



# Understanding Local Perceptions of the Drivers/Pressures on the Coastal Marine Environment in Palawan, Philippines

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## OPEN ACCESS

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### Specialty section:

This article was submitted to  
Marine Ecosystem Ecology,  
a section of the journal  
Frontiers in Marine Science

**Received:** 28 January 2021

**Accepted:** 21 July 2021

**Published:** 14 September 2021

### Citation:

Madarcos JRV, Creencia LA,  
Roberts BR, White MP, Nayoan J,  
Morrissey K and Fleming LE (2021)  
Understanding Local Perceptions  
of the Drivers/Pressures on  
the Coastal Marine Environment  
in Palawan, Philippines.  
*Front. Mar. Sci.* 8:659699.  
doi: 10.3389/fmars.2021.659699

The Philippines, as a tropical archipelagic country, is particularly vulnerable to environmental changes affecting coastal and marine settings. However, there are limited studies investigating how these changes are perceived by the local populations who depend directly on the marine environment for their livelihoods, health, and well-being, and who are the most vulnerable to such changes. To explore these issues, we conducted an in-home face-to-face structured survey in 10 coastal communities in Palawan, Philippines ( $n = 431$ ). As part of the survey, respondents were asked to comment on how important they believed a list of 22 drivers/pressures (e.g., “land-use change”) were in affecting their local marine environment. Statistical analysis of this list using Exploratory Factor Analysis suggested the 22 drivers/pressures could be categorized into 7 discrete groups (or in statistical terms “factors”) of drivers/pressures (e.g., “urbanization,” “unsustainable fishing practices” etc.). We then used ordinary least squared regression to identify similarities and differences between the perspectives within and across communities, using various socio-demographic variables. Results suggested that among the seven identified factors, four were perceived by the local communities as making the marine environment worse, two were perceived as having no impact, and one was perceived to be making the marine environment better. Perceptions differed by gender, education, ethnicity, and study site. A subsequent survey with 16 local coastal resource management experts, suggested that public perceptions of the most critical drivers/pressures were broadly consistent with those of this expert group. Our findings highlight how aware local coastal communities are of the drivers/pressures underpinning the threats facing their livelihoods, health, and well-being. Ultimately, this information can support and inform decisions for the management of local marine resources.

**Keywords:** coastal marine, drivers, pressures, coastal management, fisheries livelihoods, marine environment, public perception

## 1 INTRODUCTION

The ocean plays a critical role in supporting human well-being; from relatively proximal goods/services such as providing food, livelihoods, and recreational opportunities, to more distal services such as diluting pollution and regulating the global climate (Halpern et al., 2012; Moore et al., 2013; Fleming et al., 2014, 2015). The Philippines, as a tropical, archipelagic country, is particularly dependent on the goods and services provided by the marine environment. However, the ocean is increasingly facing cumulative direct and indirect threats that alter marine ecosystems locally and worldwide (Inniss et al., 2016; Lotze et al., 2018). The management and governance of coastal marine resources is complex. To ensure the sustainability of the marine environment, conservationists and researchers are increasingly recognizing the importance of the knowledge, involvement, and stewardship of local communities and community-based resource management more broadly (Castilla, 1999; Winther et al., 2020).

Originating in the small-scale fisheries sector, community-based resource management has become a key strategy for small-scale fisheries and coastal marine conservation (Evans et al., 2011). In the Philippines, the systematic management of coastal resources began in the mid-1970s using community-based management approaches to address coastal environmental degradation, and the over-exploitation of aquatic resources (Pomeroy and Carlos, 1997; Alcalá, 1998). This strategy is composed of several essential features, and inherently takes place in a highly complex social-ecological environment influenced by external factors as well as community-specific conditions (Rivera and Newkirk, 1997; Beyerl et al., 2016). Stakeholder misunderstandings, lack of participation, non-compliance, or conflict, are frequently encountered problems in this type of management (Eder, 2005; Bloomfield et al., 2012; Glaser et al., 2018). According to Beyerl et al. (2016), most of these problems are largely driven by the varying perceptions of environmental changes, coping strategies, and social processes of local communities. Thus, understanding how local communities perceive the marine environment is an essential component of the ecosystem approach, and can be partially attributed to the success or failure of environmental management goals (Potts et al., 2016). The ecosystem approach is a strategy for the integrated management of natural resources that promotes conservation and sustainable use in an equitable way (CBD, 2021). However, empirical evidence in the understanding of the linkages between local communities' knowledge, perceptions, and collective actions have been limited, but is needed to achieve sustainable marine resource management (Kitolelei and Sato, 2016).

Individual perceptions are the product of a complex interaction between an individual, their material and non-material circumstances, and their surroundings (Beyerl et al., 2016). Understanding public perception is widely recognized as key to the management of the coastal marine environment. However, to date, most of these studies have been focused in high-income continents, e.g., Australia (Cvitanovic et al., 2014; Clarke et al., 2016) and Europe (Gelcich et al., 2014; Aretano et al., 2017; Tonin and Lucaroni, 2017; White et al., 2017;

Carpenter et al., 2018). Although there have been numerous studies on perceptions of the marine environment conducted in the Global South, these were mostly site-specific on a case-by-case basis (Slater et al., 2013; Chaigneau and Daw, 2015; Gehrig et al., 2018; Glaser et al., 2018). Furthermore, differences in perceptions can relate to socio-demographic characteristics (Wright and Lund, 2003; Safford and Hamilton, 2012; Cvitanovic et al., 2014; Halkos and Matsiori, 2018). These socio-demographic variables typically include gender (Smith et al., 2015; Chakraborty et al., 2017; Ensor et al., 2018), age (Arcury and Christianson, 1990), income (Van Liere and Dunlap, 1980), education (Sparrevik et al., 2011), location (country and village level) (Chaigneau and Daw, 2015; Buckley et al., 2017; Carpenter et al., 2018; Gehrig et al., 2018) and ethnicity (Jones, 2002). Although their findings are variable, some potential trends emerge, suggesting that women, higher educational attainment, younger people, those with a higher income, ethnic minorities, and urban residents show greater environmental concern compared to their counterparts (Liu and Mu, 2016; Ergun and Rivas, 2019).

In particular, studies are needed which aim to understand the drivers and pressures of changes to the coastal marine environment, incorporating the views of the local community. Thus, the current study aims to explore these issues in the context of several relatively small coastal communities on the Island of Palawan in the Philippines. To understand local community perceptions of the drivers/pressures affecting their coastal marine environment, we developed the following objectives: To explore coastal communities' perceptions toward the perceived drivers/pressures facing their marine coastal environment and compare these to those of experts; and to assess the interrelationship between these perceptions with socio-demographic characteristics.

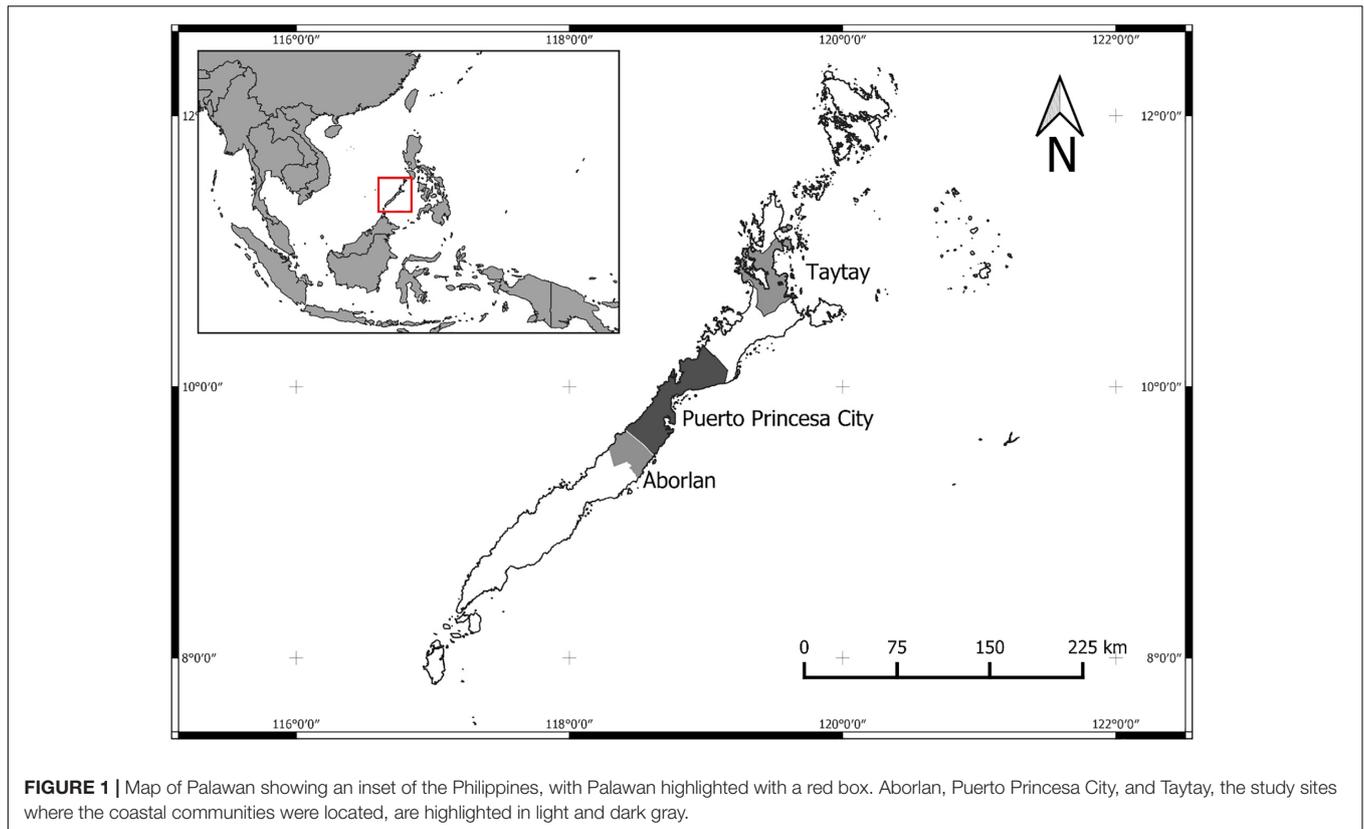
To do this, we used data collected as part of the GCRF (Global Challenges Research Fund) Blue Communities<sup>1</sup> project. The GCRF Blue Communities project aims to investigate the complex impacts of changes in the regulatory backdrop of marine spatial planning for coastal communities located in and around UNESCO Biosphere Reserves and Marine Protected Areas (MPAs) across Southeast Asia. The current work was formed as part of Project 6 of this program, which assessed the well-being benefits and risks of coastal living. For the current study, we used data from a bespoke survey co-created with local stakeholders and administered to three coastal communities (Aborlan, Taytay, and Puerto Princesa) in Palawan, Philippines.

## 2 MATERIALS AND METHODS

### 2.1 Study Area

Palawan forms an elongated strip, oriented in a north-southwest direction, between a latitude of 7°C and 11°N and a longitude of 117° and 199°E, with the Sulu Sea bordering the eastern coast and the South China Sea on the western coast (**Figure 1**; Förderer and Langer, 2019). The province has an area of 14,896 km<sup>2</sup> in total, comprising around 1,780 islands (Itano and Williams, 2009).

<sup>1</sup><https://www.blue-communities.org/Home>



**FIGURE 1** | Map of Palawan showing an inset of the Philippines, with Palawan highlighted with a red box. Aborlan, Puerto Princesa City, and Taytay, the study sites where the coastal communities were located, are highlighted in light and dark gray.

Including its marine area, it occupies almost one-fifth of the country's territory and has a population of approximately one million people (PSA, 2016). The Presidential Proclamation 2152 of 1981 declared the entire province of Palawan as Mangrove Swamp Forest Reserves and a UNESCO Man and Biosphere Reserve (MAB) in 1991, in recognition of its rich natural resources and high biodiversity. The key economic sectors and major sources of employment in Palawan are agriculture, fisheries, forestry and tourism (PCSD, 2015).

Three coastal areas were selected as study sites (village location): Aborlan, Taytay, and Puerto Princesa (**Figure 1**). The provincial capital, Puerto Princesa City is located in the central part, Aborlan is a municipality located 69 km south of the capital; and Taytay is located 206 km to the north (**Figure 1**). All these areas have extensive coastal ecosystems and the local communities are highly dependent on fisheries (Salao et al., 2013; WWF, 2016). In the last decade, there has been a substantial increase in the human population and a deterioration of major marine ecosystems across Palawan (PCSD, 2015). A climate change exposure map has been created for the Philippines (HDN, 2013; The Climate Reality Project, 2016). This map shows how specific geographical factors contribute to the vulnerability of different zones of the country and identifies specific risks of climate change. Northern Palawan, including the municipality of Taytay, falls under cluster III of the climate change exposure map: vulnerable to extreme heating events, unstable water supply, and sea-level rise. The rest of mainland Palawan, including Aborlan and Puerto Princesa City, fall under Cluster XI (i.e., sea-level

rise). This makes Palawan an ideal area to study both community and environmental changes in the coastal marine environment.

## 2.2 Developing the Survey Instrument

The survey, which was administered to the local communities, was designed using a co-creation process. Focus group discussions and workshops were conducted with local stakeholders in three local government units (LGU) of Aborlan, Taytay, and Puerto Princesa. Each focus group involved 12–15 participants. Participants included representatives from provincial, municipal, and barangay (the latter the smallest government unit in the Philippines, similar to a village) LGUs for the environment, fisheries, health, and legislative offices, as well as non-government organizations (NGOs) and private stakeholders. Representatives from the fishing communities, healthcare workers, environmental officers, and community leaders also participated.

The findings that emerged during the focus group discussions, along with relevant academic and gray literature, suggested an emerging structure of complex causes affecting marine ecosystems, whose effects on health and well-being outcomes would be mediated by the extent to which people were exposed to the affected ecosystems. Following discussion as a team, we recognized that, although unplanned, these issues closely mirrored the structure of an existing framework which linked changes in ecosystems to human health and well-being. The ecosystems-enriched Drivers, Pressures, State, Exposure, Effects, Actions, or “eDPSEEA” model (Reis et al., 2015) builds on earlier

frameworks such as DPSIR (Drivers, Pressures, State, Impact, Response) (Kristensen, 2004; Patrício et al., 2016), but focuses on ecosystem services in operationalizing “State,” and unpacks “Impact” but separating “Exposure” and “Effects” in line with a public health (rather than just an environmental) focus.

Subsequently, we developed the survey to contain all aspects of the eDPSEEA model, but given the complexity of the data that emerged, the current study focuses primarily on the first two aspects—Drivers and Pressures. For the purpose of the survey and analysis that follows we use the term “drivers/pressures” to describe the environmental issues identified by local stakeholders that have changed or could change the quality of the coastal marine environment. We recognize that in some senses ‘Drivers’ are more distal causes of changes to states (in our case changes in ecosystems and the services they provide) than “Pressures,” which tend to be more proximal. However, in reality, assigning environmental issues to discrete categories is complex (Oesterwind et al., 2016), thus we have chosen the joint term of “drivers/pressures.”

### 2.3 Overview of the Community Survey

The community survey was structured into six sections (see **Supplementary Materials 1**). Section 1 sought to explore how Palawan has changed over the last 10 years and what the local people think will happen in the next 10 years, using a list of 16 items related to resources, habitats, and water quality. Their perceptions were measured on a seven-point scale with anchor points (1) “much worse” to (7) “much better.”

The key section for the current paper was Section 2 which contained a list of 22 marine-based, land-based and environmental management issues (i.e., our drivers/pressures) and asked participants to evaluate the impact of that activity on the quality of the coastal marine environment using the same seven-point scale.

Section 3 sought to explore the interactions of local people with the coastal marine environment by asking the respondents how often they had engaged in marine activities relating to their livelihoods, day-to-day activities, and environmental management in the last week, using an eight-point scale with anchor points (0) “zero days” to (7) “7 days.” Section 4 focused on individual-level health outcomes with respondents asked if they experienced any of the 15 health outcomes as a result of spending time in/on/around the coastal marine environment using three choices; (1) “no,” (2) “yes, but did not talk to health workers” and (3) “yes and talked to health workers.” Section 5 focused on the importance of health services, infrastructure and facilities, and land/coastal management factors to local people’s health and well-being using a scale from (1) “not important at all” to (7) “very important.” An option of (99) “don’t know/prefer not to answer” was also provided for each of the questions in all of the sections. Finally, Section 6 of the survey was about the socio-demographic data of the respondents, and included age, education, ethnicity, income, location, and gender.

For this study, only the data of Section 2 (drivers/pressures) and 6 (socio-demographics) were used to understand local perceptions of the drivers/pressures on the coastal marine environment (other aspects will be explored in subsequent

publications). The community survey was piloted by the research staff from the Western Philippines University and received ethical approval from the National Ethics Committee of the Philippines (2019–002–Creencia–Blue) and the University of Exeter Medical School Research Ethics Committee (May19/B/185).

### 2.4 Survey Participants

The target population were households within coastal marine areas in our three selected geographic regions; and the respondents were restricted to 18 years old and above. A total of 431 respondents participated (see **Table 1**) from 10 barangays: two barangays in Aborlan, four in Taytay, and four in Puerto Princesa City, with a higher number of females than males [ $n = 257/431$  (60%)]. The higher percentage of female participants was in part due to the time of day the interviews were conducted (morning and afternoon), as many male household members would have left home for work at sea. For the groupings of income from marine activities, we used the income cluster of the Philippine Institute of Development Studies (Albert et al., 2018; see **Table 1** for further description).

### 2.5 Procedure

Face-to-face surveys were conducted between June 2019 and July 2019 in the 10 barangays. A Computer-Assisted Personal Interviewing (CAPI) program was used to record answers on a tablet device, with a pre-loaded questionnaire available in Filipino and English (see **Supplementary Materials 1**). Interviews were carried out by 10 experienced and trained research staff from Western Philippines University, who were divided into five teams. In a procedure agreed with local Barangay leaders and stakeholders in advance, each team selected a starting point within each barangay and randomly chose a household to be interviewed. Only one member per household was interviewed, with a preference for the head of the family. Where the head of the family was not available, any adult member of the household present during the visit was recruited for the interview. If any of the members in the chosen household did not want to complete the survey or were unavailable, the interviewer would proceed to the next household until the target sample of 40–60 households per barangay was reached. Before starting the face-to-face interviews, the survey participants were provided with information sheets explaining the background of the study, and informed consent was obtained.

### 2.6 Expert Survey

To collect data on the perceptions of local coastal resource management experts on the “drivers/pressures” that have changed the quality of the coastal marine environment in Palawan, a Delphi technique interview (Okoli and Pawlowski, 2004; James et al., 2009) with slight modification was conducted in April 2020. Experts were identified based on their involvement in marine conservation (e.g., working in NGOs, government offices, research, and academic institutions) (Easman et al., 2018). A pre-selected list of experts were contacted personally via email, with a link to the survey which included the seven grouped pressures/drivers, as identified by

**TABLE 1** | Socio-demographic profile of adult participants in Palawan, Philippines.

Socio-demographic variables	Total sample (n = 431)		Aborlan (n = 75)		Puerto Princesa (n = 169)		Taytay (n = 187)	
	n	%	n	%	n	%	n	%
<b>Gender</b>								
Female	257	(59.6)	42	(56.0)	104	(61.5)	111	(59.4)
Male	173	(40.1)	33	(44.0)	65	(38.5)	75	(40.1)
Missing	1.0	(0.2)	0	(0.0)	0	(0.0)	1	(0.5)
<b>Income from marine activities</b>								
Low	260	(60.3)	50	(66.7)	93	(41.4)	117	(62.6)
Moderate	151	(35.0)	23	(30.7)	70	(55.0)	58	(31.0)
Missing	20	(4.6)	2	(2.6)	6	(3.6)	12	(6.4)
<b>Age</b>								
19–29	61	(14.2)	15	(20.0)	22	(13.0)	24	(12.8)
30–39	102	(23.6)	17	(22.7)	47	(27.8)	38	(20.3)
40–49	114	(26.5)	17	(22.7)	50	(29.6)	47	(25.1)
50–59	84	(19.5)	16	(21.3)	33	(19.5)	35	(18.7)
60–99	66	(15.3)	10	(13.3)	17	(10.1)	39	(20.9)
Missing	4	(0.9)	0	(0.0)	0	(0.0)	4	(2.1)
<b>Education</b>								
Elementary	168	(39.0)	37	(49.3)	68	(40.2)	63	(33.7)
Secondary	201	(46.6)	28	(37.3)	82	(48.5)	91	(48.7)
College	56	(13.0)	10	(13.3)	18	(10.7)	28	(15.0)
Missing	6	(1.4)	0	(0.0)	1	(0.6)	5	(2.7)
<b>Ethnicity</b>								
Visayan	185	(42.9)	48	(64.0)	109	(64.5)	28	(15.0)
Non-Visayan	242	(56.1)	27	(36.0)	60	(35.5)	155	(82.9)
Missing	4	(0.9)	0	(0.0)	0	(0.0)	4	(2.1)

the participants in the community surveys (grouping methods are outlined in **Table 2**). Experts were asked to rate how the issues have changed the quality of the coastal marine ecosystem. Sixteen local experts in Palawan participated in this survey. Their perceptions were also measured using a 7-point Likert scale, ranging from (1) “made much worse” to (7) “made much better.”

## 2.7 Data Analysis

Data were analyzed using SPSS version 25. Values from the community and expert survey were converted from the original one (“much worse”) to seven (“much better”) scale to an easier to interpret bi-polar scale of  $-3$  (“much worse”) to  $+3$  (“much better”). Descriptive statistical analysis were used to understand the profiles of the respondents in our survey, and the mean and standard deviation was calculated for questions relating to individual perceptions of the drivers and pressures.

An Exploratory Factor Analysis (EFA) using principal component analysis was used to reduce the 22 potential drivers/pressures to a reduced set of “factors” (Finch, 2013; Chen et al., 2018; Goretzko et al., 2019) indicative of each participants “mental model” (Binder and Schöll, 2010) of the perceived core underlying drivers/pressures in the coastal marine environment.

To conduct the EFA, the oblique rotation method with direct oblimin rotation (Jennrich and Sampson, 1966) was applied. This rotation method was selected because we assumed that variables are correlated. The number of the retained factors was based on the criterion of the eigenvalue ( $> 1.0$ ) and examination of

the scree plots (Costello and Osborne, 2005); items with factor loading and corrected item-total correlations below 0.3 were considered too small to be of consequence (De Vellis, 2003; Field, 2013). The factor loading patterns and meaningful relationships for the grouped items were used to determine the ideal factor structure (Gabriel et al., 2019). Acceptable internal consistency for the items in the respective factors was set at Cronbach's alpha values  $> 0.70$  (Field, 2013).

The individual perceptions of the drivers/pressures on the marine environment from the community survey demonstrated a good index for factor analysis as indicated by the Kaiser-Meyer-Olkins test measure (0.80) (**Table 2**). Bartlett's test of sphericity also showed a significant value for factor analysis to be appropriate with a  $p$ -value lower than 0.05 ( $p < 0.01$ ). We concluded that the sample available here was suitable for EFA despite not being firmly structured. A total of 22 variables were used for EFA analysis.

The result of the analysis defined six groupings with eigenvalues greater than one. However, on closer inspection the items in one grouping did not make conceptual sense, so we decided to split this into two (i.e., “unsustainable farming practices” and “urbanization”) in order to keep logical internal consistency resulting in seven factors in total (**Table 2**). Finally, we used ordinary least squared regression (OLS) analyses to measure and predict driver/pressure grouping scores based on socio-demographic variables. The perceptions of drivers/pressures based on EFA groupings served as dependent

**TABLE 2** | Local perceptions from the community survey of the drivers/pressures on the coastal marine environment of Palawan, Philippines.

Drivers/pressures	Responses (%)							Missing (%)	Mean	SD	Loadings
	-3	-2	-1	0	1	2	3				
<b>Unsustainable fishing practices</b>									<b>-1.41</b>	1.19	
Overfishing by the local community	8.1	18.1	34.8	22.7	5.3	3.9	0.9	6.0	-0.84	1.23	-0.49
Illegal fishers from other municipalities	35.3	21.8	23.7	5.3	3.0	1.6	3.2	6.0	-1.67	1.48	-0.80
Fishing by commercial (large-scale) fisheries	20.0	20.0	26.7	12.1	3.9	2.1	1.2	14.2	-1.34	1.35	-0.77
Destructive fishing practices (dynamite, cyanide)	55.9	12.1	16.5	0.7	0.5	1.2	4.9	8.4	-2.08	1.55	-0.72
<b>Coastal risks</b>									<b>-1.27</b>	1.37	
More storms at sea due to climate change	21.1	21.6	30.2	12.1	2.6	5.3	2.3	4.9	-1.22	1.48	0.91
More floods and erosion due to climate change	23.9	19.0	29.7	11.4	3.0	5.6	1.9	5.6	-1.27	1.50	0.84
Mangrove/Nypa harvesting for charcoal/building	32.3	14.8	20.0	11.8	3.0	2.8	2.1	13.2	-1.52	1.53	0.69
<b>Urbanization</b>									<b>-1.05</b>	1.63	
Poor waste management (solid/liquid/agricultural etc.)	35.3	19.3	22.5	2.6	1.6	3.7	8.8	6.3	-1.40	1.88	0.54
Poor plastic waste management	35.0	20.9	23.7	1.9	2.3	3.7	9.5	3.0	-1.36	1.89	0.59
Local population growth/migration	11.8	13.9	24.6	21.8	8.6	8.1	4.9	6.3	-0.52	1.62	0.73
<b>Unsustainable farming practices</b>									<b>-0.98</b>	1.29	
Land use change (e.g., slash and burn)	16.7	12.1	26.2	16.9	8.6	2.8	1.2	15.5	-0.98	1.44	0.64
Intensification of farming (e.g., use of inorganic/chemicals)	15.1	14.6	30.9	13.7	4.9	3.5	2.3	15.1	-1.02	1.44	0.72
<b>Fisheries livelihoods</b>									<b>0.34</b>	0.97	
Aquaculture (fish cages, mussel lines, seaweed, pearl)	1.9	3.2	8.8	35.3	17.6	10.9	4.9	17.4	0.40	1.26	-0.81
Live Reef Fish Trade	2.3	3.9	10.4	39.0	15.5	9.0	3.2	16.5	0.22	1.22	-0.84
Gleaning (low tide searching for mollusks, crustaceans, etc.)	1.2	1.4	5.3	50.8	20.4	10.0	2.8	8.1	0.40	1.00	-0.71
<b>Fisheries livelihood support</b>									<b>0.72</b>	1.41	
Supporting alternative livelihoods to fishing	7.2	2.1	4.2	18.8	15.1	19.5	26.9	6.3	1.12	1.78	0.80
Infrastructure development (e.g., new fish landing sites)	7.4	2.3	8.4	23.2	17.4	20.4	16.5	4.4	0.76	1.70	0.78
Tourism	4.6	4.9	11.4	27.8	19.3	8.1	4.6	19.3	0.18	1.43	0.32
<b>Environmental management</b>									<b>1.78</b>	1.22	
National political will and environmental protection laws/ordinances	3.0	1.2	2.8	8.4	20.0	26.7	34.6	3.5	1.69	1.43	0.89
The enforcement of environmental laws/ordinances	2.8	0.70	2.6	7.7	18.3	25.1	40.1	2.8	1.82	1.40	0.89
Local communities/stakeholders calling for better protection/management of the local marine environment	2.8	0.70	1.6	5.6	19.3	25.3	41.5	3.2	1.89	1.36	0.79
Research by NGOs (e.g., WWF) and local researchers	2.8	0.20	1.2	7.9	19.7	26.2	33.6	8.4	1.78	1.34	0.77

*Bold values indicate grouping means.*

variables and socio-demographic as independent (predictor) variables (see **Table 2** for groupings). A total of three models were created after running the OLS regressions, to fully understand the interrelationships between perceptions and socio-demographic characteristics of the participants. However, due to limited space, only the first model is presented below. The other two models are presented in **Supplementary Materials 2**.

### 3 RESULTS

#### 3.1 Local Perceptions of the Drivers/Pressures on the Coastal Marine Environment: Results From the Factor Analysis

Seven driver/pressure groupings were identified: unsustainable fishing practices, coastal risks, urbanization, unsustainable

farming practices, fisheries livelihoods, fisheries livelihood support, and environmental management (**Table 2**).

Among the seven identified factors, four were perceived by the local communities as making the marine environment worse, two were perceived as having no impact, and one was perceived to be making the marine environment better (**Table 2**). The factors identified as having negative impacts on the marine environment, in order from most to least harmful were: unsustainable fishing practices (mean  $\pm$  SD) ( $-1.41 \pm 1.19$ ), coastal risks ( $-1.27 \pm 1.37$ ), urbanization ( $-1.05 \pm 1.63$ ), and unsustainable farming practices ( $-0.98 \pm 1.29$ ). The participants did not perceive that fisheries livelihoods ( $0.34 \pm 0.97$ ) and fisheries livelihood support ( $0.72 \pm 1.41$ ) had any impact, either positive or negative, on the coastal marine environment of Palawan. Environmental management ( $1.78 \pm 1.22$ ) was the only factor perceived positively by the participants.

With regards to the perception of individual drivers/pressures, destructive fishing practices ( $-2.08 \pm 1.55$ ), illegal fishing ( $-1.67 \pm 1.48$ ) and mangrove harvesting ( $-1.52 \pm 1.53$ ) were

the top issues perceived by the local community to have negatively affected the coastal marine environment in Palawan. In contrast, research by non-government organizations ( $1.78 \pm 1.3$ ), enforcement of environmental laws and ordinances ( $1.82 \pm 1.40$ ), and the local communities and stakeholders calling for better protection ( $1.89 \pm 1.36$ ) were perceived as the most positive.

The result of the survey with the coastal management experts generally showed a similar pattern with the perceptions of the local communities on the drivers/pressures in the coastal marine environment (**Figure 2**). The coastal management experts also demonstrated negative perceptions of the effects of unsustainable fishing practices, coastal risks, urbanization, and unsustainable farming practices on the marine environment. Similarly, fisheries livelihoods and fisheries livelihood support were perceived as having no impact, while environmental management was perceived positively.

However, there were differences between the experts and local communities in which drivers/pressures were perceived to be worst for the marine environment. Unsustainable fishing practices were perceived as the worst by local people, whilst urbanization was perceived as the worst by the experts. Despite this difference, their views were most similar for unsustainable farming practices and fisheries livelihoods, with communities perceiving fisheries livelihood support as having a much greater positive impact on the coastal marine environment. Similarly, both groups perceive environmental management as positive but local people perceived it more positively.

### 3.2 Associations Between the Socio-Demographic Variables and Local Perceptions

**Table 3** presents the results of the OLS regression, exploring the relationship between socio-demographic variables and the seven driver/pressure groupings. By and large, we see relatively high consistency and homogeneity in perceptions across the socio-demographic variables for all seven drivers/pressures, which could help in establishing common support for certain policies. Nonetheless, some differences did emerge.

Women perceived urbanization as being worse for the marine environment compared to men ( $B = -0.53$ ,  $p < 0.01$ ; **Table 3**). Although not significant, women also had more negative perceptions of the effects of coastal risks, unsustainable farming practices, and fisheries livelihood support compared to men (**Table 3**).

In terms of education, participants in the coastal communities with a college education had significantly more negative perceptions of unsustainable fishing practices ( $B = -0.46$ ,  $p < 0.05$ ) and unsustainable farming practices ( $B = -0.56$ ,  $p < 0.05$ ) compared to participants with elementary education (**Table 3**). Although the relationship was not significant, college participants also had more negative perceptions of coastal risks, urbanization, fisheries livelihoods, and fisheries livelihood support compared to participants with elementary education. Similarly, participants with secondary education had negative perceptions of unsustainable fishing practices, coastal risks,

unsustainable farming practices, and fisheries livelihood support, although the relationships are not significant.

With regard to the effect of study sites on participants' perceptions of the drivers/pressures, there were clear similarities in the perceptions between the municipalities of Aborlan and Taytay (**Table 3**). Coastal risks were generally perceived negatively by locals, but participants in Aborlan ( $B = 0.56$ ,  $p < 0.01$ ) and Taytay ( $B = 0.78$ ,  $p < 0.001$ ) had relatively neutral perceptions, compared to participants from Puerto Princesa City. In addition, although unsustainable fishing practices were generally perceived as the worst driver/pressure affecting the coastal marine environment, participants from the municipality of Taytay had relatively neutral perceptions ( $B = 0.39$ ,  $p < 0.01$ ) compared to participants from Puerto Princesa City (**Table 3**). Participants from Aborlan perceived unsustainable farming practices and fisheries livelihoods more negatively compared to participants from Puerto Princesa City, although these associations were not significant.

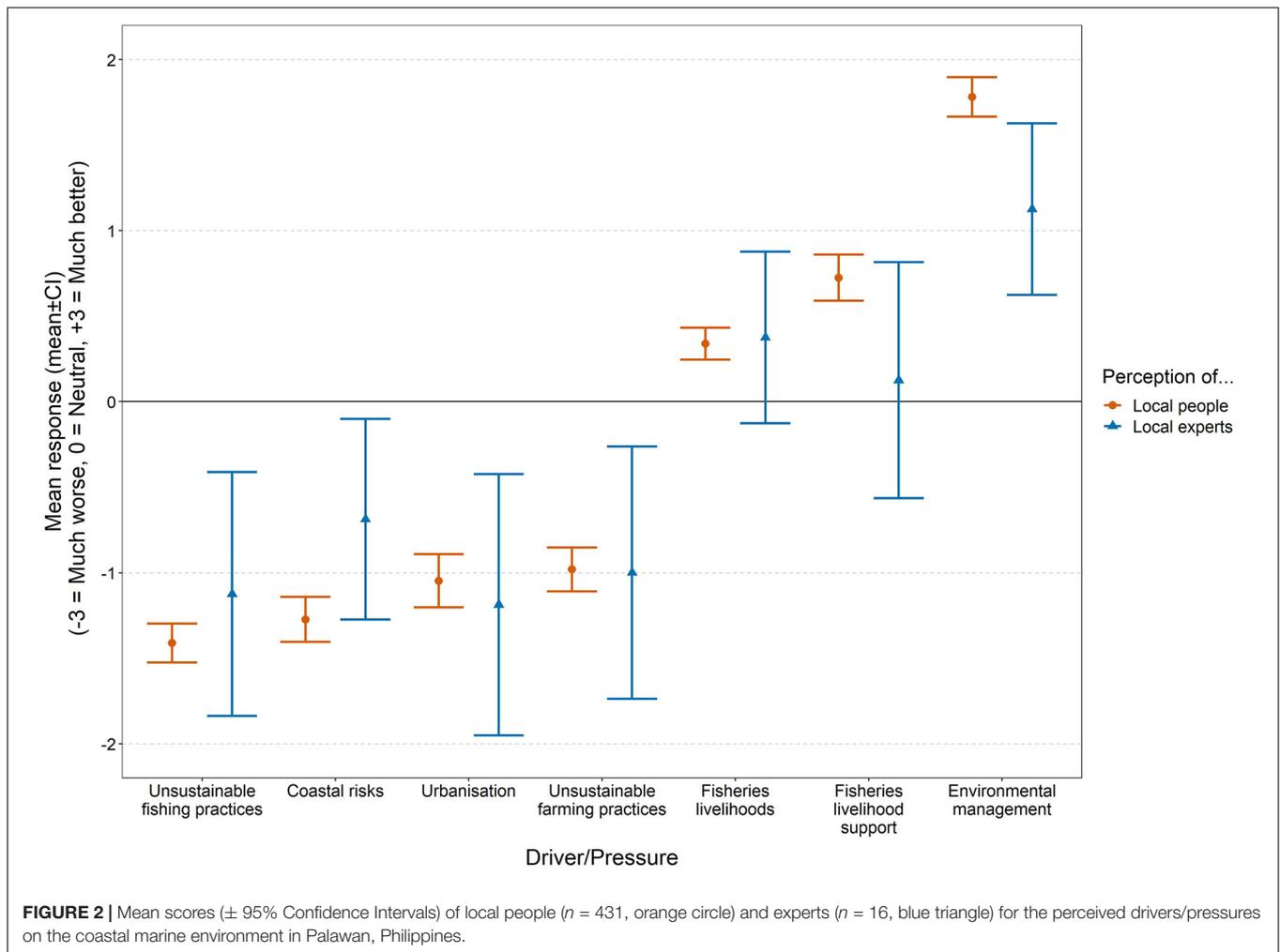
When study sites were excluded from exploratory models, ethnicity was also found to be a significant factor associated with perceptions. Visayan participants perceived unsustainable fishing practices ( $B = -0.36$ ,  $p < 0.01$ ) and coastal risks ( $B = -0.28$ ,  $p < 0.05$ ) more negatively than non-Visayan participants (**Supplementary Materials 2**). That this only emerged when the location was not included reflects the fact that less Visayan's lived in Aborlan and Taytay than Puerto Princesa. Although not significant, Visayan participants had more negative perceptions of urbanization, unsustainable farming practices, and fisheries livelihood support. Income and age were not found to be associated with people's perceptions of various drivers/pressures across all models.

## 4 DISCUSSION

### 4.1 Drivers/Pressures Affecting the Coastal Marine Environment in Palawan

In this study, we sought to (a) identify the main drivers/pressures affecting the marine coastal environment as perceived by local communities, (b) assess how these perceptions are affected by communities' socio-demographic characteristics, and (c) compare these perceptions to those of local experts. Unsustainable fishing practices were perceived as the worst driver/pressure by the local communities (**Figure 2**). We found that gender, education, and study site were associated with perceptions of specific drivers/pressures in the coastal marine environment (**Table 3**). Overall, the perceptions of the local communities and local experts were generally similar. We discuss these findings in more detail below, with a focus on how understanding perceptions can help to improve the management of coastal marine environments.

Unsustainable fishing practices (overfishing by the local community, illegal fishers, fishing by commercial large-scale fisheries, and destructive fishing practices) were perceived by the local communities as the driver/pressure that has most negatively impacted the quality of the coastal marine environment in Palawan. These results were consistent with the perceptions



of local experts, as well as previous research conducted in the Philippines more generally (Courtney and White, 2000; Eder, 2005).

Coastal risks such as storms, floods, coastal erosion, and mangrove harvesting were perceived by local people as the second biggest risk to the coastal marine environment. Developing countries in Asia are one of the most natural-disaster prone regions in the world (Jha et al., 2018), and extreme events like storms and flooding regularly put coastal communities at risk (Cochrane et al., 2009). The Philippines is an archipelagic island state located within the typhoon belt; natural disasters are coupled with other hazards such as landslides, active volcanoes, and earthquakes, making the Philippines one of the most vulnerable countries in the world (Bollettino et al., 2018; UNDRR, 2019). The social, economic, and environmental impacts of these disasters are significant, directly affecting the livelihoods of coastal communities like those explored here. Despite these risks, local experts did not perceive coastal risks as one of the biggest threats to the marine environment, having a more neutral perception. This mismatch could be due to local people and experts viewing drivers/pressures on differing scales, with local people experiencing the direct effects of such

risks, whereas experts perceive these risks at a wider scale. In the Philippines, fishers are deemed to be amongst the poorest of the poor and are most affected by the coastal risks. In turn, this is likely to undermine poverty reduction in fishing communities (Jha et al., 2018; PSA, 2020). Therefore, despite local experts not perceiving this as a key issue, coastal risks must be addressed. Reducing the effects of coastal risks can be achieved through prevention, mitigation, and preparedness measures (Sperling and Szekely, 2005).

Compared to other major marine ecosystems, mangroves have suffered the earliest and greatest degradation in the Philippines because of their relative accessibility and long history of conversion to aquaculture (Primavera, 2000). In our study, mangrove harvesting was perceived as the most negative coastal risk (Table 2). Unsustainable mangrove harvesting in the Philippines has seen mangroves decrease from 500,000 hectares in 1920 (Brown and Fischer, 1920) to just 120,000 hectares in 1994–1995 (Primavera and Esteban, 2008). Thus, mangrove replanting programs became popular, from community initiatives to government-sponsored programs to large-scale international sponsored projects. Despite all these initiatives, the survival rates of mangroves are generally low, which

**TABLE 3** | Results of ordinary least square regression model predicting perceptions of the drivers/pressures in the coastal marine environment of Palawan, Philippines from key socio-demographic variables (standard errors in parentheses).

Predictors (socio-demographic)	Dependent variables (drivers/pressures)						
	Unsustainable fishing practices	Coastal risks	Urbanization	Unsustainable farming practices	Fisheries livelihoods	Fisheries livelihood support	Environmental management
Constant (B)	-1.22 (0.24)	-1.33 (0.28)	-0.57 (0.34)	-0.43 (0.29)	0.09 (0.20)	0.75 (0.29)	1.43 (0.24)
<b>Gender (ref = Male)</b>							
Female	0.011 (0.12)	-0.22 (0.14)	-0.53** (0.17)	-0.08 (0.15)	0.08 (0.10)	-0.09 (0.15)	0.23 (0.13)
<b>Income (ref = non poor)</b>							
Poor	0.014 (0.12)	-0.16 (0.14)	-0.13 (0.17)	-0.18 (0.14)	-0.00 (0.10)	0.15 (0.15)	-0.01 (0.12)
<b>Age (ref = 19–20 years old)</b>							
30–39 years old	-0.24 (-0.19)	-0.01 (0.22)	0.05 (0.27)	-0.23 (0.22)	0.027 (0.16)	-0.32 (0.23)	-0.35 (0.19)
40–49 years old	-0.30 (0.19)	0.03 (0.22)	-0.25 (0.27)	-0.21 (0.22)	0.28 (0.16)	0.13 (0.23)	0.10 (0.20)
50–59 years old	-0.10 (0.21)	0.22 (0.24)	0.22 (0.29)	0.04 (0.24)	0.11 (0.17)	0.37 (0.25)	0.25 (0.21)
60–99 years old	-0.08 (0.23)	-0.23 (0.26)	-0.20 (0.32)	-0.32 (0.26)	0.12 (0.19)	0.10 (0.28)	0.31 (0.23)
<b>Education (ref = Elementary)</b>							
Secondary	-0.20 (0.14)	-0.26 (0.16)	0.02 (0.19)	-0.30 (0.16)	0.01 (0.12)	-0.21 (0.17)	0.02 (0.14)
College	-0.46* (0.19)	-0.43 (0.22)	-0.46 (0.27)	-0.56* (0.22)	-0.22 (0.16)	-0.09 (0.23)	0.12 (0.19)
<b>Ethnicity (ref = non-Visayan)</b>							
Visayan	-0.18 (0.14)	-0.00 (0.16)	-0.15 (0.19)	-0.16 (0.16)	0.09 (0.11)	-0.19 (0.16)	0.17 (0.14)
<b>Study sites (ref = Puerto Princesa City)</b>							
Aborlan	0.08 (0.17)	0.56** (0.19)	0.13 (0.23)	-0.03 (0.10)	-0.11 (0.14)	0.05 (0.2)	0.09 (0.17)
Taytay	0.39** (0.15)	0.78*** (0.17)	0.10 (0.20)	0.11 (0.17)	0.13 (0.12)	0.17 (0.18)	0.23 (0.15)

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ . Tables showing the regression outputs from other models are in **Supplementary Materials 2**.

could be attributed to inappropriate species and site selection (Primavera and Esteban, 2008). Laws and regulations governing the conservation of mangrove areas in the Philippines were also created. However, it is difficult or impossible for some coastal communities to comply because many of them are dependent on mangroves for fuel, wood, housing materials, and other uses (Primavera, 2000; Parras, 2001; Primavera and Esteban, 2008). Thus, the negative perceptions toward mangrove harvesting in our study could reflect that unsustainable mangrove harvesting is still being practiced by the coastal communities. It also shows that communities understand the negative environmental impacts caused by mangrove harvesting, but due to their potential dependence, they are not willing/able to stop even though they know it is bad.

In this study, both fisheries livelihoods (aquaculture, live reef fish trade, gleaning) and fisheries livelihood support (alternative livelihoods, infrastructure development, tourism) were perceived as having no impact on the coastal marine environment. This

could be due to lack of public knowledge on these issues because some of these, such as tourism, are not present in our study sites. This finding is further supported by our results that participants with higher levels of education had more negative perceptions of these drivers/pressures.

Previous research on public knowledge concerning ocean conditions revealed that while there is a general realization that the ocean and coastal areas are at risk due to pollution, overfishing, etc., the public have little knowledge about ocean functioning and ecology (Steel et al., 2005). This was supported by Buckley et al. (2017) who found that people felt quite well informed about highly publicized issues such as pollution and overfishing, but are less knowledgeable about more complex issues such as ocean acidification or impacts on wildlife. In the case of mangroves, while it is widely known that their destruction for pond conversion is one of the negative impacts of aquaculture, other potentially more subtle ecological impacts such as eutrophication (Martinez-Porchas and Martinez-Cordova, 2012)

are less well known. Therefore, despite our findings showing communities are concerned about the drivers/pressures affecting the marine environment, increasing their knowledge could lead to even greater concern.

Environmental management was the only factor that was perceived positively and included activities such as national political will, environmental laws and policies, community support for protection and management, and further research. These can be viewed within the “social license concept.” Social license is an unwritten social contract that reflects the opinions and expectations of the community toward the impacts and benefits of industry and government practices, including research on the environment (including the ocean) (Kelly et al., 2018). Improving social license among stakeholders could further strengthen the conservation of the coastal marine environment by allowing communities to engage with the issues and voice their opinions and views (Kelly et al., 2018).

As stated above, coastal resource management in the Philippines works as a group of behaviors involving various stakeholders. Our results showed consistencies between the perceptions of experts and local communities for the various coastal drivers/pressures. This suggests good communication between locals and policymakers/experts, and shows that the various government programs which support the management of coastal and marine resources in Palawan are effective at the grassroots level.

However, although they have a similar pattern of perceptions in general, local communities and experts had different perceptions of negative drivers/pressures on the coastal marine environment. Their differences could suggest that these issues are happening at different scales. For example, unsustainable fishing practices are a very local issue, impacting the local people directly, whereas urbanization is a broader issue happening at a higher scale possibly across the whole of Palawan/the Philippines. Therefore, it highlights that these two groups (experts and locals) can sometimes operate at different scales.

Another possible explanation of this gap may be related to the different levels of awareness or sources of information. While experts are more likely to get information from scientific research and data, the public uses fewer and less reliable information sources to gain information about the marine environment (Potts et al., 2016; Lotze et al., 2018). Previous studies found a clear gap between public and marine expert perceptions of the top threats to the marine environment (Potts et al., 2016; Lotze et al., 2018). Another study found a significant difference in the level of perceived impact of coastal threats between professionals and the public (Easman et al., 2018).

These discrepancies in findings may be due to experts' perceptions sometimes not aligning with specific local issues (Deng et al., 2017). With regards to management, varying perceptions between experts and local people, as is the case with coastal risks perceptions in our study, could raise concerns regarding the prioritization of action. This highlights the importance of transparent discussions around issues between local people and all concerned stakeholders, ensuring actions are planned collaboratively with a clear and accepted

distribution of responsibilities (Blake, 1999; Sparrevik et al., 2011; Beyerl et al., 2016).

## 4.2 Role of Socio-Demographic Factors on Perceptions of Pressures/Drivers on Marine Coastal Ecosystems

To better understand the differences and heterogeneity in the perceptions of participants, we assessed the interrelationships between their perceptions and socio-demographic variables. Our results showed that gender (women vs. men), education (secondary and college level vs. elementary level), and study sites (Taytay and Aborlan (more rural areas) vs. Puerto Princesa City) affected the perceptions of local participants.

With regard to gender, this finding is consistent with previous research that showed women reported stronger environmental concern and attitudes compared to men (Lai and Tao, 2003; Gkargkavouzi et al., 2019). A comprehensive survey of European citizens in 10 countries showed that men considered themselves to be better informed about most environmental issues, whilst women expressed higher levels of concern across all issues (Buckley et al., 2017). A review of research by Zelezny et al. (2000) found that women tend to report stronger environmental attitudes and behaviors compared to men because they had higher levels of socialization, were more “other-oriented,” and more socially responsible.

In a small-scale coastal community setting in the Philippines, women are the ones who typically attend community meetings, seminars, and training provided by various government and non-government organizations, and were more likely to participate in the current study, while men usually devote time offshore catching fish. Likewise, the participation of women in fisheries in the Philippines is mostly limited to beach seining, net hauling, and marketing of fish catches, suggesting that they have little direct involvement in offshore capture fisheries (Lim et al., 1995; Siason, 2000; Muallil et al., 2013). Since women generally spend more time in the community than men, they often develop more richly ramified local social networks which may be the reason for their higher perceptions of selected drivers/pressures in the coastal marine environment (McGoodwin, 2001). Nevertheless, as noted earlier, due to women being more available to take part in our interviews, we need to treat these gender results with caution (i.e., it may be that men who were absent fishing actually have more similar attitudes to women than men not engaged in these activities).

On the relationship between education and perceptions, our finding is consistent with previous studies of Cao et al. (2009) and Shen and Saijo (2008) which showed that people with higher educational attainment tend to have more concern for the environment. In several countries, people with more education, in general, are more concerned about the environment (Arcury and Christianson, 1990; Lai and Tao, 2003; Bi et al., 2010; Sparrevik et al., 2011; Gehrig et al., 2018; Guzman et al., 2020).

Recent studies have supported the idea that perceptions differ based on location, with individuals within the same community tending to have more similar views (Cao et al., 2009; Buckley et al., 2017; Carpenter et al., 2018). In Zanzibar,

the fishing village was found to be associated with fishers' perceptions of environment and governance compared to any other variable such as occupational group. This suggests that where people live is a strong predictor for the level of differences in attitudes, understanding, and interpretation among fishers (Gehrig et al., 2018).

A previous study in the Philippines showed that differences between villages significantly predicted attitudes toward Marine Protected Areas (Chaigneau and Daw, 2015). In this study, study site was the strongest predictor for perceptions of drivers/pressures in the coastal marine environment. Participants from Aborlan and Taytay, which are more rural compared to Puerto Princesa, perceived unsustainable fishing practices and coastal risks to be less negative compared to their city counterparts. This may be because these drivers/pressures have been improving in recent years potentially because of the effective government support and interventions at the community level (PCSD, 2015), with residents from Aborlan and Taytay seeing these changes on the ground.

## 5 STRENGTHS AND LIMITATIONS

Compared to previous studies on environmental perceptions, the current research has the following advantages. First, instead of using existing survey questionnaires and theories, we co-created our survey with stakeholders and local communities, supported by existing literature. This allowed us to explore issues in a more localized context. Second, our survey was framed using a standard conceptual model, the eDPSEEA. This research is also part of a larger cross-country project including coastal communities in Malaysia, Vietnam, and Indonesia. As the project progresses this means that cross-country findings from neighboring coastal communities may be used to gain greater insight and learning about the role of the marine environment in creating healthy coastal communities in Southeast Asia. Third, the survey was conducted via face-to-face interviews using a uniquely large sample, maximizing the quality of the data collected. Lastly, although a different survey technique and study design were used for local populations and local experts, the results showed strong consensus on how they perceived drivers/pressures in the coastal marine ecosystem.

However, we also recognize several limitations of our study. First, we felt we could not distinguish between Drivers and Pressures in the current study, despite them being differentiated in the eDPSEEA framework, and indeed other frameworks such as DPSIR. However, we do not see this as a major limitation given that we were primarily interested in lay people's perceptions toward the marine environment (in relation to experts), and felt that the frameworks distinction was unnecessarily subtle for our purposes. The important point was that in people's minds, there appeared to be seven key groupings (or statistical factors) of causes driving ecosystem change. Second, we are also aware that we were unable, in a paper of this length, to attempt to piece together all aspects of the survey, since this would have been far too complex for a single paper. Thus, we

recognize that several potentially interesting questions remain unanswered as yet, although we intend to address these issues in subsequent papers, such as how perceptions of drivers/pressures are related to perceived States and in turn Effects (depending on the moderating potential of exposures).

Third, we also observed that there was a tendency for participants to select mid-point answers, particularly for critical issues. This could be attributed to recall biases in which the participants cannot remember how they were affected by the issue being asked, or it could be linked to the risk of social desirability bias of face-to-face surveys (Bollettino et al., 2018). This means that participants will answer in a way that makes them feel safe and avoids controversial answers, particularly on sensitive issues. However, the survey instrument was co-created with stakeholders and local communities and was designed to enhance respondents' cooperation and willingness to answer openly and truthfully.

Lastly, we recognize some gender imbalance in our study. As noted previously, more women participated in the survey compared to men, who had left to work at sea. Thus, we need to treat the gender results with caution.

## 6 CONCLUSION AND POLICY IMPLICATIONS

The current study offers an understanding of how local communities in Palawan, Philippines perceived the drivers/pressures in their coastal marine environment. We found that drivers/pressures affecting coastal marine environments are perceived differently by the local communities. Unsustainable fishing practices, coastal risks, urbanization, and unsustainable farming practices were perceived as having negative impacts on the coastal marine environment. Fisheries livelihoods and fisheries livelihood support were perceived as having no impact, whilst environmental management was perceived positively. The results of the expert survey showed a similar pattern of perceptions to those of the local communities. However, there were differences in how they perceived negative drivers/pressures suggesting that these two groups can sometimes consider things at different scales. Participant's socio-demographic characteristics such as gender, education, location of study sites, and ethnicity impacted perceptions toward specific drivers/pressures in their coastal marine environment.

To our knowledge, there are no previous studies in the Philippines that used the same methodological approach. However, our results support previous studies (Combest-Friedman et al., 2012; Andrachuk and Armitage, 2015; Chen et al., 2018; Almahasheer and Duarte, 2020) in understanding people's environmental perceptions. Our results can be useful for policymakers and relevant government offices in designing and implementing strategies for effective management of coastal marine environments in the Philippines, incorporating local people's perceptions and demographic complexities.

## DATA AVAILABILITY STATEMENT

The datasets presented in this article and from the entire survey will be made open access after an embargo period currently under discussion with the international consortium which is collecting similar data in three other countries in South East Asia. Request to access the datasets should be directed to the first author.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the University of Exeter Medical School Research Ethics Committee (May19/B/185) and Philippines National Ethics Committee (2019-002-Creencia-Blue). The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

JM: data collection, development, and design of methodology, formal analysis, writing-original draft, and visualization. LC: data collection, conceptualization, writing-review and editing, and supervision. BR: data visualization and writing, review, and editing. JN: formal analysis, visualization, and writing-review, and editing. MW and KM: conceptualization, development, and design of methodology, formal analysis, writing, review, and

editing, and visualization and supervision. LF: conceptualization and writing, review, and editing. All authors contributed to the article and approved the submitted version.

## FUNDING

This work has received funding in part from the Global Challenges Research Fund (GCRF) United Kingdom Research and Innovation (UKRI) under grant agreement reference NE/P021107/1 to the Blue Communities Programme.

## ACKNOWLEDGMENTS

We are grateful to various stakeholders and partners involved from the development until the conduct of the survey and all the study participants. Deep gratitude also goes to the Blue Communities Team of the Western Philippines University for participating during data collection.

## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fmars.2021.659699/full#supplementary-material>

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