region

Methods	Caribbean					Pacific				Total number of participants by method
	<i>Ahuyama</i>	<i>Taganga</i>	<i>Las Flores</i>	<i>San Antero</i>	<i>El Roto</i>	<i>Bahía Solano</i>	<i>Pizarro</i>	<i>Juanchaco</i>	<i>Tumaco</i>	
Fishermen interviews	18	23	31	36	17	14	15	18	23	195
Leaders' interviews	2	3	4	6	1	4	2	3	2	27
Fishery experts' interviews	5	8	5	6	7	2	2	18	4	57 <sup>a</sup>
Co-management hearings	17	10 and 18	20	27 and 28	20	35	13	13 and 17	17	235

<sup>a</sup>Thirty interviews performed in 2007 (15 from the Caribbean and 15 from the Pacific) in the feasibility study for the present research have been included in this study, for a total of 87 fishing experts interviews in total

economic, social, and cultural conditions in the community. The interview contained 15 standard questions focused on general subjects pertaining to the local artisanal fishing community. Questions were divided into five main subjects: (1) the role of local leaders in the community; (2) overview of the condition of marine artisanal fisheries; (3) fisheries problems; (4) proposed solutions; and (5) fisheries management.

Given the time and resources available, at least two fishermen from each community were interviewed for every fishing method (i.e., gillnets, mainline, longline, beach seine net with bag, harpoon, surrounding net, bottom trawl, among others). While representativeness of such a survey is always challenging, every effort was made to capture a wide range of perspectives. The interview consisted of 89 questions focused on seven main subjects: (1) personal information; (2) demographics and quality of life (family, education, living conditions, among others); (3) current fishing activity (i.e., time spent fishing, reasons for fishing, technology employed, fishing locations, marketing, among others); (4) long term changes in fishing activity and fisheries problems; (5) proposed solutions; (6) fisheries management; and (7) information regarding the community (i.e., relationships with community members, vulnerability to violence or drug traffic, happiness being a fisherman, among others).

In addition to interviews, we also utilized data from public meetings in each community related to the strategy of co- management. The meetings were held where fishermen brainstormed about top-down and bottom- up fisheries management strategies. Exchanging information and opinions, and discussing the co- management process took place in two main steps:

- Fishermen learned about fisheries management strategies, in particular, about co-management. The basic concepts and features of the major types of top-down and bottom-up fisheries management were explained. Examples of traditional management were analyzed and then contrasted with co-management to show the benefits and drawbacks of this process. This basic information allowed them to understand how fishery management has been applied in other countries, what alternatives exist, the benefits communities might gain from co-management, and the importance of working with other fisheries actors (stakeholder groups) in this process.
- An open discussion focused on the following questions:
  - What opinions do the fishermen have about management in general and co-management in particular?
  - What weakness and strengths within the artisanal fisheries community might affect the success of co- management?
  - What first steps could the community take to start the co-management process?

On the Caribbean coast, 141 community members participating in the interviews, while 81 on the Pacific coast were participated (Table 1). In addition, 140 community members participated in the hearings on the Caribbean coast and 95 on the Pacific coast. Even though it was planned to have one meeting per community, in some communities it was necessary to hold two hearings (*Taganga* and *Juanchaco* communities) because of low fishermen participation.



### Data analysis

Qualitative information from semi-structured interviews and fieldwork activities was coded into quantitative data then organized and content analysis performed using computer-assisted qualitative data analysis software (CAQDAS), N-Vivo/8 software (García-Horta and Guerra-Romos 2009; Ozkan 2004; Saldaña 2009; Thayer et al. 2007; Yin 2003). Based on Miles and Huberman (1994) and Yin (2003), coding was done by the meaning of phrases, following the elemental method and incorporated in N-vivo. Then, structural coding and the elemental method were used to pre-code questions by creating main categories of common subjects that allow different opinions to be combined in a single category. Sixteen main categories were created corresponding to the common subjects under which the codes are aggregated (Miles and Huberman 1994). Chi-Square tests were used to distinguish between the perceptions of fisheries solutions and the three groups of fisheries stakeholders. Differences in the perceptions of the main categories of fisheries solutions among stakeholders were analyzed using a Kruskal-Wallis test. In addition, Mann-Whitney tests were performed in order to measure differences in perceptions of the same main categories between the Pacific and Caribbean regions. Finally, to explore the relationships between stakeholders' perceptions of fisheries solutions and the marine eco-regions, a redundancy analysis (RDA) was performed. Descriptive statistics (percentages) were used to analyze the results of each stakeholder group and among all stakeholders.

### Results

Given the range of actors in Colombian small-scale fisheries, with their varying perceptions, agendas and power, it can be expected that there will be differences in the proposed solutions to the challenges and problems facing the fisheries. Fishermen are focused on the fishing activity, leaders on governing, and experts on technical aspects of management. The theoretical debate over fisheries governance is how to develop a consensus among stakeholders for a governance system that can allow for including multiple stakeholders.

The results are grouped into cross-cutting solutions (identified by the fishermen, local leaders and experts at the same time), inter-group solutions (identified by only two of the three stakeholders), and isolated solutions (identified by only one stakeholder). In addition to the interviews, the results from public meetings in each community related to the strategy of co-management are presented.

#### Cross-cutting solutions

Fishermen from both coasts identified 133 solutions, of which 25 were represented by more than 3 % of respondents. Leaders identified 121 solutions, of which 38 were represented by more than 3 % of respondents. Experts identified 397 solutions, of which 135 were represented by more than 3 % of respondents. The responses from the three groups generated 22 cross-cutting solutions in eight categories. The Chi Square Test was used to establish the significance of these cross-cutting solutions to the three participant groups (Table 2).

Results show that 11 cross-cutting solutions had a *p-value* less than or equal to 0.05, and thus were ranked at different levels of importance to all three groups, while 10

**Table 2** The perception of importance of cross-cutting solutions ranked by the fishermen, local leader and fisheries experts groups and analyzed using the Chi square test

Categories	Cross-cutting solutions	Code	Fisheries experts (%)	Fishermen (%)	Local leaders (%)	$\chi^2$	<i>p</i> -value
Aquaculture	Explore aquaculture as an option	Aqua	22.50	13.33	37.04	10.66	0.05
Fishermen and communities	Changes in Community attitude	Comm	2.50	5.64	7.40	1.56	0.46
	Changes in Fishermen attitude	Fish	41.25	14.35	3.70	30.28	<0.001
Fishing equipment	Open waters fishing depth sea fish – <i>pesca de altura</i>	OpenW	23.75	13.84	14.81	4.09	0.13
Fishing methods	Use friendly gears and recommendations	GearsOk	7.50	9.23	14.81	1.28	0.53
Government-Administration	Control over	Control	7.50	4.61	3.70	1.09	0.58
	Find or generate other jobs	Jobs	13.75	14.87	3.70	2.52	0.28
	Government support to real Fishermen	RealFisher	1.25	8.20	3.70	5.16	0.08
	Loan program with clear rules	Loan	11.25	1.02	3.70	15.54	<0.001
Industrial fishing activity	Restrictions on Industrial fishing	IndusRest	12.50	7.69	7.40	1.69	0.42
Organization of Fishermen	Strengthen Fishermen associations	F Asso	25.00	6.66	3.70	20.77	<0.001
	Strength Leaders	Leaders	5.00	0.51	3.70	6.31	0.04
Regulations	Create regulations	Regulate	61.25	50.76	62.96	3.34	0.19
	Create Protected Marine Areas	PMA	10.00	0.51	3.70	15.96	<0.001
	Fishing Zoning plan	Zoning	10.00	10.25	18.51	1.75	0.42
	Regulate gears	Gears	11.25	39.48	14.81	24.80	<0.001
	Increase mesh size	Mesh	7.50	6.66	3.70	0.47	0.79
	Prohibit gill nets	Not-Gill	7.50	19.48	3.70	9.36	0.01
	Change unfriendly methods for environmental friendly	C-Unfriend	11.25	40.00	3.70	31.99	<0.001
	Establish minimum size per spp.	Min-size	10.00	2.05	7.40	8.62	0.01
	Veda-Time closed season	Veda	23.75	17.43	37.03	6.07	0.05

cross-cutting solutions had similar importance. Support for proposed solutions in the category of Government-Administration were not significantly different among the groups with the exception of the need for a loan program for fishermen based on clear rules, which experts felt would be particularly valuable.

All groups perceived with a similar sense of urgency that the government must regulate the fishery sector, that other jobs must be generated to replace fishing and decrease pressure on fragile resources and ecosystems, and that the administration needs to target support for “real fishermen” rather than opportunists (participants used the term “real fishermen” to distinguish between legitimate fishermen like themselves and pretenders who show up when aid is being handed out).

In the category of Regulations, only fishermen placed high importance on the need to regulate the use of gear, to prohibit the use of gillnets, and to exchange damaging gear

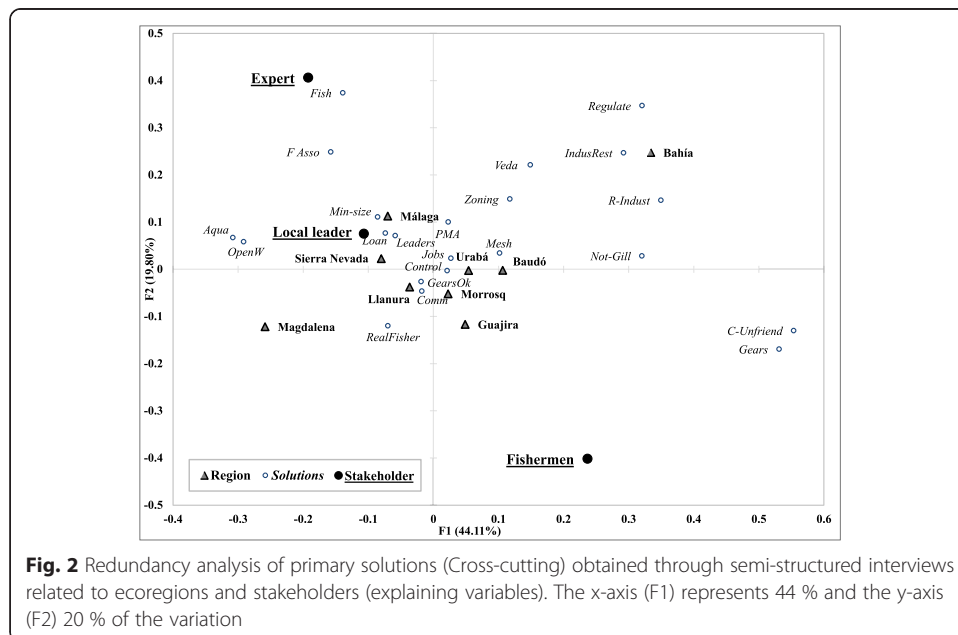


for methods that are environmentally friendly. Experts placed great importance on creation of marine protected areas and establishing minimum catch size. For local leaders, the creation of close seasons (*veda*) was particularly important. There was significant agreement in the need to create regulations for fishing. In fact, this solution had the highest representation among the three groups. The category, Organization of Fishermen, was assigned a different level of importance by each group, with only experts emphasizing the need to strengthen fishermen associations.

Non-significant differences in importance were found in solutions in the following categories: (1) Changes in community attitude (Fishermen and Communities); (2) The use of vessels that encourage open waters and deep sea fishing (Fishing Equipment); (3) The need to use environmentally friendly gear (Fishing Methods); (4) Restricting industrial fishing (Industrial Fishing Activity); and (5) The need to establish fisheries zoning in each community, and to increase gill net mesh size (Regulations).

To relate the ranked importance of the perceived solutions with different stakeholders and regions, a redundancy analysis (RDA) was carried out (Fig. 2). In Fig. 2, the first two factors of the RDA explained 63 % of the total variance. The x-axis (F1) represents 44 % of the variation of perceived solutions between fishing communities on the Pacific (positive scores) versus fishing communities on the Caribbean (negative scores). Meanwhile, the y-axis (F2) is showing a gradient of perceived solutions represented 20 % of the variation between the perceived solutions by fishers (negative scores) versus experts (positive scores). Local leaders have low representation, being located almost in the middle of the other two stakeholders.

While solutions proposed by Caribbean communities differed from solutions proposed by communities on the Pacific, differences are not as great as was the case with the problems (refer to Saavedra-Díaz et al. 2015b). The eco-regions of *Alto-Chocó* (*Bahía Solano* fishing community) and *Baudó* (*Pizarro*) are representative of the fishery situation on the Pacific, whereas the eco-region of *Magdalena* (*Las Flores*) is representative of the fishery situation on the Caribbean coast. Conversely, the Pacific eco-regions of



*Málaga-Buenaventura (Juanchaco)* and *Llanura Aluvial del Sur (Tumaco)* correspond more closely to the Caribbean situation in terms of perceived solutions. Interestingly the eco-region of *Sierra Nevada de Santa Marta (Taganga)* was closer in viewpoint to Pacific communities. On the Pacific coast, the *Bahía Solano* community shared opinions with other communities, but their strong tradition of group deliberation and awareness of the fisheries situation resulted in a clarity of thought that produced more solutions and a wider spectrum of options.

Pacific fishing communities are more aware of the need for regulations (restricting industrial fishing, prohibiting gill nets, establishing closed fishing seasons, fisheries zoning, minimum mesh sizes net, ecologically friendly fishing methods, among others), while Caribbean communities proposed fewer solutions over a narrower range. They focused primarily on the need for oversight and control of fishing activity, change in community attitude, identifying “real fishermen”, as well as for strong fishermen’s associations, change in fishermen’s attitude, exploration of aquaculture and access to open water vessels.

The y-axis (F2) shows how the opinions about solutions of fishers were far different from the opinions of experts. This result supports the impression that the opinions of fishers are not represented by experts. In fact, need for changes in fishermen’s attitude (Fish), strengthen fishermen associations (F Asso), and the creation of marine protected areas (MPA) are perceived as important solutions mostly by experts. In contrast, fishers identified solutions that were not considered important by the other two stakeholder groups, such as identifying “real fishermen” (RealFisher), and access to loans (Loan).

All three stakeholder groups identified regulation as the most important solution (fishermen 51 %, experts 61 %, and leaders 63 %). All groups agreed on five additional solutions, but differed significantly on the degree of importance. They are presented in order from the most to the least different. The change from unfriendly (environmentally damaging) to friendly (less damaging) fishing methods ( $X^2 = 31.99$ ;  $p$ - value  $<0.001$ ) was most important to fishermen (40 %). Changes in fishermen’s attitude ( $X^2 = 30.28$ ;  $p$ - value  $<0.001$ ) was most important to experts (41 %). Gear regulation ( $X^2 = 24.80$ ;  $p$ - value  $<0.001$ ) was also most important to fishermen (39 %). The fourth and fifth solutions that differ in importance, the need to strengthen fishermen associations ( $X^2 = 20.77$ ;  $p$ - value  $<0.001$ ), and to create marine protected areas ( $X^2 = 15.96$ ;  $p$ - value  $<0.001$ ), were most important to the group of experts.

#### **Inter-group and isolated solutions**

There are 37 inter-group solutions which were proposed by the stakeholder groups. These solutions are separated into nine categories (coastal uses and infrastructure, fishermen and communities, fishing resources, government-administration, institutions, marine ecosystems threatened, marketing, organization-fishermen association, regulations). The top solutions in each category are presented in Table 3.

In addition to these inter-group solutions, there were 37 isolated solutions separated in 9 categories (aquaculture, coastal activities and infrastructure, fishermen and communities, government- administration, institutions, national situation, marketing, organization-fishermen association, regulations). The largest number of inter-group solutions were proposed by experts. These included improved fishery information, more research, co-management, and learning about successful management from other

**Table 3** Main inter-group solutions shared by two stakeholder groups

Main intergroup solutions	% both coasts		
	Fishermen	Local leaders	Fisheries experts
Coastal Uses and Infrastructure			
Tourism		25.90	2.40
Fishermen and Communities			
Invest in Fishermen Education-read and write		11.11	16.67
Assume responsibility as Fishermen and improve attitude	14.36		7.14
Fishing Resources			
Find new target spp.	0.51		10.71
Government-Administration			
Recognition of the importance of Fishermen role and the job-chain involved		18.52	13.10
Empower community	7.20		17.86
Institutions			
Academia important actor		3.70	13.10
Establish Real Fishery institution	3.60		56.95
Marine Ecosystems Threatened			
Recover mangroves and breeding zones		7.40	3.60
Marketing			
Have or improve their own selling and marketing process		14.81	5.95
Improve product manipulation and quality		7.41	5.95
Organization - Fishery Association			
Promote all Fishermen to be associated and the importance of it		3.70	8.33
Support Fishermen in organizing their F.A.		3.70	8.33
Regulations			
National Fishery policy-regulations		22.22	16.67
Work and control fish buyers or merchant		7.41	4.76

countries. Two of these 37 solutions contain sub-solutions. Establishing a real fishery institution was described in 10 sub-solutions, and creating a national fishery policy was identified in 22 sub-solutions.

In order to understand differences at the category level, solutions in the first (cross-cutting solutions), second (inter-group) and third (isolated) orders were combined for analysis. The Kruskal–Wallis test (Kruskal and Wallis 1952) was used here to evaluate differences among categories with respect to the three interviewed groups (Table 4). No significant differences were found in the categories of Fishing Equipment, Fishing Methods, Industrial Fishing Activity, and Regulations; all stakeholders viewed these categories with the same level of importance. Leaders and experts contributed to categories such as Marketing and Fishermen Associations. The former gave great feedback about solutions related to the category of Coastal Uses and Infrastructures. The latter brought substantial investigative experience to the national fishery situation through their knowledge in the categories of Institutions and Government Administration. Fishermen were not highly represented in any category compared with the other two stakeholders.

The Mann-Whitney test was used to evaluate differences among the categories with respect to the Caribbean and Pacific coastal regions (Table 5). These results show that

**Table 4** Kruskal – Wallis test by the categories of solutions through the three stakeholders groups

Categories	Fisheries experts	Fishermen	Local leaders	$X^2$	$p$ -valor
Acuaquilture	0.225 (0.420)	0.133 (0.341)	0.370 (0.492)	10.621	0.005
Coastal Uses and Infrastructure	0.100 (0.302)	0.056 (0.231)	0.370 (0.492)	26.86	<0.001
Fishermen and Communities	0.438 (0.499)	0.190 (0.393)	0.444 (0.438)	21.35	<0.001
Fishing Equipment	0.263 (0.443)	0.159 (0.367)	0.185 (0.396)	3.960	0.138
Fishing Methods	0.075 (0.265)	0.092 (0.290)	0.000 (0.000)	2.783	0.24
Fishing Resources	0.125 (0.333)	0.000 (0.000)	0.074 (0.267)	24.066	<0.001
Government-Administration	0.713 (0.455)	0.333 (0.473)	0.593 (0.501)	34.948	<0.001
Industrial Fishing Activity	0.125 (0.333)	0.077 (0.267)	0.000 (0.000)	4.388	0.111
Institutions	0.625 (0.487)	0.077 (0.267)	0.037 (0.192)	105.148	<0.001
Threatened Marine Ecosystems	0.063 (0.244)	0.036 (0.187)	0.148 (0.362)	6.132	0.047
Marketing	0.238 (0.428)	0.036 (0.187)	0.148 (0.362)	26.471	<0.001
National Situation	0.038 (0.191)	0.000 (0.000)	0.000 (0.000)	8.381	0.015
Organization of Fishermen	0.300 (0.461)	0.077 (0.267)	0.333 (0.480)	27.77	<0.001
Regulations	0.613 (0.490)	0.508 (0.501)	0.630 (0.492)	3.333	0.189
Small Scale Fishing	0.050 (0.219)	0.005 (0.072)	0.074 (0.267)	8.409	0.015

Mean relative value (and standard deviation between parenthesis) for each category and stakeholder is shown

category responses on one coast are not significantly different from the other, as was shown in the Redundancy Analysis (RDA).

However, exceptions are seen in categories such as Aquaculture, with higher representation on the Caribbean coast, and Industrial Fishing and Marketing, with greater feedback on the Pacific. This supports the conclusion that solutions on both coasts are basically the same, but that differences in expectations must be part of any management framework.

### Fisheries management

The three stakeholder groups – fishermen, local leaders and experts – were asked a number of questions concerning the concept of fisheries management and co-management (bottom-up management).

**Table 5** Mann-Whitney test by categories of solutions, comparing Colombia's Caribbean and Pacific coasts

Mann-whitney test				
Categories	Caribbean	Pacific	<i>U</i>	<i>p</i> -valor
Acuaquilture	0.214 (0.411)	0.122 (0.328)	11743.50	0.043
Coastal Uses and Infrastructure	0.112 (0.317)	0.070 (0.256)	11212.0	0.222
Fishermen and Communities	0.262 (0.441)	0.304 (0.462)	10297.5	0.427
Fishing Equipment	0.166 (0.373)	0.226 (0.420)	10104.0	0.194
Fishing Methods	0.086 (0.280)	0.070 (0.256)	10924.5	0.619
Fishing Resources	0.032 (0.177)	0.052 (0.223)	10536.5	0.387
Government-Administration	0.444 (0.498)	0.478 (0.502)	10382.5	0.561
Industrial Fishing Activity	0.043 (0.203)	0.148 (0.356)	9623.0	0.001
Institutions	0.193 (0.395)	0.261 (0.441)	10017.5	0.164
Threatened Marine Ecosystems	0.064 (0.246)	0.035 (0.184)	11068.5	0.270
Marketing	0.059 (0.236)	0.165 (0.373)	9608.5	0.003
National Situation	0.011 (0.103)	0.009 (0.093)	10774.0	0.868
Organization of Fishermen	0.144 (0.352)	0.183 (0.388)	10342.5	0.379
Regulations	0.503 (0.501)	0.617 (0.488)	9519.0	0.052
Small Scale Fishing	0.037 (0.190)	0.000 (0.000)	11155.0	0.036

Mean relative value (and standard deviation between parenthesis) for each category and stakeholder is shown

### **Fishermen**

Only one percent of the fishermen responded that they knew what fisheries management is. These fishermen used a variety of words or phrases to explain the concept, such as organization and order, closed fishing zones, temporary closures, fishermen's association, marketing, control, changing fishing gears, processing fish products, aquaculture, and managing fishing equipment. There is a lack of understanding among fishermen of what fisheries management is.

When asked if their community was ready for bottom-up management, 37 % answered positively and negatively at the same time (42 % Caribbean vs. 28 % Pacific), only 31 % emphatically answered positively (31 % Caribbean vs. 30 % Pacific), 9 % answered negatively (8 % Caribbean vs. 11 % Pacific), and 23 % did not know or were

unsure. Fishermen's answers revealed that they believe fisheries management is necessary because otherwise fishing will get worse (8 %), they need order and rules (7 %), and the community should try and see if it works (4 %). Fishermen reported that some communities have implemented rules by themselves. For example, *Pizarro* established a rule to use gillnets with mesh size larger than 3 in.. *El Roto* established a minimum mesh size of 3 ½ inches for gill nets. The fishermen reported that while most efforts at implementing their own rules have been unsuccessful, they are optimistic that it is possible for fishing communities to come together to establish rules. They felt that it would be possible for the community to implement fisheries management under certain conditions, such as: (1) If all fishermen agree to it; (2) If management is controlled by both community and government; (3) If training in fishery management comes first; and (4) If a subsidy mitigates a fishing restriction. However, fishermen believed that establishing bottom-up management is difficult because: (1) Fishermen's attitude prevents it; (2) It is difficult to get fishers to agree; (3) Some attempts at management had failed in the past; (4) Fishermen cannot stop fishing; (5) It could generate violence among fishers; and (6) Community features complicate the process.

When asked what their community needs to do to manage fisheries, the fishermen believed that: (1) Fishing communities need to get together and agree about implementing management; (2) All fishermen should organize and belong to the fishermen's associations; (3) Fishermen need to face the problems that threaten their livelihood and get specific training to overcome them; (4) Some fishing communities have shown that successful fisheries management is possible, and their experiences can be useful examples; and (5) Fishermen should learn to compromise and explore other job possibilities. When asked what government needs to do to manage fisheries, the fishermen stated that existing regulations needed to be effectively implemented; they should stop foreign fishermen; and training should be provided.

### **Local leaders**

Similar to the fishermen, local leaders knew nothing about fisheries management. When asked if they believed their community was ready for implementing the bottom-up process, 59 % answered positively (63 % Caribbean vs. 55 % Pacific) and 41 % answered negatively (38 % Caribbean vs. 45 % Pacific). A majority of leaders believed they were ready to implement fishery management by themselves because of:

(1) Rules already established by some communities, (2) Strong fishermen's associations, and (3) Community reliance on fishing for food. Leaders believed that bottom-up management is possible, but only if government and community work together. They reported less confidence in efforts developed solely by communities or imposed by the government.

Leaders who were pessimistic about establishing bottom-up fishery management cited fishermen's attitude - according to which the government must give them everything, but they do not make any effort (7 %). Other difficulties include: (1) Low individual representation; (2) Difficulties in getting many fishermen on the same page; (3) Lack of organization or association among the majority; (4) Prevalence of illegal gear that undercuts participation; (5) Lack of understanding of the need for fisheries management; and (6) No institutional authority is in charge.



When asked what they think that the community needs to do in order to manage its fishing resources; local leaders reported that the entire community must get together and agree to actively participate in implementing fisheries management (the process must include fish sellers). They also stated that fishermen must practice responsible fishing, they must develop a sense of belonging, they must belong to a fishery organization, and they must stop using unfriendly gears. When asked what they thought that the government needs to do in order to manage fisheries resources, local leaders reported that government should: (1) Invest in establishing regulations, including making subsidies available while restrictions apply; (2) Establishing exclusive fishing zones for each community; and (3) Closed seasons. At the same time, leaders believe that it is fundamental that any restriction or regulation be discussed with the community before it is implemented and the government should accord the small-scale fishery sector the importance it deserves.

### **Experts**

Fifty-seven percent of the experts believed that it was possible to establish bottom-up management, but 20 % were skeptical. Experts who believed that bottom-up management should work knew about recent, closely related attempts. These included projects in marine protected areas such as *Guapi* and *Sanquianga* Parks on the Pacific coast, led by WWF; San Andres Island on the Caribbean, led by CORALINA; the Special District in *San Antero* that is zoned and planned to preserve mangrove forests; and a similar effort on the Urabá Gulf. Experts described regional or local committees that could be the basis for coastal zoning or for implementing fisheries management, such as NODOS (Regional Institutional Fishery Councils), INVEMAR (regional Committees for Coastal Management), and local Community Councils (some with their own Natural Resources Code). They also listed fishermen's associations that could be local foundations of bottom-up fisheries management, such as associations in *Las Flores* on the Caribbean, and *Juanchaco* and *Bahía Solano* on the Pacific coast. Experts who were skeptical of bottom-up fisheries management doubted that communities would participate. Other concerns were the poor track records of external institutions going in and out of communities makes implementing fisheries management through external agencies difficult; fishermen's attitude and need for constant supervision and their inability to work alone; and cultural aspects of Indigenous fishing communities.

When asked what they think fishing communities need to do in order to manage their fishing resources, the experts believed that a consensus by the majority of the population in each community was necessary in order to obtain high participation. Additionally, the community should discuss and agree upon their own rules and take responsibility for ensuring compliance; fishermen must belong to a fishermen association, and that the community must have a long term vision.

When asked what they thought that the government needs to do in order to manage fisheries resources, the experts felt that the government needs to be aware that bottom-up management requires a long term vision. Additionally, investing in education in order to increase awareness of fishery management; provide active and consistent inter-institutional support in each community; promote and strengthen fishermen's associations; and adapt to community dynamics.

### **Public meetings**

A series of public meetings to discuss fisheries management were held in selected communities – five communities on the Caribbean coast and four on the Pacific coast. The meetings introduced fishermen to the basics of fishery management, why it is important, how they can be part of this process and start to work from their own communities. After presentations, open discussions allowed the participants to express their individual opinions about this fisheries management and bottom-up management and whether or not it could be useful and applied in their situation.

Even though all meetings brought up internal weaknesses, most participants believed that bottom-up management was possible if they worked hand in hand with government. The fact that some communities had already established rules resulting from their own deliberations suggested that widespread bottom-up fisheries management may be possible. Most weaknesses identified in the meetings matched those identified in the fishermen survey described above. These include disunity among fishermen, lack of participation, the presence of foreign fishermen, and weak fishermen's associations due to poor leadership. Additional weaknesses include authorities' distrust of fishermen, dislike of authority, distrust among fishermen, lack of education, lack of a sense of belonging, the involvement of fishermen in drug trafficking.

The main strengths each community identified were related to human capital such as strong knowledge and experience in fisheries issues; leaders and traditional authorities who believe that bottom-up management is the only solution; and community experience in establishing their own rules. Some believe that the presence of old, established fishermen associations are key to success. Communities cautioned that government must support local decision making processes and impose agreed-upon rules (*Juanchaco*), otherwise bottom-up management will not work. Communities stated that fisheries management needs to be designed for the long run and applied consistently over time in each community that adopts the process. There was a need to integrate non-traditional fisheries stakeholders, such as fishermen's wives, local schools and universities, and seafood supply chains into fisheries management. This shows the extent to which small-scale fishing is importantly integrated into local and national life.

Although none of the communities expressed that they enjoy optimum conditions for implementing bottom-up management, all realized its importance and expressed an urgent need to start the process. Particular characteristics of each community affected their readiness to put bottom-up fisheries management into practice.

### **Discussion**

The introduction to this paper noted that weak governance has been a major factor contributing to the overexploitation and consequent poor condition of small-scale fisheries and many of the communities that depend upon them around the world. This is no less true and Colombia and the data presented here and in Saavedra-Díaz et al. (2015b) contribute to the global comparison of this important component of the fisheries sector. The latter paper identified a number of different problems facing the Colombia small scale fishery, as perceived by different stakeholders – fishermen, local leaders, and fishing experts. While there were some difference among the stakeholders and between the two regions, several key problems emerged including destructive fishing methods, lack of regulation enforcement, pollution and industrial contamination, lack of public services,

weakness of fishermen's organizations and leadership. The majority of fisheries experts believed that the small scale fishery sector has been largely ignored by government actions. That analysis concluded that these problems require establishing a fisheries management strategy that can prioritize solutions at different levels: national, coastal, and local.

Identification of problems in any given fishery is necessary but ultimately insufficient. A path forward to solving those problems must be developed. Our approach here is to draw on expertise of fisheries, community leaders and in-country experts to highlight that path.

More than 50 % of each stakeholder group believed that implementing a bottom-up fisheries management approach, such as co-management, is possible. While it is clear that what the details of "co-management" means is still not fully shared, it is still notable that there is significant interest in attempting to take action at a local level to address the problems each community faces, and they all face in common. This approach to using co-management is not only seen to have potential by Colombian stakeholders, but also in other Latin American countries that face similar issues due to fisheries crises, such as Mexico (Salas et al. 2015), Costa Rica (Solís et al. 2015), Brazil (Futemma and Seixas 2008), Uruguay (Trimble and Berkes 2015), and Chile (Marin and Berkes 2010). Even in Colombia, there are examples of cases that have tried participatory management with varying degrees of success (Beardon 2008; Delgado et al. 2010; Navia et al. 2010).

It was notable that all of the stakeholder groups recognize two over-riding needs, 1) that governance of the fishery is urgently needed or conditions will continue to decline, and 2) that whether management is top-down or bottom up, no one group can implement effective management. This is the essence of co-management, shared governance, but shared responsibility. Clearly, fishers perceived the need for the government to help them manage some of the biggest challenges including external challenges (e.g., pollution, criminal elements), while government looked to support from fishers in making real change. Local leaders too, needed a greater willingness of fishers to come together and compromise as needed to make changes, and in dealing with the government.

Surprisingly, Colombian fishermen were the most optimistic about co-management among the three stakeholder groups; however, a majority qualified their answers and listed changes necessary for success. These conditions closely relate to changes mentioned by local leaders and government experts answering similar questions about conditions for success. Optimists believed that existing examples of bottom-up fishery management provide evidence that success is possible. However, pessimists highlighted examples of community or external management efforts that failed and made them concerned about the future of bottom-up management.

From different perspectives, concurrence was also reached on the need to train fishermen in fishery management. Fishermen would share local knowledge, communities would participate in management with greater confidence and the government would provide training that gives everyone a vested interest in the process. Basic changes will be necessary in fishing communities, foremost is increasing membership in fishermen's associations. Experts and leaders agreed on the need to promote participatory research in which fishermen-researchers work closely with teams of biologists.

Each group identified changes in government necessary for insuring successful bottom-up management. Both fishermen and local leaders urgently stressed the

need to establish a fisheries agency in order to constantly and consistently oversee the restrictions and regulations agreed to in deliberation. Fishermen and leaders believed that such restrictions would fail without strong subsidies to encourage the compliance of fishermen.

There were some real differences that will need to be resolved in order to make a management system viable. Clearly one of these is the designation of “real” fishermen versus opportunists. In other words, there is a need to develop a shared vision of who is a member of the community and in what capacity, recognized by the community itself, its leaders, and government. Another real difference in perspective, of a different character is the concern fishers have about gear types, particularly gillnets, versus government and leaders support for closed areas. These are not mutually exclusive approaches but a middle ground needs to be developed since it is clearly a major visible issue of concern for many.

Three of the nine study communities were found to have specific features that encourage them to start thinking about fishery management. These are *Ahuyama* and *El Roto* on the Caribbean, and *Bahía Solano* on the Pacific. These are communities with a small fishing population; few fishing methods; small, close-knit fishing neighborhoods; and fishermen’s association could easily start the process of fisheries management. These communities were found to have attitudes and activities which support their commitment and awareness of the need for management. It is felt that these three communities could serve as pilot sites for implementing fisheries co-management in the country.

As noted in the introduction, there is a broad theoretical framework for the governance of small-scale fisheries that has been developed by Berkes, Ostrom, Pomeroy and others (Berkes et al. 2001; Ostrom 1990, 2009; Pomeroy et al. 2004, 2011). Colombian small-scale fisheries management does not have all the elements of this framework. However the present paper and previous work in identifying problems and solutions suggests that implementing successful fisheries co-management may now be possible. Long-term direction is needed for fisheries policy in Colombia and it should include a strong governmental framework that enables local bottom-up co-management. Clear a “transition” process, is needed which can be based on these research results, that moves from the current unregulated situation towards sustainable fisheries. Lessons learned as a result of the present study suggest that work during the next five years needs to focus on building strong foundations of social infrastructure during the “transition” stage that will support and maintain viable and resilient fisheries management plans. Particular characteristics of each community affect their readiness to put bottom-up fisheries management into practice. The national framework should be flexible and adaptable to local community needs and priorities. This may be achieved through four activities: (A) small-scale fisheries program of research; (B) social marketing and awareness raising in government and community; (C) restructure governance for co-management; and (D) community organization.

## Conclusions

Understanding small-scale fisheries is key to protecting the health of Colombia’s coastal ecosystems and improving the quality of life for coastal fishing communities. All stakeholder groups included in this study generally agreed that both old and new problems

could be reduced by implementing co-management strategies at a community level with governmental support. Consistent, long-term policy direction is needed for fisheries in Colombia. If the Colombian administration continues centralized administration of the fishery sector, without adequate support and involvement at the community level, future conditions could well be worse than at present. Socio-ecological systems related to marine and coastal fisheries are fragile, such that fishing communities are vulnerable, food security is at risk, and the health of marine ecosystems is endangered.

All stakeholders engaged in this study believed that bottom-up management is possible in their communities. This concurrence of opinion and the fact that some communities have already established rules resulting from their own deliberations are evidence in favor of co-management. Most communities believed that co-management is possible working hand in hand with government. Communities that successfully established internal rules, which then failed due to the lack of enforcement, prove the need for a partner authority to assist in implementing fisheries management through co-management. This role should fall to national regulatory agencies; however, they often cannot fulfill this role due to frequent changes in policy directions resulting from changes in national administrations.

Effective fisheries management requires a mixture of national and local authority in order to work well, and steps toward a preliminary framework for a two-tiered system are suggested. Hopefully in the future communities will be able to take the lead in local management, and government agencies will grow into trusted partners by coordinating the consistent application of national fisheries policies and protecting national resources against foreign interlopers.

#### Competing interests

The authors declare that they have no competing interests.

#### Acknowledgments

This research was possible because of the participation and collaboration with Colombian marine fishers and local leaders from the communities of Ahuyama, Taganga, Las Flores, San Antero, El Roto, Bahía Solano, Pizarro, Juanchaco, and Tumaco. We also thank the national and regional fisheries experts and fisheries researchers for their open participation and for giving their life's work to make Colombian fisheries better. The main part of the data analysis was done thanks to the help and support of Berta Martín-López. We also thank Karen Alexander for her editorial assistance. This study was supported by the Conservation International Foundation, Universidad del Magdalena, University of New Hampshire, fellowship programs from COLCIENCIAS and Young Women in Science - 2008 (UNESCO - L'Oreal), and Connecticut Sea Grant.

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Received: 13 March 2015 Accepted: 19 April 2016

Published online: 16 June 2016

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