

Managerial Implications of Perceptions, Knowledge, Attitudes, and Awareness of Residents Regarding Puerto Morelos Reef National Park, Mexico

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ABSTRACT

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This study explores the perceptions of local residents of Puerto Morelos, Quintana Roo, Mexico, concerning Puerto Morelos Reef National Park using semistructured and key informant surveys. Collectively, the data provide qualitative and quantitative information regarding attitudes, knowledge, and awareness of park regulations and natural resources, as well as opinions about the formation and management of the protected area. The results show large differences in knowledge and awareness based on location of households within the community. Demographic indicators including education level, nationality, and length of community residence significantly correlate with perceptions about marine protection. There was a significant relationship between awareness of economic growth provided by the protected area and the level of support for protection, but many residents—particularly newer residents, those living farther inland, and those of lower educational levels—were unaware of the park, its resources, or its management. Further understanding of the relationships between social indicators and resource management is needed for conservation of important coastal resources. The results suggest that much more public outreach and education are needed within the region.

ADDITIONAL INDEX WORDS: *Demographic indicators, human dimensions, marine protected areas, Quintana Roo, park-people relations, social surveys.*

INTRODUCTION

Marine protected areas (MPAs) are key management tools for the conservation of biodiversity and sustainable use of marine resources (Agardy *et al.*, 2002; Bejer *et al.*, 2004; Bellwood *et al.*, 2004; Sale *et al.*, 2014). In many places local citizens, nongovernmental organizations, and national governments have conflicting views of the management of MPAs, especially concerning no-take zones and other restrictions (*e.g.*, Cook and Heinen, 2005), which can compromise managerial objectives. Each MPA is unique in that ecological, socio-economic, and demographic characteristics are highly site specific (Knowlton and Jackson, 2008; Mumby and Steneck, 2008), frequently requiring managers to arrive at compromises between best management practices for marine resources and meeting the needs and demands of local communities (Lam, 1999) and tourism (Das and Chatterjee, 2015; Hall, 2001). MPAs can improve the situation by benefiting both biota through protection and local communities through greater food security and increasing income from tourism and by instilling a sense of pride in the protection of local surroundings (Harrison *et al.*, 2012; Hind, Hiponia, and Gray, 2010; Tonioli and Agar, 2009; White, Courtney, and Salamanca, 2002).

MPAs can provide a number of actual and potential benefits over time; however, many of these are rather diffuse and

difficult to measure on human policy–cycle time frames (Cook and Heinen, 2005; Reid-Grant and Bhat, 2009). Local communities are frequently in opposition to MPAs for various reasons, some perceived and some real (Bennett and Deardan, 2014); studies in the social sciences can be used to elucidate such issues and, hopefully, ameliorate some conflicts (Bremer and Glavovic, 2013; Heinen, 2010; Kritzer, 2004). Local communities can play a key role in MPA management, and their approval and involvement likely improves the effectiveness of protection (Rodríguez-Martínez, 2008).

A key issue is whether and to what degree authorities are able to incorporate stakeholders and local communities into the management process (Hind, Hiponia, and Gray, 2010; Timilsina and Heinen, 2008). The planning process itself should ideally include both ecological and sociological factors from the beginning stages of development (Cocklin, Craw, and Mcauley, 1998). A greater part of management in many MPAs focuses on regulating human activities to minimize negative impacts. However, a more effective approach would be to promote positive park-people interactions by focusing on the interests and concerns of the community *a priori* (Jones, 2002). Pride among local groups is growing in many places, and the connection between people and MPAs is becoming more important (Johannes, 2002). In regions where many residents may be new to the area, such intrinsic values may be lacking. It is thus important to gain an understanding of the awareness and perceptions of local people in order to build appropriate outreach programs and instill a conservation ethic.

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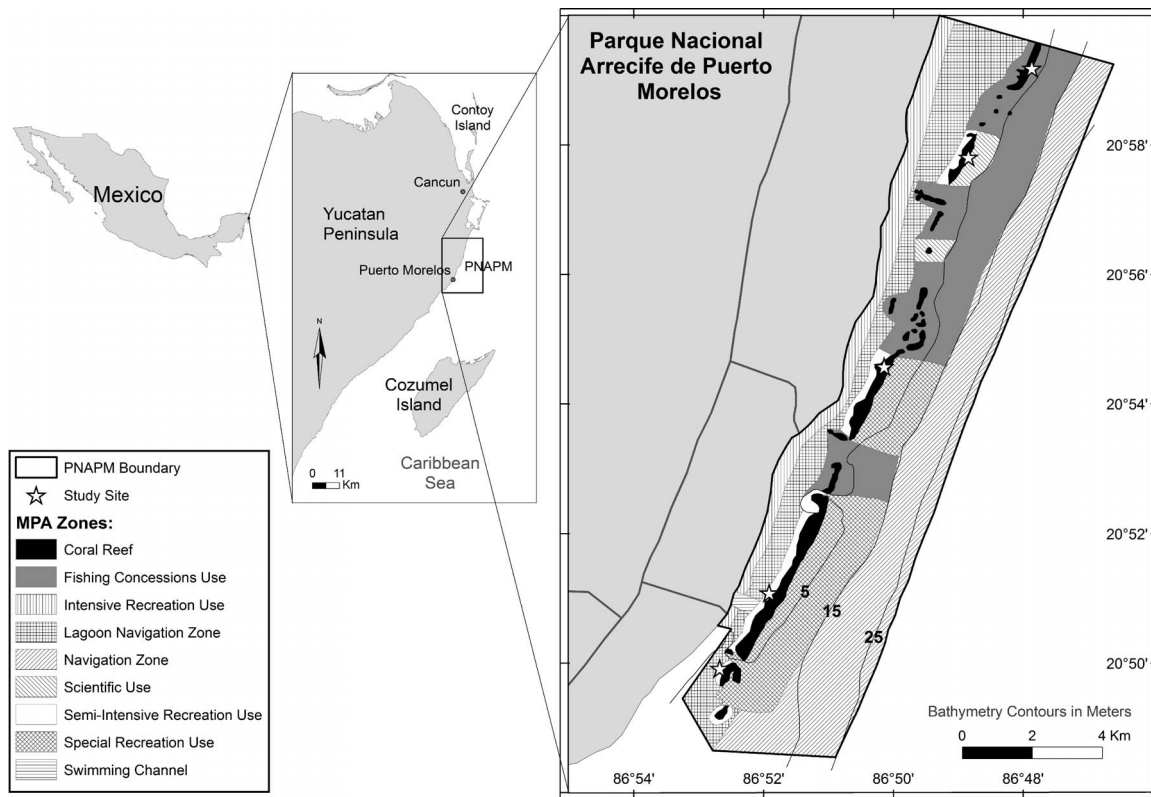


Figure 1. A map of Mexico highlighting the location of the study area within the Yucatán Peninsula and the zoning criteria for the study area.

Factors that influence environmental awareness and action include situational, psychological, social, and environmental variables (Barr and Gilg, 2006). Individuals can be influenced to act positively toward the environment when there is a perceived threat or danger to local resources (Baldassare and Katz, 1992; Mainieri *et al.*, 1997; Nancarrow, Smith, and Syme, 1996; Sguin, Pelletier, and Hunsley, 1998), when they are influenced by friends and/or family (Heinen, 1995a; Lam, 1999; Sadalla and Krull, 1995), and by intrinsic motives if knowledge and/or action results in some degree of satisfaction (De Young, 1996; Heinen, 1994). Basic knowledge of an issue or problem is, in all cases, important in affecting the level of engagement (Barr and Gilg, 2006; Schwartzman, Nepstad, and Moreira, 2000). Through education of the community, public awareness can be increased and can influence individuals to make better-informed decisions (Beger *et al.*, 2005; Bellwood *et al.*, 2004; Heinen and Rayamajhi, 2001).

Socioeconomic factors and perspectives of management are important when making conservation policy (Broad and Sanchirico, 2008; Ter-Ghazaryan and Heinen, 2006), and social science studies are thus needed in all facets of reserve planning and management (Cinner, Marnane, and McClanahan, 2005; Heinen, 2010). Factors such as awareness of objectives and rules, dependence on coastal resources, and local conditions based on demographic and socioeconomic variables can all affect levels of support for MPAs (Sesabo, Lang, and Tol, 2006). Encouraging locals to become part of conservation efforts is

possible by making some economic links between communities and protected areas (Infield, 2001; Masud and Kari, 2005).

The goal of this study is to assess the awareness, knowledge, perceptions, and attitudes of residents of Puerto Morelos, Mexico, concerning Puerto Morelos Reef National Park (Figure 1). The study addresses three main questions: (1) What level of knowledge do local residents have about the MPA? (2) Are there significant differences among residents based on household demographics concerning their perceptions, knowledge, awareness, and attitudes about the MPA? (3) What specific demographic variables are related to perceptions, knowledge, attitudes, and awareness of the MPA? We also make several managerial recommendations based on our results.

The State of Quintana Roo is the largest tourist destination in Mexico; more than half of its population lives in the northern portion along the coast from Cancún to Tulum, with new development moving southward in the Riviera Maya region (Figure 1). Increasing populations of residents and tourists alike have led to overexploitation of coastal resources; the lack of proper environmental education in Mexico, especially in Quintana Roo, is considered to be one of the major causes of marine ecosystem degradation (Rodríguez-Martínez and Ortiz, 1999). In Puerto Morelos, a coral reef-based fishing village about 30 km south of Cancún ($20^{\circ}51'13''$ N and $86^{\circ}53'55''$ W), the neighboring reef was originally protected through a community-based approach of local stakeholders assuming responsibility for management.

The national government initially denied federal protection because the area was not considered economically or ecologically important. The local community overcame governmental opposition to protection by providing scientific information about the reef requested by the Ministry of Environment and Natural Resources (Rodríguez-Martínez, 2008). The community was thus included in MPA establishment throughout the process and had a major impact on the development of the management plan (Murray, 2005). Initial outreach included a program to educate local students about coral reef ecosystems, which can be important in diffusing information to the broader community (e.g., Heinen, 1990); a number of meetings were held with citizens groups, members of the local fishing cooperative, and representatives of local dive shops and other tour operators (Rodríguez-Martínez, 2008).

Puerto Morelos Reef National Park (PMRNP), known in Spanish as Parque Nacional Arrecife de Puerto Morelos, is located off the coast of Puerto Morelos, situated in the NW region of the Mesoamerican Reef, the second largest reef system in the world (Jordan *et al.*, 1981; Ladd and Collado-Vides, 2013; Rodríguez-Martínez, 2008). In 1998, the PMRNP was deemed an International Union for Conservation of Nature category II national park (Instituto Nacional de Ecología INE-SEMARNAP, 2000; Heinen, 1995b) by the Mexican government. The national park is 9066 ha in area (90.7 km²) and is zoned for various uses. The PMRNP management plans focus on species and ecosystem protection and restoration, recreation, and local and visitor education (Instituto Nacional de Ecología INE-SEMARNAP, 2000).

METHODS

Residents from two distinct sections of the town of Puerto Morelos were interviewed. One section is located along the beach, and the second is located approximately 1.5 km inland; the former is referred to as La Playa and the latter La Colonia. La Colonia is separated from La Playa by a mangrove forest and a major north-south highway. A formal semistructured survey in Spanish was administered orally by the second author (A. Roque) in summer 2010. Also, all residents were targeted by randomly selecting households and by soliciting responses in the evenings, when many people are out shopping and socializing at local town centers. The total sample size of 300 represents approximately 5% of the population at the time of the survey (estimated to be 6000 people in 2010). Heads of household were targeted for interviews, or the oldest occupant at home if the household head was not present.

Fixed-answer questions made up the majority of the survey to allow for statistical comparison between and within stakeholder groups (see Supplementary Appendix). The survey also included some open-ended questions to allow further details or issues to be obtained from participants. The first part was divided into two sections: the first focused on the demographics of participant households and the second consisted of questions to determine what respondents knew about the park's rules and regulations and their opinions of park law enforcement. The second part questioned respondents' opinions and knowledge of the natural community; a third part concentrated on assessing residents' general

knowledge of marine protection and how effective they consider conservation in the MPA. The survey was drafted from other surveys successfully used elsewhere in protected area research (e.g., Shrivastava and Heinen, 2007; Heinen and Shrivastava, 2009). The draft was then pretested with 25 Puerto Morelos residents in 2009 by the first author and modified and updated based on the pretest.

Surveys were conducted at La Colonia and La Playa town centers and residential areas. La Playa residents answered 91 surveys, while La Colonia residents answered 209—this is the approximate proportion of the population represented by each section of the town. About 20% of individuals refused to take the survey, mostly because they felt they did not have time. Surveys took 15 to 20 minutes to complete, and no financial or other reward was offered. Statistical analyses were completed with SPSS version 19.0 (IBM Corp., 2010). Chi-square tests were used to assess summary demographic statistics, and chi-square and Mann-Whitney U tests were used to test for the location of households *vs.* a number of independent variables. A logistic regression was used to assess the association between demographic traits and attitudes towards the MPA. Spearman's rho tests were used to assess correlations between support for the MPA and whether respondents considered the MPA to be important to economic growth in the region. In all cases, a decision level of $p < 0.05$ was used.

Qualitative key informant surveys were also conducted with knowledgeable individuals, including the manager of the park, several of his staff, local law enforcement officers, and the head of the visitor's center, for additional information. Key informant surveys, widely used in many areas of natural resource management (e.g., Ter-Ghazaryan and Heinen, 2006) can be especially helpful in corroborating information gathered elsewhere (e.g., Dongol and Heinen, 2012; Shrestha-Acharya and Heinen, 2009).

RESULTS

The population was divided into two subpopulations, La Playa and La Colonia, based on the section of Puerto Morelos in which they resided, with the majority in La Colonia. Respondents were primarily male between the ages of 18 and 68, with the average age of 33.58 years. Household size ranged from 1 to 14 individuals, with the median of 4. Elementary education was the most common for household heads, followed by middle and high school. Higher levels of education were uncommon (Table 1). The average time participants lived in Puerto Morelos was 14.5 ± 12.1 years. There were three categories for origin of respondents: born in Mexico, born in the Yucatán Peninsula of Mexico, and born outside of Mexico. Born in Mexico refers to those born in all other parts of Mexico except the Yucatán Peninsula, and born outside of Mexico refers to all other countries of origin. The majority was from the Yucatán Peninsula (58.0%), 32.3% of participants came from other parts of Mexico, and 9.7% came from other countries. About 20% were born in Puerto Morelos. The most common occupations were within the hotel and food service sectors, followed by skilled labor.

A majority was aware that an MPA was located nearby, but a large minority (45.3%) was not. Nearly one-third agreed that

Table 1. Names and descriptive statistics for demographic variables derived from the survey given to Puerto Morelos residents. See the Supplementary Appendix and text for further explanation.

Variable Description	Variable Name	Mean \pm 1 SD or %	Min./Max. Value (if applicable)
Household location	Location	30.3 La Playa	
		69.7 La Colonia	
Sex of respondent	Sex	65 male	
		35 female	
Age of respondent	Age	33.6 \pm 12.2 y	15 y/68 y
Number of adults in household	Adults	2.8 \pm 1.6	1/10
Number of children (18 y and under)	Children	1.3 \pm 1.4	0/8
Education level of respondent	Education	27.9 elementary	
		26.6 middle school	
		24.6 high school	
		8.8 some college	
Household size	Total	4.2 \pm 2.6	1/14
Time lived in Puerto Morelos	Lived	14.5 \pm 12.1 y	1 y/68 y
Birthplace of respondent	Residency	32.5 Mexico	
		58 Yucatán	
		9.7 other	
Occupation of respondent	Occupation	Various; highest recorded was food service (18.3)	

SD = standard deviation.

their livelihood was dependent on the MPA, but more than half (60%) were unaware of its rules and regulations (Table 2). Of those who knew the rules, 32.2% agreed with all of them, while 9.7% agreed with only some of them. The rest disagreed with the rules of the park or were unsure of them. The majority did not know any park personnel, but most supported the existence of the MPA. A small number of respondents admitted to receiving a citation for violating a park regulation. Key informant surveys with the MPA manager and staff indicated that citations are almost always in the form of warnings to people fishing in to-take zones; very few people have been fined and none prosecuted since the MPA's establishment up to and including the time of this study. For questions that used a four-point scale (agree, disagree, neutral, don't know) relating to the management plan, increases in marine protection for critical species or habitat types (coral, fish, and sea grass), tourism management, and overall support for the MPA, most responses were "don't know."

Chi-square analyses were conducted on categorical variables to test the significance of each variable by location of residence (Table 3): La Playa ($n = 91$) or La Colonia ($n = 209$). The goodness of fit test showed a majority of variables were independent and differed significantly by location ($p < 0.05$). The only variables that did not differ significantly by location of residence were the sex of the respondent (Sex; $p = 0.060$), whether respondents felt that their livelihood was dependent on the MPA (Dependent; $p = 0.390$), whether they had received a citation (Citation; $p = 0.066$), and whether they were in favor of the creation of the MPA (Creation; $p = 0.107$).

Residents of La Playa had significantly higher levels of education than those of La Colonia (Mann-Whitney U test, $p = 0.05$; Table 4). La Playa residents also had higher mean ranks for the variables Creation, Job Opportunities, Professional, MPA Management, Experience, Coral, Sea Grass, Adequate Rules, Tourism, and Overall. The Mann-Whitney U test showed a significant difference between participants residing in La Playa and those residing in La Colonia for all variables except Sex ($U = 8437.0$, p value = 0.060), Dependent ($U =$

9032.0, $p = 0.391$), Citation ($U = 8892.5$, $p = 0.067$), and Creation ($U = 8529.5$, $p = 0.106$).

The logistic regression (results not tabulated) showed that respondent attitudes toward the establishment of the MPA and its existence as well as their overall support were all strongly related to their education level, whether they lived in La Playa and no matter how long they had lived in the area. In all cases, more support ($p < 0.05$) was expressed by those with higher educational levels, longer lengths of residence, and residence in La Playa as opposed to La Colonia. Those who were fishermen, were knowledgeable about the rules, knew an employee, and/or agreed with the creation of the MPA were also more positive overall. Spearman's rho tests showed that those who acknowledged that the MPA was important economically showed significantly more support for its establishment and support overall ($p < 0.005$ in all cases).

DISCUSSION

While MPAs have multiplied greatly over the past several decades, many face multiple governance challenges (*e.g.*, Green *et al.*, 2011; Hargreaves-Allen, Mourata, and Milner-Gulland, 2011; Lozano and Heinen, 2016; Mora *et al.*, 2006). Unlike the situation with many protected areas worldwide (*e.g.*, Heinen, 2012), PMRNP began with a local initiative, and its development included local involvement throughout the planning stages in the 1990s, as well as some efforts since inception toward public education and outreach (Rodríguez-Martínez, 2008). Yet the results here, overall, show a great deal of ignorance among the local populace regarding the MPA's management by 2010, which addresses the first question addressed in this study: what level of knowledge do local residents have about the MPA? This disconnect likely has to do with the rapid rates of demographic change in the region, as more people move in to take service-sector and construction-related employment, a phenomenon affecting many MPAs that attract tourism worldwide (*e.g.*, Wittemyer *et al.*, 2008). In the more general sense, large numbers of recent colonists can

Table 2. Variable names and descriptive statistics for survey questions from the survey administered to residents of Puerto Morelos (see the Supplementary Appendix).

Variable Description	Variable Name	Mean + 1 SD or %
Aware of MPA	Awareness	54.7 yes 45.3 no
Employed by MPA	Employment	12.7 yes 87.3 no
Employment dependent on MPA	Dependent	31.7 yes 68.3 no
Aware of MPA rules	Familiar	40.0 yes 60.0 no
How respondent became aware of rules	Media	16 by experience 61.7 don't know
In favor of regulations	In Favor	58 no 9.7 some 32.3 yes
Know any park personnel	Park Personnel	36.3 yes 63.7 no
Received a citation	Citation	8.7 yes 91.3 no
Support MPA establishment	Support	55 yes 45 no
Satisfied with MPA creation	Creation	0.7 disagree 2.7 neutral 51.3 agree 45.3 don't know
MPA creates job opportunities	Job Opportunity	1.3 disagree 8.7 neutral 38.7 agree 51.3 don't know
MPA personnel are professional	Professional	1.3 disagree 8.7 neutral 33.7 agree 56.3 don't know
Approve of MPA management plan	Management	1.3 disagree 7.3 neutral 35 agree 56.4 don't know
Attended an MPA public event	Public Event	27.7 yes 72.3 no
Public event experience	Experience	24.7 positive 2.7 neutral 0.3 negative 53 don't know
MPA protects corals	Coral	2.0 disagree 7.3 neutral 37.7 agree 59.3 don't know
MPA increases fish	Fish Stocks	5.3 disagree 8.7 neutral 26.7 agree 57.7 don't know
MPA improves sea grass protection	Sea Grass	3.3 disagree 5.7 neutral 33.3 agree 54.7 don't know
Adequate rules for protection	Adequate	3.0 disagree 10.7 neutral 31.7 agree 49.3 don't know
Adequate tourism management	Tourism	3.0 disagree 8.0 neutral 39.7 agree 45 don't know
Overall support for MPA	Overall	0.3 disagree 5.0 neutral 49.7 agree 45 don't know

Table 3. Chi-Square analyses of categorical variables based on the location of the household of respondents in Puerto Morelos, Mexico. Most variables are significant based on this one criterion, and in all cases, residents of La Playa showed more awareness and concern for the MPA than residents of La Colonia (see text).

Variable Name	Chi-Square Value	df	p Value
Sex	3.55	1	0.60
Education	23.67	4	0.000*
Awareness	8.06	1	0.005*
Employment	7.97	1	0.005*
Dependent	0.74	1	0.390
Familiar Rules	6.06	1	0.014*
In Favor	7.64	2	0.022*
Park Personnel	9.72	1	0.002*
Citation	3.37	1	0.060
Support Establishment	5.11	1	0.024*
Creation	6.10	3	0.107
Job Opportunities	10.63	3	0.014*
Professional	14.75	3	0.002*
MPA Management	17.17	3	0.001*
Public Event	11.02	1	0.001*
Experience	12.66	3	0.005*
Coral	15.64	3	0.001*
Fish	9.98	3	0.019*
Sea Grass	12.18	3	0.007*
Adequate Rules	12.24	3	0.007*
Tourism	11.44	3	0.007*
Overall	10.30	3	0.016*

df = degrees of freedom.

*Indicates statistical significance.

compromise many natural resource management issues (e.g., Timilsina and Heinen, 2008).

In Puerto Morelos, most working-class people have less formal education and live in La Colonia, where housing is more affordable. A crucial aspect for both conservation and promotion of the local economy is in understanding the main variables that influence attitudes of local residents (Infield, 2001); this addresses the second question: are there significant differences based on household demographics concerning perceptions, knowledge, awareness, and attitudes about the MPA? This study shows that knowledge about and support for the MPA depended on various demographic indicators and relationships between variables (Tables 3 and 4). The evidence supports the idea that ethics and attitudes are important in influencing residents' desires to conserve their environment; others have shown that these can frequently be used as predictors of other environmental or civic actions (Barr and Gilg, 2006). Economic incentives also need to be incorporated into MPA management to both lessen negative attitudes and provide people alternatives to extraction (Masud and Kari, 2015; Schwartzman, Nepstad, and Moreira, 2000).

The results of this study also show that the majority of variables under study are dependent on location of the household, which addresses the third main question: what specific demographic variables influence perceptions, knowledge, attitudes, and awareness of the MPA? Eighteen variables were significantly different based on household location alone and therefore demonstrate that locality plays a major role in individual responses to the MPA. Whether the participant believes the MPA provided jobs was itself dependent on which side of the community the participant lives. The results show quite strongly that residents living closer to the reef (La Playa)

Table 4. Mann-Whitney U test results for levels of knowledge and perceptions of respondents based on the location of respondent household. LP indicates the household was in La Playa, while LC indicates it was in La Colonia. See text for further explanation.

Variable Name	Mean Rank	Mann-Whitney U Test	p Value
Sex	162.29 LP	8437.0	0.060
	145.37 LC		
Education	179.22 LP	6595.0	0.000*
	135.86 LC		
Awareness	131.95 LP	7821.5	0.005*
	158.58 LC		
Employment	138.18 LP	8388.5	0.005*
	155.86 LC		
Dependent	145.25 LP	9032.0	0.391
	152.78 LC		
Familiar Rules	134.68 LP	8069.5	0.041*
	152.39 LC		
In Favor	133.23 LP	7938.0	0.010*
	158.02 LC		
Park Personnel	130.82 LP	7719.0	0.002*
	159.07 LC		
Citation	143.72 LP	8892.5	0.067
	153.92 LC		
Support Establishment	135.75 LP	8167.0	0.024*
	156.92 LC		
Creation	166.27 LP	8074.5	0.018*
	143.63 LC		
Job Opportunities	170.38 LP	8074.5	0.004*
	143.63 LC		
Professional	170.38 LP	7468.5	0.001*
	141.84 LC		
MPA Management	176.65 LP	7130.0	0.000*
	139.64 LC		
Public Event	131.01 LP	7736.0	0.001*
	158.99 LC		
Experience	169.97 LP	7738.0	0.001*
	142.02 LC		
Coral	169.45 LP	7785.0	0.005*
	142.25 LC		
Fish	161.27 LP	8529.5	0.106
	145.81 LC		
Sea Grass	170.03 LP	8529.5	0.003*
	142.00 LC		
Adequate Rules	173.48 LP	7418.0	0.001*
	140.49 LC		
Tourism	173.19 LP	7445.0	0.001*
	140.62 LC		
Overall	169.32 LP	7797.0	0.005*
	142.21 LC		

*Indicates statistical significance.

consider the protection of marine resources to be in their economic interests, and they show much more knowledge about and support for the MPA. Conversely, individuals living in La Colonia do not tend to consider the MPA economically important or important to their livelihood; this is partly the result of a wider variety of occupations of those residents and partly due to newness to the area.

But, to some degree, most livelihoods in the region—*e.g.*, tourism-related construction jobs and employment in hotels, shops, and restaurants—are related to tourism that is due in part to the MPA, and fishermen and those living in La Playa are the main people aware of this. Data from 2009, for example, showed that 124,000 people visited PMRNP, generating U.S.\$232,000 directly for the MPA (Ladd and Collado-Vides, 2013). There have been no economic studies on the total value

of tourism to PMRNP, but it is likely to be in the tens of millions of U.S. dollars based on the numbers of visitors and average daily tourist expenditures, as well as multiplier effects, estimated from other studies in the region (*e.g.*, Reid-Grant and Bhat, 2009). The results from Puerto Morelos show that much of the population is simply unaware of these economic impacts.

The level of knowledge and awareness of La Playa residents concerning the MPA was therefore comparatively advanced, but they are a minority of the population. Education level also plays a major role in generating positive perceptions toward the MPA and in the differences in perception between groups. It is likely that the more education individuals have, the more well-informed they are about a number of local issues, including marine resources and the importance of the MPA. The park's visitor's center is also located at La Playa, and locals can visit easily. For those living in La Colonia, a visit may consist of a mile (or more) walk down a narrow road through the mangroves with no sidewalks in excessive heat, or a long wait for an unreliable local bus.

A similar result in terms of greater levels of support for the MPA was seen among those who work for the MPA, are knowledgeable of park rules, agree with the regulations, know a park employee, and agree with the creation of the park. All such respondents were more knowledgeable and more positive about the MPA. There were also differences between levels of knowledge of each community in relation to being satisfied with the MPA's establishment. In these cases as well, La Playa residents showed more awareness and support for the MPA than La Colonia residents. Similar results are seen for questions regarding effective management of the MPA, better protection of biodiversity, and effective tourism management. There was no difference in knowledge base, attitudes, having received a citation, or perceived dependence between men and women for both subpopulations. The remaining variables relating to sea grass, reef, fish, tourism, park rules, and overall support for the MPA all have an influence on the community's level of awareness of marine protection. Again, La Playa residents showed more support and understanding for protection in all cases.

Previous studies have shown that education level is a significant factor influencing positive environmental action and/or attitudes toward protected areas (*e.g.*, Masud and Kari, 2015; Sesabo, Lang, and Tol, 2006). Those with higher levels of education in the present study were also more likely to support the creation of the MPA and to be in favor of the rules and regulations. In addition, the results show that the country or region of origin influenced levels of support for the MPA, as did longer residence time in Puerto Morelos. The longer someone resides in the area, the more experience they are likely to have with the MPA and its employees and with fishermen, guides, and other long-term residents who support protection. This may ultimately lead to more support for conservation. The results also found, like others (*e.g.*, Cinner, Marnane, and McClanahan, 2005), that residents are more likely to support MPAs when they perceive an increase in job opportunities and economic growth, a classic economic incentive (Heinen, 1995a). But awareness about its existence and its importance for tourism must reach a broader segment of the population to

bring about more positive attitudes and support in the region. The establishment of the MPA has improved opportunities for employment due to the tourism industry. If it continues to do so, and efforts are made to educate people about this, then more residents will likely be aware of, knowledgeable about, and supportive of the MPA in the future. More public outreach is essential.

CONCLUSIONS

MPAs are important for protection against degradation and collapse of marine resources, but Hind, Hiponia, and Gray (2010) concluded that only a small percentage actually reach their potential and can thus be considered effective. At present, Puerto Morelos Reef National Park cannot be considered effective in its societal setting given the level of ignorance of and lack of support among residents. Overall, the results of this study show that more efforts at education and community outreach are badly needed in the study area, and especially in the working-class segments of the population living in La Colonia. That is currently the major shortcoming of PMRNP. High levels of dependence on marine resources usually lead to high levels of support for protection, but this may not always be enough (Sale *et al.*, 2005). More than 50% of the residents in Quintana Roo were immigrants from other Mexican states, and 60% of residents had resided in the state for less than 10 years in 1999 (Rodríguez-Martínez and Ortiz, 1999). That study was conducted at the time of establishment of the MPA, when the majority of the residents of Puerto Morelos had been born there and had a strong connection to its marine resources. The present study, conducted over 10 years later, shows a major shift in the demographics of Puerto Morelos itself to one more similar to Cancún and Playa Del Carmen, that is, many newer immigrants. This coincides with the difficult ecological situation of the reefs and fisheries that the park protects (Ladd and Collado-Vides, 2013; Rodríguez-Martínez *et al.*, 2010), which is a local issue that requires a discussion beyond one park's jurisdiction (Sale *et al.*, 2014).

Thus the campaign for educating people about the need for and advantages of marine protection must be greatly expanded, especially to areas farther from the coastline, and continued through extended educational programs to various groups. The existing visitor's center has a strong role to play in forming partnerships with local schools and civic groups to promote visitation to the center and outreach to local schools and evening gatherings of adult residents. The National Autonomous University of Mexico (UNAM) operates its marine biology laboratory in Puerto Morelos, and staff scientists and graduate students could also be recruited to volunteer for community outreach. The key informant surveys indicated that the MPA itself has no budget for these activities, but some volunteerism by MPA staff and UNAM scientists and students could go a long way in efforts to effect more awareness of the MPA on the part of residents. These efforts, combined with relatively small grants from private foundations or local or state governments, may be all that is needed to increase awareness of the economic and ecological importance of the MPA. In many ways—given the UNAM lab, increasing numbers of tourists coming to the area to dive and fish, and proximity to centers of wealth such as Cancún and Playa del Carmen—Puerto Morelos Reef National

Park is in a much better situation than most MPAs to build such a program.

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