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Identifying ecosystem services using multiple methods: Lessons from the mangrove wetlands of Yucatan, Mexico

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Abstract. The failure to properly account for the total value of environmental and natural resources results in socially undesirable overexploitation and degradation of complex ecosystems such as mangrove wetlands. However, most ecosystem valuation research too often focuses on the question of "what *is* the value" and not enough on "*what* people value." Nonmarket valuation practitioners have used qualitative approaches in their work for some time. Yet, the relative strengths and weaknesses of different qualitative methods have been more the subject of speculation than systematic research. The statistical examination of focus group and individual interview data on ecosystem services illustrates that the two methods generate important but different ecosystem service data. Further, the data show that the use of multiple data collection methods offers a more robust understanding of what people value.

Key words: Focus groups, Interviews, Nonmarket valuation, Qualitative methods, Statistical analysis

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Introduction

The failure to properly account for the total value of environmental and natural resources results in socially undesirable overexploitation and degradation of complex ecosystems such as mangrove wetlands (Clark, 1996; Farnsworth and Ellison, 1997; Hamilton et al., 1989; Spaninks and van Beukering, 1997). Complex environmental and natural resources, such as the Yucatán's mangrove wetlands, represent substantial sources of cultural, intergenerational, environmental, and economic wealth (Aylward and Barbier, 1992; Bann, 1997; Barbier, 1994; Barbier et al., 1997; Carson, 1998; Perrings, 1995). However, most ecosystem valuation research is "too focused on the question of 'what *is* the value' and not enough on *what*, in particular, people value" (Swallow et al., 1998). There is a need for resource valuation research to identify the range and relative importance of the components of ecosystem value rather than merely estimate some value for a particular ecosystem service.

Despite this need for understanding the components of ecosystem value, it is prohibitively expensive and unrealistic to conduct detailed empirical nonmarket valuation studies of each ecosystem. The need for ecosystem valuation information is especially great for those public good services of ecosystems that are not well-captured in markets (Aylward and Barbier, 1992; Barbier et al., 1997; Carson, 1998; Mitsch and Gosselink, 1993). In particular, the value of wetland ecosystems may be especially great in developing countries where efficient markets for wetland services do not exist (Aylward and Barbier, 1992; Barbier et al., 1997; Carson, 1998). However, the availability of valuation methods for estimating wetland economic values does not necessarily mean that the pertinent resources services are identified and included in wetland ecosystem valuation studies and policy decisions.

The reported research examines two relatively inexpensive research methods for helping researchers identify relevant ecosystem services associated with a mangrove wetland. Using focus groups and individual interviews, the researcher explored what local resource beneficiaries associate with the mangrove wetland of Chelém Lagoon. The study identifies the particular mangrove wetland services important and relevant to the inhabitants of two communities along the coastal fringe west of Progresso, Mexico. The study demonstrates that the use of both focus groups and in-depth individual interviews can lead to a more robust understanding of what people value about a shared ecosystem. Furthermore, the study addresses a gap in the resource valuation literature by using an empirical

method to compare the outcomes of group discussions with individual interviews concerning ecosystem services (Chilton and Hutchinson, 1999).

First, the paper reviews some of the natural resource services attributed to mangrove ecosystems. Next, the paper describes how valuation research has used qualitative research methods in some valuation studies of natural resources. The paper then describes the research design and method that was used to test the hypothesis that focus groups and individual interviews help researchers identify substantially similar ecosystem services associated with a mangrove wetland. The research results are presented before discussing the implications of the findings on the usefulness of multiple methods, ways to improve valuation studies, and the ability of statistical analysis to shed light on the significance of qualitative data.

Background

Mangrove wetland values

The term mangrove refers to a number of tree species capable of living in saltwater or salty soils. Mangroves and their ecosystems are found in intertidal areas of sheltered coastlines called lagoons and estuaries. Ecologically, mangrove wetlands maintain high levels of biological productivity; export nutrients to outside waters; and provide habitat for valuable plant and animal species (Clark, 1996). Mangrove ecosystems are also important to the subsistence livelihood of tropical coastal communities (Hamilton et al., 1989; Hamilton and Snedaker, 1984). Mangrove ecosystems potentially provide an array of important indirect services – prevention of storm damage, flood and water control, support of fisheries, waste absorption, recreation, and transport (Barbier, 1994; Barbier et al., 1997). Mangrove ecosystems may be directly exploited by extracting goods such as fish, agriculture, wildlife, wood, and fresh water (Bann, 1997; Bennet and Reynolds, 1993; Farnsworth and Ellison, 1997; Hirsch and Mauser, 1992; Kunstadter et al., 1985; Ruitenbeek, 1992). Additionally, mangrove wetlands have also been said to be significant sources of nonuse benefits that do not flow from direct use of the ecosystem (Aylward and Barbier, 1992; Barbier, 1994; Barbier et al., 1997).

Mangrove ecosystems, like other complex environmental and natural resources, are potential sources of an array of use and nonuse values (Barbier, 1994; Barbier et al., 1997; Carson, 1998; Hamilton et al., 1989). While not dependant upon entry directly into markets, use values require that some *in situ* activity takes place that benefits individuals (Freeman, 1993). Examples of natural resource use values include camping, hunting, wood collection, fishing, farming, as well as such things as breathing clean air. Values independent of *in situ* activities have been called passive use or nonuse values. Examples of nonuse values include the value of knowing the resource simply exists, the value some people attribute to some potential use of the resource, and the value of knowing that future generations will have the resource (Freeman, 1993). In order to properly account for the total value of ecosystems in their decision-making, policymakers should understand the extent and magnitude of use and nonuse values associated with the resource.

Qualitative methods and valuation studies

Social scientists in diverse fields of study regularly use qualitative methods as comprehensive research tools and as important components in designing and implementing reliable research studies (Krueger, 1994; Morgan, 1997; Schwarz, 1997; Sudman et al., 1996; Weiss, 1994). Studies for estimating the economic value of environmental and natural resources range from market or behavior-based methods to direct methods such as contingent valuation (CV) studies.[1] For some time, resource valuation researchers have been advised to consider using focus group interviews as well as individual interviews for questionnaire pretesting and development (Mitchell and Carson, 1989). Despite some initial skepticism of the utility of qualitative methods for designing nonmarket valuation studies (e.g., Arrow et al., 1993), focus groups have been increasingly recognized and relied upon as important aspects of resource valuation questionnaire design and evaluation (Carson and Mitchell, 1993; Schkade and Payne, 1994; Chilton and Hutchinson, 1999; Hutchinson et al., 1995). Individual interviews have also been reported to provide efficient means for collecting information on beneficiaries' use and understanding of mangrove ecosystems at the local level (Kovacs, 1999).

Work by cognitive psychologists and survey method researchers underscore the value of qualitative research methods for questionnaire design (Schwarz, 1997; Sudman et al., 1996). These same researchers point out that one qualitative research method alone may be insufficient to learn about respondents' resource use and understanding. Some researchers suggest that focus groups and individual interviews may lead to the discovery of different information (De Jong and Schellens, 1998; Kitzinger, 1994a, 1994b). Other researchers assert that focus group research should be combined with other types of research, including individual interviews, to triangu-

late or corroborate research findings (Bryman, 1988; Morgan, 1996). Multiple qualitative methods such as focus groups and one-on-one interviews may be useful for revealing a wide range of local beneficiaries' ideas about and conception of complex environmental and natural resources (e.g., Carson et al., 1994; Chilton et al., 1998; Hutchinson et al., 1995). Thus there is a need for research that compares the outcomes of focus group and individual interviews regarding the respondents' understanding of complex ecosystems (Chilton and Hutchinson, 1999).

Research design and method

Research question

The relative strength and weakness of particular qualitative research methods "has been more the subject of speculation than systematic research" (Morgan, 1997: 13). A few researchers have explored differences in focus group and individual interview information (De Jong and Schellens, 1998; Kitzinger, 1994a, 1994b). Qualitative methods may be used successfully to learn from local beneficiaries how they use, perceive, and value environmental and natural resources (Mandondo, 1997). Studies also show that resource beneficiaries' ideas about natural resources may differ from those of scientists and so-called experts (Talawar and Rhoades, 1998). This reported research examines the research hypothesis that focus groups and individual interviews, all else being equal, reveal similar sets of information about a shared mangrove ecosystem.

Participants

The communities of Chelém and Chuburná, Mexico are located along a 15-kilometer stretch of coastal fringe that borders the Gulf of Mexico on one side and Chelém Lagoon on the other. These villages are comprised of families that have traditionally relied upon the natural resources of the region, including the mangrove wetland, for their subsistence and livelihood. Focus group interviews and individual in-depth interviews were conducted with residents of these communities as part of a study evaluating the importance of mangrove wetlands in Yucatán, Mexico. Chelém and Chuburná share similar socio-economic characteristics and have roughly 475 and 215 households respectively (Instituto Nacional de Estadística Geografía e Informática (INEGI), 1992). A total of 97 year-round residents from the two communities were interviewed in one of 12 focus groups[2] or 19 individual in-depth interviews.[3]

Design and procedure

The research design allowed for examination of the collected data across interview type, gender, and community (see Figure 1). Research assistants canvassed randomly selected sections of the target communities at staggered times of day to recruit participants. The focus groups were comprised of between four and seven individuals of the same gender from the same village. No respondent or their family members participated in more than one focus group or interview. The focus groups and individual interviews were designed and implemented following the generally accepted practices of Morgan[4] (1996, 1997, 1998) and Weiss[5] (1994) respectively. A Mexican professional moderator using a specially prepared discussion guide conducted the focus groups and individual interviews. All focus group and individual interviews were tape-recorded and subsequently transcribed.

Qualitative analysis

The qualitative data analysis allowed the researchers to (1) discover themes, (2) consider the choice and meanings of words, (3) consider the context(s) of data collection, and (4) consider the consistency of responses (Krueger, 1994). Although work remains in developing uniform guidelines and rules for the qualitative coding and analysis process (Fredricks and Miller, 1997), the researcher attempted to systematically reveal elements of respondents' experience and perceptions. The qualitative analysis did not produce simple counts of things, but rather "fractured" the data and rearrange it into categories that facilitated understanding the data and comparing the data within and between categories (Maxwell, 1996; Strauss and Corbin, 1990). After the transcripts were read, the analyst used memos (researcher's notes and observations), categorizing strategies (coding and thematic analysis), and contextualizing strategies (narrative analysis and individual case studies).

The 12 focus group and 19 individual interview transcripts resulted in more than 500 pages of text. An iterative, grounded theory approach (Strauss and Corbin, 1990) was used to code the transcripts. First, almost every word of a randomly selected subset of transcripts was coded (open coding). Next a set of thematic or summary codes was developed (axial coding). When no new open codes were necessary to code additional transcripts, all of the study's transcripts were axial coded. The final iteration of coding the text, selective coding, focused on organizing the data into 36 categories relevant to respondents' resource use, value, understanding, perception, and control of the ecosystem. The reported research is one means for

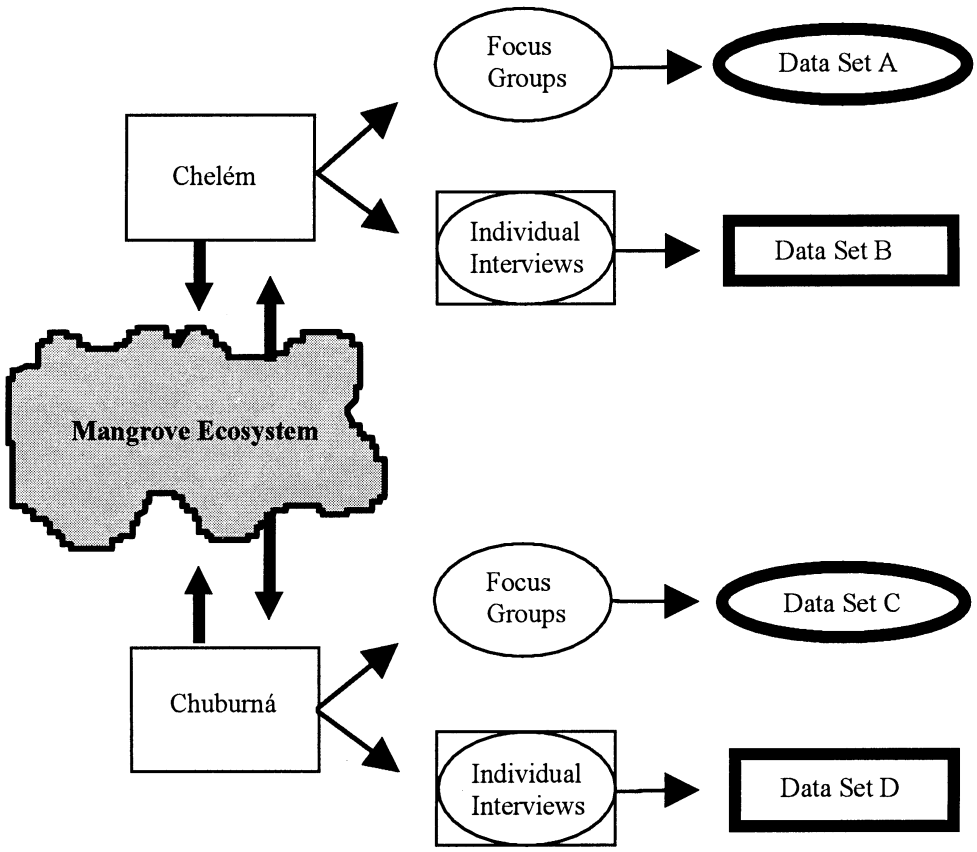

Figure 1. Research design.

trying to understand the significance of what the qualitative research revealed about local beneficiaries' use, perception, and understanding of Chelém Lagoon.

Operationalizing hypothesis test

If focus groups and individual interviews concerning respondents' relationships with a local mangrove ecosystem yield similar data on beneficiaries' perceptions and appreciation of ecosystem services, one would expect, all else being equal, that transcripts of those sessions would evidence a similar set of data on such services. That is, it would be reasonable to expect that a uniform process of coding the focus group and individual interview transcripts would result in similar distributions of codes that capture use and nonuse services associated with the mangrove ecosystem. Likewise, if there were particular use and nonuse services of importance to resource beneficiaries, one might expect that systematic analysis of the focus group and individual interview data would evidence a higher frequency of such codes. This paper focuses on testing the hypothesis that focus groups and individual interviews reveal substantially similar information concerning resource services associated with a mangrove ecosystem. Presentation of research findings concerning resource beneficiaries' social conflicts and discussion of socially sensitive topics may be found elsewhere (Kaplowitz, 1998, 1999; Kaplowitz and Hoehn, 1998).

While for some qualitative researchers, summary discursive reports of their findings (e.g., consumer preferences among brands of a product) are sufficient, other researchers rigorously test their research hypotheses with a statistical analysis of collected qualitative data (e.g., De Jong and Schellens, 1998; Krippendorff, 1980). The statistical analysis of qualitative data has been found to be both possible and helpful (De Jong and Schellens, 1998; Krippendorff, 1980; Weber, 1990). Differences in focus group and individual interview data of text evaluation exercises have been tested using code frequencies, *t*-tests, and analysis of variance (De Jong and Schellens, 1998). Similarly, the analysis of manifest attributes of text and accompanying inferential attributes has been performed using various counts, percentages, and statistical measures (Gray and Denstein, 1998). In their recent analysis of focus group data collected in anticipation of a contingent valuation studies, Chilton and Hutchinson (1999) "quasi-quantified" qualitative data to test divergence of respondent and researchers definitions of goods.

Table 1. Ecosystem service variables.

Topic variable	Example	% sessions rasing topic	
		Focus groups	Individual interviews
Beauty	Wetland is beautiful; a pretty place to see; enjoy the views	100	11
Chivita	*Melongena melongena*; small shellfish collected; as food and in commerce	100	95
Crab	Collected as bait; frozen for use during 2 month octopus season	92	42
Lagoon fishing	We fish in lagoon; people come to fish in wetland; there are nets day and night at lagoon entrance	92	90
Salt extraction	Used to be salt here; salt ponds once lucrative; construction destroyed salt business	92	37
Shrimp	Seawater brings shrimp; when shrimp here, all fish for them; not as many shrimp as in past	75	16
Nongame species	Flamingoes; crocodiles; heron; turtles; seagulls	67	42
Ducks	Ducks sometimes here; few locals benefit; need permit to hunt ducks	42	42
Recreation	Take guests for ride there; sometimes picnic there; celebrate Mass there annually	42	32
Storm protection	Can protect boats from storm; helps if water rises;	42	16
Wood	Some collect wood for fires; not much wood collection lately	17	5

The research reported here created and used discrete variables grounded in economic theory that were derived from the iterative reading, analysis, and coding of the transcripts. These discrete variables recorded those instances that focus group discussions and individual interviews raised topics concerning wetland ecosystem services associated with Chelém Lagoon. For example, the variable Lagoon fishing, recorded discussion of fishing for corvina, mullet, or other species in the lagoon. Such variables accommodated wide-ranges of discussion topics as well as allowed the coded transcript data to be subsequently analyzed using statistical software. The research question was operationalized to statistically test the null hypothesis that respondents' discussions of the wetland ecosystem raised the same wetland services equally during focus groups and individual interview sessions.

Results

The focus group and individual interview transcript data were transformed into 12 summary variables to test the research hypothesis. One summary variable, Interview type, records the type of interview (e.g., focus group or individual interview) associated with each case of coded data. The other 11 summary variables capture those wetland ecosystem services raised by respondents during the focus groups and individual interviews. Table 1 illustrates the 11 ecosystem service variables that resulted from the coding and variable transformation process of the focus group and individual interview data. Table 1 also presents some examples of representative references and the percentage of focus group and individual interview sessions that raised each topic. As can be seen, most of the services discussed by participants are extractive or consumptive use services (e.g., crab, shrimp, and wood collection). Some of the services discussed are nonconsumptive uses (e.g., recreation, storm protection). A few ecosystem discussed by participants appear to be noncunsumptive uses but arguably may evidence some nonuse value (e.g., beauty, nongame species).

Table 2 illustrates the relative ranking of frequencies for the ecosystem services variables for the focus group and individual interview data. It illustrates, for example, that wetland beauty was raised during every focus group discussion (rank 1), but was only the seventh most frequent service topic raised during individual interviews (rank 7). While perhaps a similar range of ecosystem services were discussed in the focus groups and in the individual interviews, not every individual interview or focus group raised the entire range of mangrove services. However, apparent differences in aggregate frequencies alone however are insufficient to support or reject the null hypothesis.

Table 2. Rank of service frequencies.

Rank	Focus groups	Individual interview
1	Beauty	Chivita
	Chivita	
2	Crab	Lagoon fishing
	Lagoon fishing	
	Salt extraction	
3	Shrimp	Crab
		Ducks
		Nongame species
4	Nongame species	Salt extraction
5	Ducks	Recreation
	Recreation	
	Storm protection	
6	Wood	Shrimp
		Storm protection
7		Beauty
8		Wood

Absolute differences may be statistically insignificant when sample size, proportions, expected frequencies, and distributions are taken into account.

As a result, crosstabulation analysis of each ecosystem service variable with the interview type variable was generated to test the null hypothesis that, in the sample population, the same percentage of focus groups and individual interviews raised each wetland service for discussion (see Table 3). Table 3 illustrates the Pearson chi-square test of the distribution of observed instances that focus groups and individual interviews raised each ecosystem service topic against the null hypothesis that each interview type results in the same frequency of the topic being raised. The null hypothesis was rejected for four variables – Beauty ($P < 0.001$), Crab ($P < 0.006$), Salt Extraction ($P < 0.003$), and Shrimp ($P < 0.001$). To examine the strength of the association of interview type with respondents' raising the particular ecosystem service in discussion, odds ratios were computed. Table 3 shows, it is about 9 times more likely that a focus group of local resource beneficiaries raises the topic of the mangrove ecosystem's beauty than an individual interview. The topics of crab collection, salt extraction, and fishing for shrimp are respectively 15, 19, and 16 times more likely to be raised in focus groups than raised by individual during one-on-one interviews.

To further appreciate the significant differences observed in the frequencies of discussion of ecosystem services by focus group and individual interview data, it should be remembered that 4 times as many people participated in focus groups (78) than in individual interviews (19). All else being equal, if there are differences in focus group and individual interview data that are a linear function of number of people, the expected odds ratios should be closer to 4. However, the observed odds ratios are two to four times that. This suggests that more than the larger numbers of participants in focus groups is responsible for the increased frequency that certain topics were raised by focus groups.

Four of the six most frequently mentioned topics differed significantly in the frequency in which focus groups and individual interviews raised them in discussions. Therefore, the research findings support the rejection of the null hypothesis. The data show that focus groups and individual interviews revealed significantly different ecosystem service information.

Table 3. Focus group and individual interview data associations.

Topic		Interview type		χ^2	P	Odds ratio
		Group	Indiv.			
Beauty	Yes	12	2	23.77[a]	0.001	9.50
	No	0	17			
Chivita	Yes	12	18		n.s.	
	No	0	1			
Crab	Yes	11	8	7.62[a]	0.006	15.12
	No	1	11			
Fishing	Yes	11	17		n.s.	
	No	1	2			
Salt extract	Yes	11	7	9.08[a]	0.003	18.86
	No	1	12			
Shrimp	Yes	9	3	10.87[a]	0.001	16.00
	No	3	16			
Nongame	Yes	8	8		n.s.	
	No	4	11			
Ducks	Yes	5	8		n.s.	
	No	7	11			
Recreation	Yes	5	6		n.s.	
	No	7	13			
Storm protection	Yes	5	3		n.s.	
	No	7	16			
Wood	Yes	2	1		n.s.	
	No	10	18		n.s.	

[a] d.f. = 1, $N = 31$

Discussion

The two methods, focus groups and individual interviews, do not reveal equal sets of information nor do they rank ecosystem services comparably. While the data illustrate that resource beneficiaries associate a variety of ecosystem services with complex ecosystems, most of the services discussed tended to be extractive uses of the ecosystem. The focus groups and individual interviews were dominated by discussion of lagoon fishing of one type or another. Although wetland beauty was raised in all of the focus groups, the low frequency of its discussion by individual interviews seems to more accurately reflect individual beneficiaries' relative appreciation for nonconsumptive and nonuse values of the ecosystem. This is no surprise given the economic difficulties facing the communities and Mexico as a whole. The focus groups and individual interviews were replete with discussions of the difficulty for providing for one's family. Increasing commercial fishing pressure in the Gulf of Mexico has decimated the once rich coastal fishing resource. Local beneficiaries increasingly rely upon the lagoon and its mangrove ecosystem for subsistence. Therefore, it is no surprise that consumptive use services predominate conversations about the ecosystem.

Only 4 of the 11 wetland services discussed by participants were non-extractive in nature – Beauty, Nongame species, Recreation, and Storm Protection. The relatively low frequencies associated with the use services of storm protection and recreation in both focus groups and individual interviews support the notion that these services are not particularly significant to most residents. The other two non-extractive services, Beauty and Nongame species, arguably capture some respondents' recognition and appreciation of nonuse ecosystem services. While wetland beauty and the presence of nongame species in the ecosystem may be classified by some as use values because of the benefits derived from *in situ* enjoyment of these services, these variables also capture participants' expressed sentiments that wetland beauty and diversity should be preserved for future generations.

Value of multiple methods

It appears important that wetland beauty was ranked first by groups and seventh by individuals. The statistically significant difference in the frequency that focus group and individual interview discussions raised wetland beauty comports favorably with the findings of De Jong and Schellens (1998) concerning focus group and individual interview data. The mangrove ecosystem focus groups did lead researchers to discover different information about ecosystem services than the individual interviews. Had only focus group information been collected and relied upon, it would haven been reasonable to believe that wetland beauty was extremely important to local beneficiaries (perhaps on a par with lagoon fishing). Conversely, had researchers only relied upon individual interview data, wetland beauty and nonuse values might have easily been dismissed as unimportant or beyond the apprehension of respondents. However, using both individual interview and focus group data revealed that wetland beauty was significant to individuals but only accessible after a dynamic exchange of information. The focus groups seem to have provided a dynamic that allowed respondents to identify and discuss nonconsumptive and, at times, nonuse ecosystem services such as wetland beauty. This finding is in line with the recent work by cognitive psychologists that shows that increased interaction and exchange of information improves respondents' understanding of complex ideas (Schwarz, 1997; Schwarz and Sudman, 1995; Sudman et al., 1996). This result, researchers learning of different and complimentary ecosystem services using focus groups and individual interviews, clearly supports the desirability of using multiple methods to corroborate qualitative research findings in future ecosystem valuation work (Bryman, 1988; Morgan, 1996).

Implications for valuation research

The results also underscore the difficulty of designing studies and instruments for estimating the total economic value of a complex ecosystem. Valuing nonmarket and nonuse services associated with natural resources, especially in developing countries, seems to require extra care. While the study supports the notion that nonconsumptive and nonuse values may be significant for wetland ecosystems in developing countries (Aylward and Barbier, 1992), the data reveal the potential import of using multiple qualitative methods for identifying potential values to be measured.

In the case at hand, local resource beneficiaries seemed better able to identify and appreciate nonconsumptive and nonuse values in focus group discussions rather than in individual interviews. Since valuation methods such as contingent valuation or contingent ranking rely upon individuals, not in groups, making trade-off choices to reveal nonuse and total economic values, the findings suggest the import of designing better valuation survey instruments. The results seem to suggest the value of researchers using groups to learn about the array of services that matter to beneficiaries before using individual interviews to validate such findings. Likewise, it seems important to use

sequential qualitative methods to evaluate how best to communicate and increase information exchange concerning ecosystem services in value elicitation instruments.

Researchers' perceptions and beneficiaries' understanding

The literature is full of lists of use and nonuse services that in some but not all cases can be associated with mangrove ecosystems (e.g., Barbier, 1994; Barbier et al., 1997; Janssen and Padilla, 1996; Spaninks and van Beukering, 1997). These mangrove services include on-site fisheries, fuelwood collection, timber harvests, off-site fishery support, aquaculture, carbon sequestration, growing of medicinal plants, biodiversity, recreation, transportation, meat production, flood control, storm protection, option values, existence values, and bequest values. A daunting set of services to have to include in a particular valuation effort. However, the findings show that by using qualitative methods, beneficiaries can help researchers narrow the set ecological services to those most relevant for study.

In Chelém, the focus groups and individual interviews left no doubt that lagoon fishing (especially for "chivita", crab, and shrimp) is of utmost importance to local people. A few nonconsumptive uses and possible nonuse values were articulated by respondents (nongame species and the beauty of the ecosystem) while the relative insignificance of ecosystem storm protection services and wood collection was also made apparent. Furthermore, the small role that mangrove wood and wood collection plays in the lives of local beneficiaries in Chelém Lagoon contrasts with the findings of Kovacs (1999). Together, the use of focus groups and individual interviews allowed the researcher to identify those service most relevant to local beneficiaries and to further investigation.

Significance of differences

The most frequent and least frequent ecosystem services raised using the two methods were not statistically different across methods. This seems to imply that, regardless of method, participants recall and articulate common wetland ecosystem uses equally at the extremes of usage or importance in focus groups and individual interviews. For example, the collection of chivita (*Melongena melongena*) from the muddy bottom of Chelém Lagoon has become the predominant subsistence strategy for the regions' communities.[6] Chivita collection has replaced more conventional lagoon fishing and collection of crab as the most important ecosystem service. Therefore, it is no surprise that more than 90% of both the focus groups and individual interviews raised chivita collection and lagoon fishing in discussions. Conversely, the ecosystem services that only occupy a minor or cursory place in the communities' appreciation of wetland services do not differ significantly in their frequency of discussion in focus groups and individual interviews.

However, the frequency that several ecosystem services raised in focus groups and individual interviews did differ significantly. The extractive ecosystem services that differed significantly may be thought of as sub-components of the more general mangrove ecosystem "fishing" service. The difference in these frequencies may be a function of the difference in the dynamics of a focus group discussion and a one-on-one depth-interview. For example, shrimp collection (mentioned in 75% of focus groups and 16% of individual interviews) happens to be an occasional and contentious phenomenon in the lagoon. The recent construction of a duck habitat restoration dike by Ducks Unlimited and activities of the Mexican Navy, according to participants, have resulted in drastic curtailment of the once annual or biannual inundation of shrimp in the lagoon. The data show that it is 16 times more likely that shrimp collection be raised in focus groups than individual interviews. The lower frequency that individual interviews raised the topic of shrimp collection may well reflect the decreased role of shrimp collection in beneficiaries' use of the mangrove lagoon. The topic's high frequency of discussion in focus groups may reflect a collective need or desire of individuals to process or air feelings associated with the loss of this service.

Similarly, a statistically significant divergence between focus group and individual interview data was observed in salt extraction data. At one time, individuals in the region could construct salt ponds, flood them with seawater, allow the water to evaporate, and then collect and sell crystallized sea salt. However, the area's lucrative salt mining business has been defunct for years. The change followed the flooding and ipso facto enlarging of Chelém Lagoon that resulting when the Mexican government dredged and constructed a safe harbor and naval station in the lagoon in the late 1960s and early 1970s (Paré and Fraga, 1994). Like the shrimp collection data, individual interviews raised salt extraction as an ecosystem service significantly less often than focus groups. It is about 19 times more likely that a focus group raise salt extraction than an individual interview raise that same topic. People's discussion of the lagoon in groups seemed to trigger discussion of the loss of ecosystem services, like salt extraction.

Apparently, focus group data can leave researchers with an impression about the significance of a resource

service that substantially differs from the impression left by individual interview data. The differences observed in the frequencies of the discussions of crab collection, salt extraction, and shrimp fishing activities illustrate that specific components of inclusive use values (e.g., Lagoon Fishing) are more likely to be raised in focus groups rather than individual interviews.

Better understanding from qualitative methods

There was not obvious difference in the frequency that groups and individuals raise chivita collection or the broader discussion topic of lagoon fishing. It seems that virtually every family in the two communities, at one time or another has adopted chivita collection as part of their subsistence survival strategy. Furthermore, it is common for almost everyone in the area to refer to himself or herself as a "pescador" (fisherman). This despite the fact that many of these individuals provide for themselves and their families by working in nearby factories or doing construction work. Not only do individuals perceive themselves as fisherpeople, it was learned throughout the groups and interviews that respondents include chivita collection, crab and shrimp collection together with line and net fishing for other species when speaking about lagoon fishing. What makes this especially important, is that local researchers from nearby Mérida working on coastal zone management in the region were surprised to learn of the extent to which the respondents relied upon chivita collection. It was their belief that chivita was a minor component of residents' subsistence strategy and that near-shore fishing in the gulf was the predominant occupation in the area.

The researcher learned that unfortunately as one respondent put it,

> We used to make a living fishing in the sea . . . Now you can't make a profit more than 2–3 months from fishing in the sea . . . The same problem is also happening in the estuary, it used to be that you could take all the crab you wanted. Now only the small ones are around . . . While some try to work elsewhere, people sustain their families with chivita from the wetland (Transcript 18).

The individual interview data and the focus group data about beneficiaries' uses and perceptions of Chelém Lagoon services appear to be complimentary. While both methods revealed information about ecosystem services, the relative weight that each of the services received differed by method. For example, ecosystem beauty was raised in every focus group. However, only 11 percent of individual interviewees raised ecosystem beauty. This contrast indicates that the notion of a nonconsumptive or nonuse ecosystem service may be difficult for individuals to conceptualize and associate with an ecosystem without the benefit of a dynamic exchange of information (e.g., informational priming in a survey instrument). The use of multiple qualitative methods would seem valuable to researchers charged with the task of designing a study or instrument addressing beneficiaries' stated preferences or values for nonconsumptive use services and nonuse services associated with complex ecosystems.

Conclusion

This study demonstrates that use of multiple qualitative methods can help researchers develop a more complete understanding of beneficiaries' natural resource values. Reliance upon one qualitative method, focus groups or individual interviews, would have provided researchers with a less than complete understanding of beneficiaries' uses, perceptions, and values associated with their shared mangrove ecosystem. This study shows the two qualitative research methods to be complementary, not substitute, methods for learning about ecosystem services.

The study demonstrates the value of using individual interviews in addition to focus groups in the economic valuation study design process. Such interviews can be used to evaluate the effectiveness of the instrument at communicating complex information as well as to judge respondents' ability to meaningfully undertake the requisite valuation tasks. Incorporating both focus groups and individual interviews into the conceptualization and design phase of valuation studies seems capable of shaping ecosystem valuation research so that it is more concerned with "*what* people value."

The incorporation of statistical examination of focus group and individual interview data on ecosystem services illustrates that the two methods generate different ecosystem service data. The findings suggest that focus group ecosystem service data reflect differences that may be attributable to dynamic processing of information. This finding is in line with others' research that shows increased interaction and exchange of information improves respondents' understanding of complex ideas (Schwarz, 1997; Schwarz and Sudman, 1995; Sudman et al., 1996). The systematic statistical analysis of individual interview and focus group data can provide an empirical basis for better understanding of ecosystem services and their value to respondents.

Notes

1. Contingent valuation (CV) studies elicit economic values for environmental amenities and natural resources using carefully designed and administered surveys. CV studies are one type of stated-preference approach researchers use to reveal how individuals value environmnetal and natural resources.
2. Focus groups are carefully planned discussions designed to learn about subjects' perceptions on a defined area of interest in a permissive, nonthreatening environment. They are conducted by a skilled moderator who follows a discussion guide and involve as few to as many as 12 informants.
3. Individual interviews (also called unstructured, exploratory, intensive, in-depth, and depth interviews) are guided conversations whose goal is to elicit from interviewees (also called informants) rich, detailed materials that can be used in qualitative analysis. The interviewer used the same discussion guide as used in focus groups to guide the one-on-one conversations.
4. Dr. David Morgan is a highly regarded and widely published focus group researcher. He is a Professor in the Institute on Aging and the Department of Urban Studies and Planning at Portland State University. His works include such classics as *Focus Groups as Qualitative Research* (1988) and *The Focus Group Kit* (1998).
5. Dr. Robert Weiss is Director of the Work and Family Research Unit and Professor at the University of Massachusetts. Weiss is renown as a qualitative researcher and the author of *Learning from Strangers: The Art and Method of Qualitative Interview Studies* (1994).
6. Chivita (*Melongena melongena*) is a small mollusk found in the mud flats on estuaries. It is also known as a West Indian Crown Conch.

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