Range Mgmt. & Agroforestry 37 (2) : 133-141, 2016
ISSN 0971-2070

User's perception on conservation on communal lands in Cumbres de Monterrey national park, Mexico

Kathryn M. Clifton[1,3*], Jianbang Gan[1] and Humberto Ibarra Gil[2]

[1]Texas A&M University, Department of Ecosystem Sciences and Management, College Station, TX 77843, United States
[2]Universidad Autónoma de Nuevo León, Monterrey, N.L, México
[3]Present address: International Center for Agricultural Research in the Dry Areas, Amman 11195, Jordan
*Corresponding author e-mail: kathrynmarieclifton@gmail.com
Received: 5th May, 2016 Accepted: 12th November, 2016

Abstract

Little is known about what strategies successfully alter the norms people hold about conservation, particularly when the resources in question are relied upon for subsistence. We surveyed 235 households in communal lands with grazing and forest management in *Cumbres de Monterrey* national park in Mexico to identify factors that influence conservation perceptions. When asked how the establishment of the park has affected member's natural resource management practices, 14.7% stated toward less conservation, 43.6% stated no impact and 41.8% stated toward more conservation. We found that; incentives for a limited few can cause negative perceptions of conservation, very clear property/resource boundaries are essential for positive conservation perceptions, land users that practice rotational grazing believe that the park has worsened conservation practices, and the number of trainings received did not significantly improve perceptions. These findings shed new light on the conservation interaction between a protected area and its inner and adjacent communal lands.

Keywords: Forestry, Government programs, Land management, Payment for ecosystem services, Rangeland, Watershed recharge zone

Introduction

Roughly one tenth of the world's land surface is classified as protected and global protected areas have grown substantially in the last 40 years (Dudley, 2008). The International Union for the Conservation of Nature (IUCN) defines protected areas as "a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values" (Dudley, 2008). The quick growth of protected areas has often been driven by the pressure or urgent needs for protecting important areas from development without careful analysis on the maintenance requirements of these areas. National parks are uniquely important in the scheme of protected areas as they should be of a sufficient size and quality to maintain ecological function and processes (Dudley, 2008). People have often historically resided in and utilized natural resources in protected areas and as such displacement presents many problems (Rangarajan and Shahabuddin, 2006). Thus understanding how to achieve land management and conservation with park residents is not an easy task and perceptions of conservation often vary between stakeholders. It is important to understand the perception of park residents so that mutual views of conservation can be achieved. Conservation strategies that take residents perceptions into account are believed to be more successful than strategies that only represent the view of the conservation enforcement actors (Stolton and Dudley, 1999). This research measures the perceptions of conservation of park residents within *Cumbres de Monterrey* national park in Mexico and has implications for other protected areas with permanent residents.

Cumbres de Monterrey national park is an important conservation area that provides 70% of drinking water for the city of Monterrey, Nuevo León (the 3rd largest city in Mexico), and is a habitat for many bird species and the black bear (CONANP, 2007). The principal river in the park is the Santa Catarina that collects about 80% of the hydrologic resources of the region. Inside the park, there are many factures, faults, and permeable geologic structures that make this area a watershed recharge zone. Raising livestock is allowed and is an important economic activity as in many parts of the park it is the only feasible economic activity due to either steep slopes or lack of rainfall. Livestock is supposed to be managed sustainably so that it does not cause soil erosion or soil degradation;

however this is not always followed (Ortiz *et al.*, 2013). However, survey results showed that fewer goats are being reared than were historically with greater current preference on cattle. Currently there are 1,666 cattle, 1,288 goats, and 363 equine livestock on a total of 21,481 hectares. Half of livestock owners put their animals in closures part of the time. Drought and lack of forage is the principal cause of livestock mortality (Ortiz *et al.*, 2013). Thus finding a balance between conservation and forage availability is important. Land use in the park has dramatically changed since the formation of the park. Many of the survey respondents grew up herding large flocks of goats. Almost all communal land members own livestock mainly for local sale and consumption and many own donkeys for transit. Livestock are not allowed to graze near streams, on steep slopes, or be on roads and livestock owners can get in trouble in the case of such an event. Many respondents were worried that the park would take their livestock away. The park has a history of tension from surrounding areas appealing for its conservation. The area was declared a National Park in November 2000. Many communities that traditionally resided in this area relied on livestock grazing, subsistence agriculture and intensive agriculture (CONANP, 2007). Since the formation of the park, trees and wild herbs are no longer able to be legally harvested, and animals must graze inside communal boundaries. Communities varied in their accessibility, with some near paved roads and many off dirt roads that can become impassible depending on the weather.

Instead of relocating inhabitants as many countries have chosen (Cernea *et al.,* 2006), Mexico has allowed communities to reside inside *Cumbres de Monterrey* national park, however they must follow certain conservation rules. These communities are called *ejidos* or *communidades* and manage much of their natural resources in a communal manner. According to the 2007 *Ejido* Census, 54.1% of the land in Mexico is covered by *ejido* or *communidad* tenure (INEGI, 2008). The majority of the remaining forests in Mexico (80%) reside in 8,000 *ejidos* and *comunidades* (Klooster, 2000). This serves as an important case study not only for how to improve relations with communal land managers in Mexico's national parks but also for common conflicts between stakeholders that utilize land for livelihoods and stakeholders who want the land conserved for water and conservation purposes. Little is known about what factors potentially influence perceptions of conservation of land users by conservation agencies.

This study aims to explore the variables that effect the perception of national park promoted conservation by park inhabitants. This is important to understanding how the park can promote following rules in the *Cumbres de Monterrey* National Park and to reduce conflict between the park authority and the residents inhabiting on the communal lands within the park's boundaries.

Materials and Methods

Study site: *Cumbres de Monterrey* national park is located in the northeast of the Sierra Madre Oriental geological province and is the third largest national park in Mexico (López-Ramos, 1979). In this part of the geological province, many mountain peaks reach approximately 3,400 meters above sea level (SEMERNAT, 2009). In the highest areas of the park temperatures oscillate between -3°C and 18°C in the winter months of November through January (CONABIO, 2008). Lowland areas of the park at 400 meters above sea level will reach maximum temperatures of 32°C while the highest parts of the park will reach 26°C and 27°C in the months of June and July, respectively (SEMERNAT, 2009). Dry winds come in from the west and create a dryer climate in the northwestern part of the park where the landscape is characterized by many dry land plants. In the highest elevations of the park where the slope permits tree growth, intact fir and spruce forests are found. In the lower parts of the park near rivers, sedentary agriculture is found. Throughout the park pine and oak forests are found. A sub-mountain shrub ecotone is found throughout the park on hillsides and indicates a forest transition. In areas with tree and shrub cover, *Helietta parvifolia* and *Acacia berlandieri* are found. In areas with shrub cover *Leucophyllum frutescens* and *Acacia ridigula* are found. On a smaller scale both *Agave lechuguilla* and *Euphorbia antisyphilitica* are found throughout. The tree species that are found throughout the park are principally *Pinus pseudostrobus*, *Abies vejari*, and *Picea martinezi*. Other species that are also found throughout are *Quercus polymorpha*, *Q. rysophylla, Q. graciliformis*, *Q. laeta*, *Q. mexicana*, *Q. rugosa*, *and Q. laceyi* (SEMERNAT, 2009).

Survey: Two hundred and thirty-five household surveys were conducted in *comunidades* and *ejidos* that resided in or had partial boundaries inside the park. All households were attempted; many people were absent due to migratory labor. In total 14 communities were included in the survey. In two communities, respondents showed resistance towards surveyors. Resistance was received from a total of 15 households which represents

6% of the sample size. In these two communities snowball sampling, where the first respondent identifies people the surveyor should talk to next (Trochim and Donnelly, 2007), was used. Study thus used both census sampling and snowball sampling methods. Community members who lived permanently outside of the community yearlong were excluded from this study because of their inaccessibility and non-resident status. People migrate outside for short period but still lived in the community on an intermittent basis were included. Many of the survey respondents were goat herders in their younger years and livestock rearing has been practiced in the park historically before its formation.

Although a census sampling methodology attempts to survey all members, due to the fact that respondents were not always available a sample size formula was used. Using the formula to determine our survey sample size was to ensure that an appropriate confidence interval could be achieved, that is, the sample was statistically adequate. The national park estimates that there were 9,335 park inhabitants in 2008 (CONANP, 2007) and the United Nations Educational, Scientific, and Cultural Organization (UNESCO) stated that the park had 2,000 inhabitants (UNESCO, 2011).

Prior to the application of the sample size formula, we needed to select the values of alpha (α) and beta (β). Alpha (α) defines the type I error in which there is an incorrect rejection of the null hypothesis. Beta (β), type II error, is the probability of falsely accepting the null hypothesis when the alternative hypothesis is true (Kotrlik and Higgins, 2001). (1-β) is statistical power, the ability of a statistical test to detect if the effect exists (Cohen, 1988). The alpha in this study was set to 0.05 and the 1-beta is equal to 0.7, with beta being 0.3. The standard deviation (S) for the population was unknown so an S of 0.5 was chosen. This is a conservative estimate since $S^2 \approx p(1-p)$, which attains its maximal value when *p* = ½. The margin of error (*e*) is 08. The sample size formula used is given below as reported by (Kuehl and Kuehl, 2000):

$$n_0 = \left(\frac{(Z_\beta + Z_{\alpha/2})^2 S^2}{e^2}\right)$$

where Z_α is the value associated with the confidence level which is 95% for this sample and thus Z takes a value of 1.96 (Zar, 1984). Z_β is 0.5238 from the Z table. Based on this formula, a sample size of 241 was desirable. However, since this is a finite population, a finite filter was used as follows (Lohr, 2010): With n_0=241 and N= 9335 this gave

$$n = \left(\frac{n_0}{1+\frac{n_0}{N}}\right)$$

an n of 235. With n_0=241 and N= 2000 this gave an n of 215. We collected 235 surveys from this population. The dataset had a total of 61 women respondents, which was about 25% of the total sample.

Data analysis: Ordinal logistic regression was run for all models with scaled responses. While multinomial logistic regression can be used, ordinal logistical regression results have simpler interpretations and potentially greater power than baseline-category logit models. A cumulative probability for *Y* is the probability that *Y* falls at or below a particular point. For outcome category *j*, the formula used for cumulative probability is given below as reported by Agresti (2007):

$$P(Y \leq j) = \pi_1 + \ldots + \pi_j, \quad j = 1, \ldots,$$

The score test for the proportional odds assumption was used to determine the goodness of fit. This tested whether the parameters are the same across logits, simultaneously for all predictors. Models with score values of Pr > ChiSq greater than 0.05 were interpreted. The model used for the score test for the proportional odds assumption was the same as the cumulative logit model, and it is (Agresti, 2007):

$$logit[P(Y \leq j)] = \alpha_j + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k, \qquad j = 1,2,3$$

falls at or below category *j*. The above formula shows the cumulative probability for j. In this model, β_k is the increase in log-odds of falling into or below any category associated with a one-unit increase in X_k, holding all the other *X*-variables constant. This model uses cumulative probabilities up to a threshold, thereby making the whole range of ordinal categories binary at that threshold. The response *is Y=1,2,..., k* where the ordering is natural. X_1, X_2, X_K are indicator or dummy variables; they indicate categories for the predictors. Multicollinearity tests were run for all models and variables are removed that have a variance inflation factor (VIF) of three or greater. This is to assure that explanatory variables in the regression models were not highly correlated one another. The formula used was given below:

$$tolerance = 1 - R_j^2 \ , \ VIF = \frac{1}{tolerance}$$

where R_j^2 was the coefficient of determination of a regression of dependent variable *j* on all independent variables. A tolerance of less than 0.20 or 0.10 and/or a VIF of 5 or 10 and above indicates a possible multicollinearity problem. In this study, the independent

variables with a VIF greater than or equal to three were removed.

Results and Discussion

The establishment of the park has affected the natural resource management practices of *ejidos* and *comunidades* that reside within or have boundaries inside the park. When asked how the establishment of the park has affected member's natural resource management practices, 14.7% stated-toward less conservation, 43.6% stated-no impact, and 41.8% stated toward more conservation. The park's impact on conservation behaviors of the communal members was regressed on compensation, pasture rotation, pasture boundaries, number of trainings received in a year and the frequency of communication with other members about natural resource management via ordinal logistic regression. A few variables in the survey were significantly related to these responses (Table 1) and merit further review to understand how park promoted conservation can be improved. The significant variables are how clear the pasture boundaries are, if compensation for conservation is received from community members, as well as if the community practices rotational grazing. These variables are significant as people that receive compensation and rotate pasture are likely more aware of conservation than other respondents. The clarity of pasture boundaries directly effects whether conservation can be achieved as it reduces open access or multiple access problems and is linked to clarity in roles and responsibilities (Table 2).

Compensation: Only 13.4% of respondents stated that community members received compensation. Respondents who received compensation were less likely to think that the park has improved their conservation practices when compared to respondents who had not received compensation, with a p-value of 0.0189 and an estimated coefficient of -1.0011. A one unit increase in compensation going from 0 to 1 (no compensation=0 to compensation=1) had an expected 1.0011 decrease in the log odds ratio of being in a higher level of park promoted conservation, given that all the other variables in the model are held constant. Members who had received compensation generally received it for labor affiliated with assisting with stopping forest fires, planting seedlings or maintaining nurseries. Lindberg *et al*. (1996) associated negative attitudes of park residents with perceptions of not receiving a fair share of the benefits. Several authors propose inclusion of communities in the designation process and decision making related to

Table 1. Association between park conservation and selected independent variables

Dependent	Independent
Prk_cnsv	(cnsv_cmp, Pst_rot, cmnc_NtR, Past_bnd, Trn_t_Yr)

Variable	Code	DF	Estimate	Standard Error	Odds Ratio	Wald Chi-Square	Pr>ChiSq
Intercept	1	1	-0.431	0.3973		1.1765	0.2781
Intercept	2	1	2.0943	0.429		23.8325	<.0001
Cnsv_cmp	1	1	-1.0011	0.4265	0.368	5.509	0.0189
Pst_rot	1	1	-0.9179	0.3935	0.399	5.4425	0.0197
Cmnc_NtR	2	1	-0.3736	0.3725	0.688	1.0058	0.3159
Cmnc_NtR	3	1	-0.5796	0.4098	0.56	1.9998	0.1573
Cmnc_NtR	4	1	-0.3486	0.4152	0.706	0.705	0.4011
Past_bnd	2	1	-1.1274	0.3907	0.324	8.3288	0.0039
Past_bnd	3	1	-1.1568	0.5118	0.315	5.1084	0.0238
Past_bnd	4	1	-0.8069	0.6707	0.446	1.4472	0.229
Trn_t_Yr		1	-0.231	0.1271	0.794	3.3024	0.0692
Cases Included in Analysis					N=194 (82.6%)		
-2 Log Likelihood					384.896		
Correct Model Prediction Percentage					66.5		

Park_cnsv = Park conservation; Cnsv_cmp = Conservation compensation; Pst_rot = Pasture rotation; Cmnc_NtR = Communication about natural resource management; Past_bnd = Pasture boundary; Trn_t_Yr = Training time per year

Table 2. Variable Descriptions and Measurements

Variable Name	Description	Response Key
	Dependent Variable	
Park_cnsv	How has the establishment of the park affected your natural resource management practices?	(1=toward less conservation 2=no impact 3= toward more conservation)
	Independent Variables	
Past_bnd	How clear are the boundaries in which members are allowed to graze?	(1=very clear 2=clear 3=slightly clear 4=not clear)
Pst_rot	Does this community practice rotational grazing?	(0=No 1=Yes)
Cnsv_cmp	Do community members receive compensation for conservation activities?	(0=No 1=Yes)
Cmnc_NtR	How often do you communicate with other community members about resource management?	(1=Every few months 2=Monthly 3=Weekly 4=Daily)
Train_timeP	Has anyone come to your community to offer a training? If so, how frequently do they come?	(0=never 1=yes)

compensation. Overlooking this can further hamper the implementation of conservation goals (Li and Liu, 2010; Frauman and Banks, 2011).

Pasture rotation: Only 10.6% of the respondents stated that they practiced rotational grazing, thus it is not a widely adapted practice in these communities. Rotational grazing is loosely defined here as people move their animals from one area to the next. Those who stated that they practiced rotational grazing were more likely to state the park had lessened their conservation practices ($p = 0.0197$; regression coefficient = -0.9179). A one unit increase going from 0 to 1 (no rotation=0 to rotation=1), would see an expected 0.9179 decrease in the log odds ratio of being in a higher level of park promoted conservation, given that all of the other variables in the model are held constant. Semi-nomadic and nomadic pastoralists are citied as often times having rich conservation knowledge (Goldman, 2003; Stave *et al*., 2007). It is possible that those who rotated their animals for grazing had a superior conservation knowledge as shown in Stave *et al*. (2007) when they compared the ecological knowledge of semi-nomadic to sedentary pastoralists. While those who rotate their animals are not nomadic they are more mobile than the other herders in the study area. Different resource users and income groups can have different tendencies to support conservation measures (Natura, 1995; Mehta and Kellert, 1998). It is evident here that those who rotate their animal s were less likely to think the park had improved their conservation practices. Park promoted conservation or park acceptance amongst this group may be more difficult to achieve. Light rotational grazing has better conservation outcomes than the elimination of grazing from rangelands (Belgacem *et al*., 2013).

Pasture boundaries*:* Wade (1994) and Ostrom (1990) specified the importance of the clarity of property/resource boundaries for communal land management success. Boundary clarity is also mentioned in conservation literature; unclear boundaries are seen as a threat to conservation that can lead to conflict (Yasmi *et al*., 2007; Wunder *et al*., 2008). When respondents were asked "How clear are the boundaries in which members are allowed to graze," 16.6% responded "very clear," 64.3% responded "clear," 13.2% responded "slightly clear" and 6% responded "not clear." Respondents that selected "clear" were less likely to think the park has positively

influenced their conservation practices compared to those that stated "very clear" (p = 0.0039; regression coefficient = -1.1274). A one unit increase in boundary clarity going from the base of 1 (very clear) to 2 (clear) would expect to see a 1.1274 decrease in the log odds ratio of being in a higher park conservation category, given that all of the other variables in the model are held constant. Respondents that selected "slightly clear" were less likely to think that the park had positively influenced their conservation practices compared to those that selected "very clear," with a p value of 0.0238 and an estimated regression coefficient of -1.1568. An increase in pasture boundary clarity going from 0 (very clear) to 3 (slightly clear) would expect to see a 1.1568 decrease in the log odds ratio of being in a higher park conservation category, given all of the other variables in the model are held constant. Those that answered "not clear" did not hold a significant relationship with park promoted conservation practices. The park had a more positive impact in communities where boundaries were very clear. It is possible that respondents that stated "very clear" have received clarification from external government authorities. Efforts to clarify boundaries amongst community members who had "slightly clear" and "clear" property boundaries could improve conservation promotion amongst park communal land inhabitants. Since only 16.6% of respondents selected "very clear" and 77.5% of respondents selected "clear" and "slightly clear," additional clarification could have substantial benefits by preventing users from grazing outside of the community boundary further promoting plant regeneration in the buffer areas around human settlements.

Training time per year: Trainings are a common method to promote conservation amongst natural resource users. However, trainings can have varied success rates in promoting conservation and adaptation (Mehta and Kellert, 1998; Deressa *et al.*, 2009). Trainings were often mentioned in the field, and to understand its effect on conservation promotion it was included in this study. Multiple conservation actors (SEMARNAP, CONANP, and local NGOs) and governmental actors (municipal and government assistance agencies) stated to have given trainings in these communities. However, the vast majority of the respondents could not recall from whom they had received training. Figure 1 shows a distribution of responses regarding the frequency of trainings received in the year prior to our survey. The majority of respondents (67.8%) stated that they had not received training in the previous year and 32.2% stated that they had received one or more trainings in the year before. Respondents who received more trainings were less likely to state that the park had improved the respondents conservation practices with a p= 0.0692 and an estimated regression coefficient of -0.231. This variable was not significant at the 95% confidence level and thus there is no need to be interpreted further.Training does not always lead to changes in farmer's practices (Kumar *et al.,* 2015).

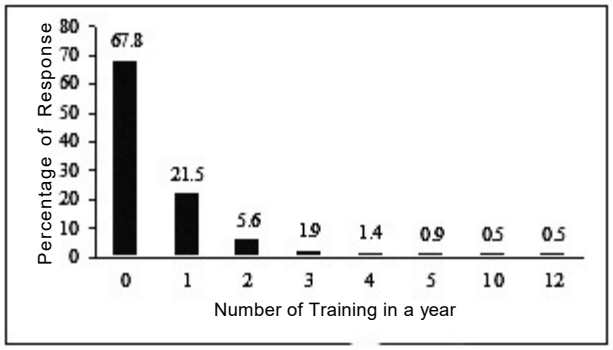

Fig 1. Number of trainings received and responses

The frequency of communication about natural resource management: Communication frequency about natural resource management was included in the logistic regression model due to its possible influence on trustworthiness and fairness with the park authority. In a study conducted amongst trustee's and trustors, the level of perceived trustworthiness was effected by the frequency of communication (Becerra and Gupta, 2003). The frequency of communication about natural resource management could also influence the respondents' trustworthiness of the park. In a study examining the complex relationships between superiors and subordinates, fairness perceptions were found to often be constructed by workgroup members through discourse (Sias and Jablin, 1995). Thus, increased communication frequency could influence how the park either promotes or discourages conservation practices by increasing trust and fairness perceptions. Baland and Platteau (1996) and Wade (1994) stated that interdependence among members and ease of enforcement of rules are important for successful communal land management. To inquire about this relationship further, questions were asked for the respondents about the frequency of communication regarding natural resource management among communal members to determine its importance. However, it did not have a significant relationship with park promoted conservation practices in this case study. Perhaps members are not talking often about the park when discussing natural resource management.

Conclusion

Overall the park had a positive impact as 41.8% of the respondents stated that establishment of the park has affected their natural resource management practices towards more conservation. It is proposed to include communities in the designing process and decision making related to compensation. Overlooking this can further hamper the implementation of conservation goals (Li and Liu, 2010; Frauman and Banks, 2011). A focus group discussion with those that practice rotational grazing by an independent actor could facilitate further discussion and management solutions to change the negative perceptions of this group. Efforts to clarify boundaries amongst community members who have "slightly clear" and "clear" property boundaries could improve conservation promotion amongst park communal land inhabitants. Boundary clarification could also prevent users from grazing outside of the community boundary, further promoting plant regeneration in the buffer areas around human settlements. Improved messaging of the trainer's affiliation could assist with clear messaging and eliminating the user versus them mentality that many respondents portrayed. This is important as there are multiple conservation and land management actors in the park. Further research regarding communication frequency is needed to understand its relationship with perceptions in conservation. Communal land management literature talks about the need for external environments not to undermine local authority (Ostrom, 1990; Wade 1994). However, it does not talk specifically about how conservation agencies may influence perceptions of conservation. Clearly defined boundaries are promoted as important group characteristics (Ostrom, 1990; Wade 1994). It is important to note that where boundaries were very clear, there were also increasing perceptions of park promoted conservation. While it has been advocated in the communal land management literature that appropriate levels of external aid are important to compensate local users for conservation activities (Baland and Platteau, 1996); this study found the presence of compensation to decrease perceptions in conservation. Protected area management literature advocates the need for stakeholder involvement in decision making and a sense of fairness for compensating schemes (Lindberg *et al.*, 1996; Li and Liu, 2010; Frauman and Banks, 2011). Further research understanding how fairness and stakeholder involvement can be managed and scaled across large areas is needed to inform achievable policy actions in this realm.

Acknowledgement

This study was made possible by a grant from the spring 2010 Field Research Award from Texas A&M University's Department of Ecosystem Science and Management, USA. The publication was also made possible by the International Center for Agriculture Research in the Dry Areas (ICARDA). The generous time of the community members of *Cumbres de Monterrey* national park made this study possible.

References

Agresti, A. 2007. *An Introduction to Categorical Data Analysis*. Wiley-Inter science, Hoboken, NJ.

Baland, J. M. and J. P. Platteau. 1996. *Halting Degradation of Natural Resources: Is There a Role for Rural Communities?* Food and Agriculture Organization of the United Nations, Rome, Italy.

Becerra, M. and A. K. Gupta. 2003. Perceived trustworthiness within the organization: The moderating impact of communication frequency on trustor and trustee effects. *Organization Science* 14: 32-44.

Belgacem, A. O., N. Al Kaabi, H. Al Wawi and M. Louhaichi. 2013. Effect of livestock grazing on plant cover and species diversity in desert rangelands: A case study of Musawar Al Ottoria in Qatar. *Range Management and Agroforestry* 34: 88-92.

Cernea, M. M. and K. Schmidt-Soltau. 2006. Poverty risks and national parks: Policy issues in conservation and resettlement. *World Development* 34: 1808-1830.

Cohen, M. 1998. Monitoring and enforcement of environmental policy. *The International Year Book of Environmental and Resource Economics* 3: 44-106.

CONABIO (Comisión Nacional Para el Conocimiento y Uso de la Biodiversidad). 2008. El Potosi-Cumbres de Monterrey. RTP-81. *CONABIO*. http://www.conabio.gob.mx/conocimiento/regionalizacion/doctos/rtp_081.pdf (accessed on Sept. 24, 2009).

CONANP (Comisión Nacional de Áreas Naturales Protegidas). 2007. Programa de Manejo: Parque Nacional Cumbres de Monterrey. http://www.conanp.gob.mx/anp/consulta/PCM-20DIC06.pdf. (accessed on Sept. 24, 2009).

Deressa, T. T., R. M. Hassan, C. Ringler, T. Alemu and M. Yesuf. 2009. Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. *Global Environmental Change* 19: 248-255.

Dudley, N. 2008. *Guidelines for Applying Protected Area Management Categories*. IUCN, Gland, Switzerland.

Frauman, E. and S. Banks. 2011. Gateway community resident perceptions of tourism development: Incorporating Importance-Performance Analysis into a Limits of Acceptable Change framework. *Tourism Management* 32: 128-140.

Goldman, M. 2003. Partitioned nature, privileged knowledge: community based conservation in Tanzania. *Development and Change* 34: 833-862.

INEGI (Instituto Nacional de Estadística y Geografía). 2008. Resultados Preliminares del IX Censo Ejidal. *INEGI*. http://www.google.com (accessed on Dec. 27, 2013).

Klooster, D. 2000. Community forestry and tree theft in Mexico: Resistance or complicity in conservation? *Development and Change* 31: 281-305.

Kotrlik, J. W. and C. C. Higgins. 2001. Organizational research: Determining appropriate sample size in survey research appropriate sample size in survey research. *Information Technology, Learning, and Performance Journal* 19: 43.

Kuehl, R. O. and R. Kuehl. 2000. *Design of Experiments: Statistical Principles of Research Design and Analysis.* Duxbury/Thomson Learning, Pacific Grove, CA.

Kumar, M., R. P. Singh and A. K. Misra. 2015. Adoption level of green fodder production practices and constraints faced by the farmers of Rajasthan. *Range Management and Agroforestry* 36: 217-220.

Li, W. and M. Liu. 2010. Several strategic thoughts on China's eco-compensation mechanism. *Resource Science* 5: 002.

Lindberg, K., J. Enriquez and K. Sproule. 1996. Ecotourism questioned: Case studies from Belize. *Annals of Tourism Research* 23: 543-562.

Lohr, S. L. 2010. *Sampling: Design and Analysis.* Brooks Cole, Boston, MA.

López-Ramos, E. 1979. *Geología de México*, 3rd Edn. Instituto De Geología, UNAM, Mexico City.

Mehta, J. N. and S. R. Kellert. 1998. Local attitudes toward community-based conservation policy and programmes in Nepal: a case study in the Makalu-Barun Conservation Area. *Environment Conservation* 25: 320-333.

Natura, F. 1995. Local communities and protected areas: attitudes of rural residents towards conservation and Machalilla National Park, Ecuador. *Environmental Conservation* 22: 241-249.

Ortiz, S., A. Cantu, J. Uvalle and F. Gonzalez. 2013. Actividates Peucarias. In: C. Cantú Ayala, M. Rovalo Merino, J. Marmolejo Moncivais, S. Ortiz Hernández and E. Seriñá Garza (eds). *Historia Natural Del Parqu Nacional Cumbres de Monterrey Mexico*. Universidad Autónoma de Nuevo León, Monterrey. pp. 288-295.

Ostrom, E. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action.* Cambridge University Press, Cambridge, England.

Rangarajan, M. and G. Shahabuddin. 2006. Displacement and relocation from protected areas: Towards a biological and historical synthesis. *Conservation and Society* 4: 359.

SEMERNAT (Secretaria de Medio Ambiente y Recursos Naturales). 2009. *Estudio Sobre el Cambio de Uso de Suelo en el Parque Nacional Cumbres de Monterrey, Periodo 1976 – 2008*. Comisión Nacional de Areas Naturales Protegidas, Región Noreste y Sierra Madre Oriental, Monterrey, NL.

Sias, P. M. and F. M. Jablin. 1995. Differential superior subordinate relations, perceptions of fairness, and coworker communication. *Human Communication Research* 22: 5-38.

Stave, J., G. Oba, I. Nordal and N. C. Stenseth. 2007. Traditional ecological knowledge of a riverine forest in Turkana, Kenya: Implications for research and management. *Biodiversity and Conservation* 16: 1471-1489.

Stolton, S. and N. Dudley. 1999. *Partnerships for Protection: New Strategies for Planning and Management for Protected Areas*. Earthscan, New York.

Trochim, W. M. and J. P. Donnelly. 2007. *Research Methods Knowledge Base,* 3rd Edn. Atomic Dog. Mason, OH.

UNESCO (United Nations Educational, Scientific and Cultural Organization). 2011. UNESCO- MAB Biosphere Reserves Directory, Biosphere Reserve Information, Cumbres de Monterrey, Mexico. http://www.unesco.org/mabdb/br/brdir/directory/biores.asp?mode=all&code=MEX+21 (accessed on Nov. 11, 2009).

Wade, R. 1994. *Village Republics: Economic Conditions for Collective Action in South India.* ICS Press, San Francisco, CA.

Wunder, S., B. Campbell, P. G. Frost, J. A. Sayer, R. Iwan and L. Wollenberg. 2008. When donors get cold feet: the community conservation concession in Setulang (Kalimantan, Indonesia) that never happened. *Ecology and Society* 13: 12.

Yasmi, Y., C. Colfer, L. Yuliani, Y. Indriatmoko and V. Heri. 2007. Conflict management approaches under unclear boundaries of the commons: Experiences from Danau Sentarum National Park, Indonesia. *International Forestry Review* 9: 597-609.

Zar, J. H. 1984. *Biostatistical Analysis*. Prentice-Hall, Englewood Cliffs, NJ.