

THE FEASIBILITY OF SPORT HUNTING AS A WILDLIFE CONSERVATION AND  
SUSTAINABLE DEVELOPMENT TOOL IN SOUTHERN MEXICO

By

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In memory of my mother, Jeannie S. Lechuga

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Wildlife decline in southern Mexico is mainly attributed to overexploitation and habitat destruction. The Mexican government recently developed a progressive wildlife management strategy based on a system of wildlife conservation, management, and sustainable use units (SUMA), which allows sustainable uses of wildlife while providing economic alternatives to local communities. The greatest attribute of the new wildlife management program is the structure it offers for community-based co-management of the resource on ejido lands.

This study evaluated the success of the SUMA strategy on ejidos that support sport hunting as a wildlife use option in southern Mexico. The evaluation was divided into two parts: sport hunting as a tool for wildlife conservation, and sport hunting as a tool for sustainable development. Sport hunters, subsistence hunters, and ejido non-hunters were interviewed on hunting importance, wildlife value, knowledge, perceptions, economics and demographic information. The information gathered was used to analyze

stakeholder dynamics, current use practices, game population trends, economic feasibility and stakeholder compatibility.

Wildlife conservation, management, and sustainable use units (UMAs) that provide sport hunting as a wildlife use option have not been successful in Quintana Roo and Campeche, but show great potential for future success. Data showed that several insufficiencies have hindered success. Potential for improvement exists because stakeholders show a willingness to conserve and work together.

Based on the results of this research and other successful community-based management projects, it was suggested for ejidos to charge UMA entrance fees to sport hunters. This would generate revenue for community development and provide a stronger incentive to value and conserve wildlife populations.

The strengths and weaknesses of Mexico's wildlife management program add to the understanding of community-based wildlife co-management and conservation in the neotropics.

## CHAPTER 1 INTRODUCTION

Natural resources in Mexico's southern region have faced increased pressure for the past thirty years. For example, during the 1970s, the government encouraged colonization of sparsely populated states in southern Mexico. This resulted in overexploitation of forest and wildlife resources (Escamilla et al., 2000). Escamilla et al. (2000) found that the two greatest threats to tropical wildlife populations are habitat destruction and hunting pressure. To address these threats, Bodmer and Puertas (2000) suggest that management strategies must fit the socio-economic and political realities of the region.

Southern Mexico is economically poorer than the rest of the country, yet is rich in natural resources. Campeche, Quintana Roo, and Chiapas are among the states with the lowest contribution to domestic GNP and the lowest employment rates in the country (Instituto Nacional de Estadística, Geografía e Informática, 1999a). Mexico's southern region also has a large percentage of ejido (communally owned) lands (Calmé and Sanvicente, pers. com.). To address local needs and develop acceptable alternatives to overexploitation, an effective strategy is community-based conservation (Bodmer and Puertas, 2000).

### **Wildlife Management Approaches**

There are several basic structures of wildlife management. These include management by the state, communities, and co-management between various stakeholder



groups. Wildlife management in the United States has a central structure under federal and state control. The Fish and Wildlife Service develops, implements and enforces wildlife management plans. Africa offers examples of community-based wildlife management. The Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) in Zimbabwe and the Administrative Management Design for Game Management Areas (AMADE) in Zambia are examples of a community-based wildlife management programs that use sport hunting as a wildlife conservation and sustainable development tool. The programs provide employment and revenue at a local level, and have experienced varied success in some districts. The communities in Zimbabwe that implemented CAMPFIRE with bureaucratic control had less success than those that used a community-based decision-making process and a means for direct economic benefits (Metcalf, 1994). This suggests that communication and consensus in a community increase the chances for the success of the management strategy.

Lewis and Alpert (1997) discuss how trophy hunting provides important economic revenue for wildlife conservation in Zambia. Using the Zambian case, Gibson and Marks (1995) raise important issues regarding direct and indirect socio-economic benefits and empowerment through community-based management. They found that simply generating income was not enough to ensure the success of a wildlife conservation program. They argue that for community-based management to achieve intended goals, leaders must realize the importance of wildlife to local residents, consider how the decision-making process works, and how the economic benefits are distributed.

The African programs focus on addressing hunting motivations. Based on these motivations, the programs focused on providing incentives to change behavior. In

situations where wildlife is perceived as a common resource, experts believe that if communities have legal rights and a significant stake in the resource, they are motivated to conserve (Gibson and Marks, 1995). Gibson and Marks (1995) also found that community-based management may improve enforcement, but does not necessarily guarantee equitable distribution of socio-economic benefits. In the Zambian case, tribal leaders were given significant decision-making power, including selecting personnel (i.e.: as game wardens) and a location for the program. Since the ADMADE program did not clearly specify management composition or procedure, the chiefs used the benefits of the program to reward kin and loyalists (Gibson and Marks, 1995).

There are various lessons to be learned from community-based wildlife management programs, including the importance of identifying motivations for wildlife use, perceptions of resource access, and the decision-making process. This understanding could ensure more equitable distribution of economic benefits, and support for the program.

Bodmer and Puertas (2000) discuss a community based co-management approach for wildlife in the Tamshiyacu-Tahuayo communal reserve in the Peruvian Amazon (RCTT). Community members took an active role in managing wildlife with the support of other stakeholders, including researchers, NGO extensionists, and government agencies. The community provided information from the skulls of hunted animals. In addition, the community maintained a hunting registry to track hunting pressure. The authors outline numerous benefits of the approach, including commitment, information sharing, and trust among the various stakeholder groups.

There have not been any reports in Latin America of co-management on communal lands using sport hunting as an economic incentive to conserve, other than those from Mexico. Since the first game law of 1952, Mexico has made great progress in developing a policy that incorporates conservation and economic development with wildlife management.

### **Mexico's Wildlife Management Program**

The Mexican Game Law of 1952 was the first law to address wildlife use and conservation in the country (Instituto Nacional de Ecología, 1999a). The purpose of the law was to “direct and guarantee the conservation, restoration, and development of the wildlife which live freely in Mexican territory, regulating its exploitation” (Leopold, 1959, p. 531). The game law decreed wildlife as the property of the nation under Article 3. The law established sport hunting as the only wildlife use option. Article 33 regarded hunting or taking wildlife without a hunting permit and without an arms license as an offense. Hence, those without a hunting license or arms permit, such as subsistence hunters, were acting against the law. Article 16 prohibited commercial hunting (Leopold, 1959; Sanvicente, 1996). It also considered “the sale, commerce in or advertising of meats, products, or remains of wild animals” as an offense (Leopold, 1959, p. 535). Only by presidential authorization could wildlife be used for investigation, cultural purposes, and breeding programs. Thus, the game law had many deficiencies, including not addressing local needs, other sustainable uses, and alternatives for wildlife management and conservation (INE, 1999a).

The General Law of Ecological Equilibrium and Environmental Protection, *Ley General del Equilibrio Ecológico y la Protección al Ambiente (LGEEPA)*, was passed on

January 28, 1988 and ratified on December 13, 1996 (INE, 1999b). The purpose of the law was to define principles of environmental policy and instruments for its implementation, and to address social and economic benefits compatible with ecosystem preservation. Article 87 authorizes wildlife use for economic gain if the population can be replenished in captive or semi-captive breeding projects, or if the harvest is less than the reproductive rate of the population (INE, 1999b).

The wildlife conservation and production diversification program in the rural sector and the SUMA (system of wildlife conservation, management, and sustainable use units) strategy laid the foundation for a new progressive wildlife law to be passed in Mexico. The new wildlife law, *Ley General de Vida Silvestre*, was passed in 2000 (Llorens, pers. com.). It is more progressive than the Mexican game law of 1952 because it not only supports conservation, but also supports alternative sustainable uses of wildlife, including subsistence, commerce, research, and other nonconsumptive utilities (Guerrero, pers. com.). Although *post facto*, it gives a legal framework to the SUMA program and gives SEMARNAP, *Secretaria de Medio Ambiente, Recursos Naturales y Pesca* (the Secretariat of Environment, Natural Resources, and Fish) the authorization to execute and manage the program.

## **Extractive Uses of Wildlife**

### **Subsistence Hunting**

The three predominant extractive uses of wildlife in Mexico are subsistence hunting, small-scale commerce, and sport hunting (Leopold, 1959). Household consumption was the most important wildlife use among the agricultural community and economically impoverished rural population (Leopold, 1959; Avila, 1995; Jorgenson,

1993). Only a few individuals in the rural communities hunted as their primary daily activity, and the greatest hunting pressure occurred when farming conditions were unfavorable (Leopold, 1959). Leopold (1959) suggested that over hunting is due to subsistence hunting in poor socio-economic conditions. Further, he stated that wild game was an important protein source in the diet.

Hunter preference for a particular species has been consistent for many years. In 1959, Leopold found that white-tailed deer was the most important game for sport and subsistence hunters. Recent studies from Quintana Roo and Campeche also report white-tailed deer as one of the most important game for ejido communities (Escamilla et al., 2000; Quijano, 1999; Reyna et al., 1999).

### **Small-Scale Commerce**

Before the 1952 general game law, *Ley de Caza*, wildlife products were sold in open markets (Leopold, 1959). Although wildlife trade was declared illegal, it was and still is practiced in the rural communities. Leopold (1959) concluded that wildlife trade existed in lesser proportion than hunting for food and trophy, and was the least beneficial to the country.

### **Sport Hunting**

The sport hunting tradition existed in the wealthy and governing classes of Mexico for hundreds of years (Leopold, 1959). Sport hunting today is still practiced by a small section of the population. Leopold (1959) believed that sport hunting had a negligible impact on wildlife populations. In 1950, 3 out of 10,000 individuals held a hunting license. In 1954, only 8,162 licenses were sold in Mexico (Leopold, 1959). This does not represent the number of hunters in Mexico at the time, since the majority of the

population could not afford a license and law enforcement was very scarce (Leopold, 1959).

Current information on sport hunting statistics is very limited. Guerrero (2000b) found that the revenue generated from sport hunting permit sales in Campeche increased from approximately \$988 USD in 1995 to \$5,468 in 1997. After 1997, the number of permits sold fell by 92 causing a loss of about \$1,735 USD. Instead of being reinvested in wildlife programs, the revenue from the permit sales goes to the federal government.

Mexican sport hunters have to fulfill several requirements before they can legally hunt. Mexican citizens must first obtain a gun permit from the *Estado Mayor de la Secretaria de la Defensa* (Office of the Defense Secretary) in order to obtain a hunting license. Sport hunting clubs facilitate the purchase of the gun permit by vouching for the conduct of its' members. Sport hunting club membership is a prerequisite to obtaining a hunting license (Leopold, 1959 and Guerrero, pers. com.). Article 18 of the *Ley Federal de Caza* states that every licensed hunter must be a member of a club registered with the *Federación Nacional de Caza, Tiro, y Pesca* (National Hunting, Shooting, and Fishing Federation).

The sport hunting club of Quintana Roo, *Club de Caza Tiro y Pesca de Quintana Roo, A.C.*, is located in the capital city of Chetumal. The club has approximately 60 members, of which 36 primarily hunt and the rest fish. The registered club in Campeche, *Club de Caza, Pesca y Tiro de Campeche, A.C.*, has about 98 members. The club of Campeche has three women registered as members, but Quintana Roo has none.

Based on the premise that sport hunters spend money wherever they hunt, Leopold (1959) stated that sport hunting should be encouraged to benefit the local

economy. He believed that the social and economic values of wildlife lie principally in its recreational potential rather than in subsistence and commerce.

Sport hunting has been used successfully as a management strategy for wildlife conservation in various parts of the world including North America, Africa, and Europe. Sport hunting in the United States is an effective management tool for conservation because it not only helps manage wildlife populations at a level that the environment can support, but also funds conservation efforts. Hunting and license fees serve as important revenue for wildlife management programs (Williamson, 1987). Furthermore, there are numerous examples of game population recovery because of sport hunting. For instance, wild turkeys were on the brink of extinction in 1910, but after decades of regulated hunting and reinvestment of hunting revenues into management they increased to about 4 million in 1996 (Budiansky, 1996). Likewise, the population of pronghorn antelope has grown from about 5,000 in 1910 to over a million in the 1990s (Budiansky, 1996). Sport hunting has been argued to be an effective conservation tool because hunters value and want to conserve game species in order to enjoy the activity in the future.

Mexico's wildlife management program, *Sistema de Unidades para la Conservación y Aprovechamiento Sustentable de la Vida Silvestre* (SUMA), was introduced in 1997. It addresses important conservation issues which were neglected in the Mexican Game Law of 1952 (Llorens-Cruset and Berlanga-Garcia, 1998). The SUMA strategy is designed to include local communities in the management plan and to allow other sustainable uses of wildlife, including subsistence and commercial (Guerrero, pers. com.). For the first time, Mexico is integrating community development, wildlife conservation and natural resource management.

### **Wildlife Conservation, Management and Sustainable Use Units: UMAs**

*Unidades para la Conservación, Manejo y Aprovechamiento Sustentable de la Vida Silvestre* (UMAs), translated to wildlife conservation, management and sustainable use units, are areas of land that allow nonconsumptive and consumptive uses of wildlife based on an approved management plan (Guerrero, pers. com). Nonconsumptive uses include ecotourism and environmental education. Consumptive uses encompass sport hunting, subsistence hunting, and small-scale commerce of wildlife. Sport hunting through the SUMA strategy is a means to bring financial resources from urban areas to the rural sector (Villarreal, 2000). The UMA strategy incorporates wildlife and habitat conservation, while giving local people new, legal and economic alternatives, and decision-making power. This study is focused on the sport and subsistence hunting options under the SUMA plan.

A national program directed by the Instituto Nacional de Ecología (INE), a branch of SEMARNAP, created the UMA strategy. The program was called *Programa de Conservación de la Vida Silvestre y Diversificación Productiva en el Sector Rural 1995-2000*, or the program for wildlife conservation and production diversification in the rural sector 1995-2000 (Diario Oficial, 1998). The program's objective was to integrate conservation and sustainable use of wildlife by giving the rural sector economic alternatives. It aims to provide revenue for species management and economic benefits to the property owners and managers. The required management plans and yearly reports serve as an important database for government agencies to manage wildlife more efficiently (Llorens-Cruset and Berlanga-Garcia, 1998).

There are two types of UMAs. Intensive UMAs are fenced-in wildlife breeding farms. These areas are relatively smaller than extensive UMAs. They are used to



propagate endangered or rare species, and for environmental education, investigation, or the production and commercialization of wildlife and derived products (Calmé, pers. com.). Extensive UMAs are larger non-fenced areas that incorporate habitat management and population monitoring, and are used for sport hunting, ecotourism, or wildlife commercialization (Llorens-Cruset and Berlanga-Garcia, 1998).

UMAs are often found in the buffer areas of national reserves, private land, government land (federal, state, municipal), and ejido lands. In general, a large percentage of the UMAs in northern Mexico are privately owned and in the south are ejido owned (Llorens and Quinto, pers. com.).

A number of steps need to be followed to register a parcel of land as an UMA. Any individual or group of individuals holding land title may submit an application to SEMARNAP to make an area of their land an UMA. A technician must be contracted to conduct a biological assessment, including habitat description and censuses of the species of interest. The technician then consults with the title owners and recommends harvest based on the species biology and population size (Guerrero, pers. com.). The locals then decide how they want to use a species. For example, if 20 white-tailed deer could be harvested in one year, the community-members may decide to allot 7 for sport hunting and 13 for subsistence. The technician must produce a management plan and submit it with the biological study to SEMARNAP for approval. UMAs can be registered, but cannot operate without a management plan. The management plan must contain the number of animals of each species proposed to be harvested based on the census data, a management plan, and enforcement strategies. The UMA also has to provide an annual report. Therefore, in order for an UMA to operate, it must be registered with

SEMARNAP, have and execute a management plan, monitor wildlife populations, regulate use, and have a participatory enforcement program (Llorens-Cruset and Berlanga-Garcia, 1998).

The first UMAs were registered and operating in 1997, although intensive and extensive sport hunting ranches were operating before then (Guerrero, pers. com.). There are 2,175 registered UMAs in Mexico, encompassing 14,427,176 hectares. As of the summer of 2000, Quintana Roo had 7 extensive UMAs. Three UMAs focus on ecotourism, 2 focus on commerce, and 2 concentrate on sport hunting. At the same time, Campeche had 11 intensive and 34 extensive UMAs registered, of which only 10 and 17 respectively, were in operation. The others did not have management plans. Eight of the operating UMAs were on ejidos; the others were on private lands (Guerrero, 2000a).

Sport hunting is very popular and lucrative in the north of Mexico, but has not been as successful in the south (Llorens, pers. com.). No information exists on the impacts of sport hunting in the south, or the impacts of the UMAs on the local communities where the sport hunting takes place. To determine the success of sport hunting UMAs in the south of Mexico and what program improvements might be necessary, information is needed on stakeholder activities, wildlife population dynamics, and current use practices.

### **Ejidos**

In 1992 there were approximately 29,000 ejidos (communal land holdings with a collective title), comprising 50% of the land territories in Mexico and containing about 25% of the Mexican human population (Land Tenure Center, 1992; Chavez, 2001). The amendment to Article 27 of the 1917 Mexican Constitution and a new agrarian law

passed in 1992 gave the ejido members (*ejidatarios*) more economic and political strength (Aguina, 1993).

Ejidos are organized into three land use areas that include a housing area in the community center, individual parcels, and a communal area (Procuraduría Agraria, 1999). The communal area cannot be divided and the natural resources are usufruct. The benefits derived from the communal area are divided among all *ejidatarios* (Quinto, pers. com.). Since 1992, *ejidatarios* are allowed to sell, rent, sharecrop, or mortgage their individual parcels after gaining a two-thirds vote in their general assembly (Procuraduría Agraria, 1999; Land Tenure Center, 1992). Therefore, each *ejidatario* could economically benefit from the production on his individual parcel. This fosters a new perception of private property for the ejido residents, and may have implications on conservation attitudes (Freese, 1998).

UMAs located on ejido lands enable community-based co-management to be an integral part of Mexico's wildlife conservation and rural development plan. The success of UMAs on ejidos depends on how well the management plan fits into the socio-economic organization of the community.

### **Research Objectives**

Two research objectives were identified to determine the feasibility of sport hunting as a wildlife conservation and sustainable development tool under the SUMA program in southern Mexico. The first was to examine sport hunting as a wildlife conservation tool based on stakeholder dynamics, current uses, and population trends. Stakeholder dynamics were based on five criteria: 1) importance of hunting, 2) importance of wild game species to each stakeholder group, 3) perceptions of wildlife

ownership, 4) knowledge about the SUMA program, and 5) enforcement of hunting restrictions. Assessment of current uses was based on selection of game by sex, age, hunt period, and hunt locations. Evaluation of population trends was based on perceived wildlife population decline and distance from the center of the community.

The second research objective was to determine if sport hunting is a feasible tool for sustainable socio-economic development in southern Mexico. Economic feasibility and stakeholder compatibility were analyzed to meet this objective. Economic feasibility entailed determining agreement on entrance fee price and employment possibilities through sport hunting. Stakeholder compatibility was based on group attitudes and perceptions concerning other stakeholders.

This study evaluates the current success and future feasibility of sport hunting UMAs in southern Mexico. The study provides information on Mexico's program for wildlife management and sustainable development that may serve as a useful model for other countries in Latin America.

### **Focal Game Species**

Numerous studies have looked at the importance of game species in Latin America (Bodmer, 1995a; Bodmer, 1995b; Jorgenson, 1993; Quijano, 1999; Reyna et al., 1999; Robinson and Bodmer, 1999; Robinson and Redford, 1991). Based on previous research, preliminary interviews, and on conversations with reliable sources, seven game species were identified as among the most important game to both sport hunters and ejido residents. Escamilla et al. (2000) observed in their study that the most important species for subsistence in southern Campeche were white-tailed deer, brocket deer, collared peccary, agouti paca and curassow. In this study, the game species discussed include the

white-tailed deer (*Odocoileus virginianus*), brocket deer (*Mazama americana* and *Mazama pandora*), white-lipped peccary (*Tayassu pecari*), collared peccary (*Pecari tajacu*), agouti paca (*Agouti paca*), ocellated turkey (*Agriocharis ocellata*), and the curassow (*Crax rubra*).

### Study Approach

To understand the effectiveness of sport hunting as a tool for wildlife conservation and sustainable development, the study groups are described using general background information. Information gathered includes an individual's place of origin, number of years as a resident of the study area, resident status if living in an ejido, age, education, occupation, number of individuals living in the household, and annual income.

Information on origin demonstrates the regional mix of the predominantly *mestizo* rural (ejido residents) and urban (sport hunters) populations studied. Length of residence is often related to respondent's personal investment in an area. For ejido communities, in particular, length of residence often determines the individual's influence on the community.

The resident status of the ejido population factors in their influence on decisions made in the ejido. Two types of resident status exist in most ejidos: *ejidatario* and *poblador*. *Ejidatarios* not only have a parcel to work, but also have voting privileges during their community assemblies. *Pobladores* do not have voting privileges, but possess land parcels, and thus impact wildlife management. *Ejidatarios* are, therefore the most influential in the decision-making process in the ejidos. The *pobaldores* are less influential, but are active users of wildlife.

Information on age, education, and occupation is useful for wildlife managers to effectively communicate wildlife conservation plans. Information on the number of individuals living per household, and their economic profiles gives important baseline information on the financial status of each group. Annual income provides a basis for comparison between groups in economic analyses.

The second section of the analysis evaluates the feasibility of using sport hunting as a tool for wildlife conservation in the region. For any wildlife conservation plan to be successful, stakeholder dynamics, current use practices, and wildlife population dynamics must be considered. The three stakeholder groups in this analysis are the two main user groups, sport hunters and ejido residents (including subsistence hunters and non-hunters), and the government agency, SEMARNAP. It is important to understand the motivation and value the users have towards hunting and wild game, in order to develop proper incentives for groups to participate in the program on a long-term basis. SEMARNAP should effectively communicate relevant information to the users and enforce the management plan.

### **Stakeholder Dynamics**

Analysis of stakeholder dynamics includes 1) perceived value of hunting, 2) game importance, 3) perceptions of resource access, 4) knowledge about the management plan, and 5) enforcement of hunting restrictions. The perceived value of hunting is based on tradition, motivation, hunting frequency, and financial expenditures, in the case of sport hunters.

The traditional or cultural importance of hunting is often manifested in multiple generations within a core family unit (i.e.: immediate kin) practicing the activity. For the purpose of this study, an activity is considered to have the strongest traditional ties when

the immediate family, especially the “family lead figure” engages in the activity. In Mexican society, “family lead figure” refers to the patriarch, be it the father and/or grandfather. Response categories of “father”, “grandfather,” and “father and grandfather” indicate the strongest ties and possess equal weight. The “other family member” category carries less weight, and the “no one in the immediate family” response category indicates the weakest traditional ties. The study hypothesizes that hunting has equally strong traditional ties for sport and subsistence hunters, but is more of a tradition in the family for hunters than for non-hunters.

Information about differences in the motivations to hunt aids group understanding and facilitates stakeholder collaboration. For instance, the question “does one group hunt significantly more for food and/or revenue compared to other groups?” may indicate the room for compromise by the groups to work together under the UMA plan. Hunting due to need allows for less flexibility in making compromises than if the motivation is recreational.

Reasons for non-hunters not to hunt were also recorded to understand if abstinence was due to conviction or opportunity. Reasons given as lack of opportunity may indicate that the individual may hunt in the future if the chance arises. Lack of opportunity is expected to be the predominant response for this section.

The number of times an individual hunts may also reflect the importance of the activity. Groups hunting often are considered to value the activity more than those who hunt less frequently. Subsistence hunters are expected to hunt more often than sport hunters.

The amount one spends on a recreational activity is compelling evidence of how an individual values the activity. The more money one spends on anything associated with hunting in relation to their income, the more important the activity may be to the individual. This analysis focuses on sport hunters since they do not hunt on the basis of need. This information will aid in understanding how groups value recreational hunting.

Understanding the perceived value of the wildlife that is most consumed helps identify common objectives and facilitates stakeholders to work together. Identifying species that are most important helps to understand which species faces the greatest hunting pressure by a particular group. Thus, conservation efforts can focus on these species and work more efficiently. These findings also show if a particular species is important for more than one group. In this case, these groups have a greater stake in working together to ensure the viability of the population. This information can be used to help sport hunters and subsistence hunters cooperate to ensure the future enjoyment of the species under the UMA plan. In this study, wildlife value is defined by the following criteria: a) use, b) hunting pressure, c) revenue gained from meat sales (for ejido residents), d) consumption frequency, and e) species preference.

Species uses are analyzed using a continuum from “food and revenue” at one end followed by “food”, “sell”, “food and trophy”, “food, fun, and trophy”, and “trophy” on the other. This order follows a gradient with “need” at one end and “want” at another. The primary use of a species is discussed as well as the group having the greatest need for the species. The study hypothesizes that there is a difference in use patterns between groups and that subsistence hunters use the species more for food and sport hunters use the species more for trophy.



The number of animals of a species that the group hunts indicates its value to the group. The higher the hunting pressure, the higher the species value. This analysis does not account for a hunter's skill and chance as possible biases. Information identifying a group that places the highest hunting pressure on a particular game population can be used to help direct conservation efforts.

Ejido residents were the only groups to sell game meat as an important part of their annual revenue. The higher the revenue gain from selling meat of a particular species, the more important that species is for the individual. The study hypothesizes that species value in this respect is the same for all ejido residents.

The species most often consumed is the most important wild game for a group's diet. Consumption frequency is based on the amount hunted and/or bought. The groups with the highest consumption of each species will also be reviewed. To understand the importance of wild meat in the diet, wild meat consumption frequency will be compared to domestic meat intake. The hypothesis is that all groups consume chicken in the greatest amount because it is the cheapest and most available meat, and wild meat in the least amount, due to its higher price and limited availability.

Game preference also indicates the importance of a species to an individual. If a relationship exists between game preference and hunting pressure and/or consumption frequency, it is important to know which species is the most preferred by a group. This information can also serve as an element of common ground to motivate stakeholders to work together.

Apart from hunting and game importance, perceptions of wildlife ownership have a large impact on resource conservation. If an individual feels a claim to the resource, he

will have a higher tendency to conserve it in order to ensure future enjoyment. When one perceives a resource as having no owner and openly accessible, the individual is in competition with others for resource access. As a result, there is little incentive to conserve (Hardin, 1968). The majority of sport hunters are expected to consider wildlife as belonging to no one, and as open access, while the ejido residents are expected to consider the wildlife as belonging to the ejido. Taking one step further, ejido residents are expected to consider the wildlife belonging to the ejido, even when found on their parcel of land.

Stakeholder knowledge about the UMAs and relevant regulations is critical for the program's success. This section evaluates the SEMARNAP's effectiveness of providing information to sport hunters and subsistence hunters about the UMA strategy and its regulations. Because the number of hunting tags a sport hunter is permitted to purchase varies between UMAs, the hypothesis is that sport hunters are more knowledgeable than subsistence hunters about the UMA program, the uses possible under the strategy, and the new wildlife law that gives the program legal authorization.

Enforcement of hunting regulations is important to ensure the sustainable use of wildlife resources. Educating main stakeholders of the UMA may not be sufficient, since some individuals may choose not to follow the regulations without enough incentives. The study hypothesizes that there is a general sentiment among all participants that the government is doing a below-average job of enforcing hunting restrictions, due to limited resources.

The three ejidos studied have a core forest area considered a key resource base and is conserved by the community. The ability of ejido leaders to enforce restricted

hunting zones is an additional factor in wildlife conservation. Based on the economic conditions among its population, the study hypothesizes that the quality of the enforcement of hunting restrictions within the ejido is not effective.

### **Current Use Practices**

Data on current hunting practices will indicate if efforts are needed to improve sustainable use of wildlife. Sport hunting as a conservation tool may not be enough to make the UMA system successful. If hunting groups do not discriminate between the age and sex of an animal, or between the periods of harvest, more education may be needed to assure the viability of the wild game populations. Targeting males of a hunted species as opposed to not differentiating between sexes will allow the females to reproduce and replenish the population. Avoiding the harvest of juveniles will help the population's chances to reproduce in the future. Abstaining from hunting during critical time periods of a species' life cycle, such as reproductive periods, will help populations reproduce and sustain limited harvesting pressure. Since sport hunters are expected to have more interest in the trophy value of a kill and subsistence hunters focus on the value of a species as a food source, the hypothesis is that sport hunters hunt more adult males during specific month intervals, and that subsistence hunters will not discriminate between age, sex, or time period when harvesting a species.

### **Population Dynamics**

Studying the population dynamics of a species helps identify if a population can be harvested and at what level. This analysis focuses on perceived changes in population size and distance from the communities. Local perspectives and document review were used to determine wildlife population decline. Users' perspectives on population trends were treated as a source of information. The study hypothesizes that there is general

consensus that populations are perceived to be diminishing and their proximity to the community is decreasing.

### **Economic Feasibility**

The study also evaluates the feasibility of sport hunting as a tool for sustainable development in the ejidos of southern Mexico. In order for sport hunting to be a feasible tool for wildlife conservation, it must address the needs of the communities for the resource. In this case, working with the economic needs of the community through community development would be an option. To determine if sport hunting is a feasible tool for sustainable development, economic feasibility and group compatibility should be considered.

Contingent valuation was used to determine economic compatibility, which refers to an overlap of the price that one group of respondents was willing to pay and the price another group was willing to charge. The Contingent Valuation Method (CVM) is a popular method for estimating economic values of nonmarket resources drawn from the ecosystem (Milon and Johns, 1982). CVM is based on an individual's reaction or claimed behavior in a hypothetical situation, and can be used to identify potential impacts of a new project before it is implemented. CVM directly measures consumers' willingness to pay for a particular good or service (King and Mazzotta, 2000). It involves measuring consumers' responses based on the description of a detailed hypothetical scenario that includes the expected results if the scenario was implemented, and if it was not (Portney, 1994). The greatest advantage of CVM is that it provides managers and policy-makers an idea of possible consequences of changing current management practices (Layman et al., 1996). The biggest drawback of CVM is the hypothetical nature of the method. Its value lies solely on what people *say* they will do, as opposed to how

they *actually* behave (Milon and Johns, 1982). Many decision makers, therefore, place little faith in the model. However, after extensive study, the National Oceanic and Atmospheric Administration (NOAA) determined that CVM studies “can produce estimates reliable enough to be the starting point of a judicial process of damage assessment, including lost passive use values” (Portney, 1994, p. 8). Portney (1994) believes that CVM may be the only mechanism able to indicate potentially important values of nonmarket resources because it reveals people’s intended behavior in a realistic hypothetical scenario.

To evaluate the economic feasibility of sport hunting as a sustainable development tool, sport hunters were asked about their willingness to pay an entrance fee and to hire locals as assistants. Specifically, they were asked about their willingness to pay an entrance fee to hunt in an ejido if that revenue would be used for wildlife management. If the sport hunters were willing to pay a fee, they were asked the maximum price they would be willing to pay. Using the same scenario, sport hunters were asked if they would be willing to pay an entrance fee if the revenue would be used for community development projects, and if so, what the maximum price would be. This study also explored sport hunters’ willingness to provide subsistence hunters direct incentives to hunt less and allow sport hunting, if sport hunters provided employment opportunities.

Ejido residents, on the other hand, were asked about their willingness to accept an entrance fee from sport hunters to hunt in their ejido, with the understanding that they would use the income for wildlife management. If residents supported this option, they were asked what the minimum price they were willing to accept per sport hunter. The

same questions were repeated for income that would be meant for community public works projects that may benefit more people. Prices mentioned by sport hunters and ejido residents were then compared. Lastly, ejido residents were asked if they would be willing to work for a sport hunter as a guide or cook with the understanding that the employment was meant to reduce their need to hunt.

### **Stakeholder Compatibility**

The study explores group perceptions and inter-group compatibility to determine the feasibility of stakeholders working together. Sport hunters were asked if they held a positive opinion of ejido residents, and if they believed that subsistence hunters placed too much pressure on wildlife populations. Ejido residents were asked if they had a positive opinion of sport hunters, and if they would allow foreign sport hunters hunting in their ejidos. Ejido residents were asked if they believed that sport hunters were putting too much pressure on wildlife populations. Finally, the study explored if sport hunting is thought to benefit the ejidos. Ejido residents were asked if they feel that sport hunting benefited them personally, and if it benefited their community.

In sum, this study provides baseline information on the importance of hunting to sport and subsistence hunters, as well as the importance of the most used game species to the wildlife consumers in Quintana Roo and Campeche. The study also examines the possibilities of sport hunters and ejido residents working together under the SUMA program. Information was gathered through a survey of local perceptions and an analysis of economic incentives. This research serves as a guide for government agencies and local decision makers to effectively conserve wildlife while meeting local economic needs.

## CHAPTER 2 METHODS

### Study Sites

Research was conducted from 4 May 2000 – 15 August 2000 in five study sites in Quintana Roo and Campeche, located on Mexico's Yucatan peninsula. In Quintana Roo, the ejidos of Tres Garantias and Caobas were surveyed because they contain the only sport hunting UMAs in Quintana Roo. The ejido of Xbonil, located west of the Calakmul Biosphere Reserve, was the sport hunting UMA studied in Campeche. All three ejidos have large forested areas of at least 20,000 hectares. Data on sport hunting was collected in the capital cities of Chetumal and Campeche.

The state of Campeche is located at 19.50 N latitude and 90.32 W longitude, on the west coast of the Yucatan peninsula (INEGI, 1995). The state's land is composed of 1.1% agriculture, 6.8% pasture, 83.4% forest, and 4.5% mangrove (INEGI, n.d.). The capital city of Campeche has a surface area of 43.6 km<sup>2</sup> and elevation of 10 msnm. The climate is warm and humid with mean temperature of 26° C and mean precipitation of 1,000-1,100 mm (CNA. registro mensual de precipitación pluvial). The state of Campeche has a population of 689, 656 individuals, of which 178,160 people live in the capital city (INEGI, 1999a).

Quintana Roo is located on the eastern side of the Yucatan peninsula, at latitude 18.30 N and longitude 88.18 W (INEGI, n.d.). Land cover comprises 0.05% agriculture,

0.7% pasture, 89.9% forest, and 3.0% mangrove (INEGI, n.d.). The capital city of Chetumal has a surface area of 27.5 km<sup>2</sup> and elevation of 10 msnm. The state is characterized by a warm sub-humid climate with average rainfall 1200-1300 mm. Quintana Roo has 873, 804 inhabitants, of which 115,152 live in Chetumal (INEGI 1999a).

The ejido Tres Garantias is located 114 km southwest of Chetumal and consists of 44,000 ha of land, including an UMA of 20,000 ha (SEMARNAP, 2000; Avila, 1998b). The ejido was founded in 1943 and has a population of 749, of which 346 are women and 403 are men. There are 105 *ejidatarios* (ejido members with all community privileges) and 298 *pobladores* (ejido residents without rights to economic benefits from communal resources or voting privileges). No woman formally has the status of *ejidataria*.

Caobas is located 87 km southwest from Chetumal. The ejido was founded in 1950 and has 1,342 inhabitants, including 300 *ejidatarios* (Caballero, 1996). Fifty-one percent of the ejido population is men and 49% is women. The ejido is composed of two communities, Caobas and San Jose. Since both Caobas and San Jose share the same socio-economic and political benefits in the ejido, they are considered together in this study. The ejido Caobas has a total surface area of 68,533 ha, of which 30,000 ha are forest, 15,000 ha agriculture, and 23,533 ha cattle ranches. The UMA comprises the 30,000 ha forested area (Jimenez, 1996).

Apart from subsistence agriculture, the main economic activity in Tres Garantias and Caobas is timber harvesting. Since 1985, each ejido has communally managed a sustainable timber harvest with the help of forest technicians from the civil association, *Sociedad de Productores Forestales Ejidales de Quintana Roo*, located in Chetumal. The



ejidos also have a tree nursery program to replant harvested areas. Other important economic activities include cattle ranching, and honey and gum production (although gum production has been suspended since the late 1990s) (Avila, 1995).

Xbonil is located 200 km southeast of the capital Campeche and encompasses 46,600 ha. The Mayas founded the ejido originally in 1929, although the population is now of mixed origin (Reyna et al., 1999). In the year 2000 local clinic report, the population of the ejido was 492 (242 women and 250 men) comprising 140 families, including 191 *ejidatarios*. The UMA was established in 1997 and is 25,000 ha, which corresponds to the area dedicated to forest harvesting (SEMARNAP, 1999). The main economic activity aside from subsistence agriculture is honey production. The most lucrative crops are jalapeño and habanero chilies (Reyna et al., 1999). Forest harvesting has been suspended since 1998, because the exploitation permit has not been renewed (Reyna et al., 1999).

### **Sampling Method**

The sample for this study represents at least 95% of the hunter populations in each of the three ejidos. Ninety-eight percent of the hunter population in Tres Garantias was surveyed. In Caobas, all but 7 people on the list of hunters were interviewed. The seven not interviewed were not available. In Xbonil, all the available hunters in the village were interviewed. Approximately four hunters were not available.

Sport and subsistence hunters were selected nonrandomly. Individuals who had hunted at least once within the past three years were interviewed to obtain a current perspective. Non-hunting residents were also interviewed since they are often consumers of wild meat and take part in the decisions made by the ejido general assembly. Ejido

residents who never hunted or had not done so within the past 5 years were considered non-hunting residents. Non-hunters were randomly selected until 30 individuals were interviewed.

A total of 282 men were interviewed. The sample was composed of 41 hunters and 32 non-hunters in Tres Garantias, 64 hunters and 40 non-hunters in Caobas (including the San José annex), 22 hunters and 22 non-hunters in Xbonil, 31 sport hunters in Chetumal, and 30 sport hunters from Campeche. Interviews in Tres Garantias took place between May 15 and June 16, in Caobas from May 30 to June 19, and in Xbonil from July 17 to July 19, all in 2000. Sport hunters from Chetumal were interviewed from May 22 to August 7, 2000. In Campeche, sport hunters were interviewed from July 3 to July 21, 2000.

All ejido residents known to hunt were identified and interviewed. In Tres Garantias, two hunters-turned guides and the town restaurant owner, who is the principal wild game buyer of the community, identified 29 hunters. Twelve additional hunters were identified and interviewed during the non-hunter surveys.

Local hunters who had given up hunting after becoming hunting guides, acted as assistants for the study. Respondents were assured anonymity and were assigned numbers.

### **Surveys**

Three surveys were tailored to the three main user groups of sport hunters, subsistence hunters, and ejido non-hunters (Appendix C). The surveys were divided into six different sections: introduction, preference and motivation for use, contingent valuation, knowledge and perceptions, and demographic information. The introduction

and demographic sections collected background information for individual profiles. Preference and motivation identified the species used, in what manner and how often. Information collected in this section was analyzed to understand species use, hunting pressure, hunting practices, species preference, consumption frequency and perceptions on population dynamics.

Hunting pressure was asked for the years 2000, 1999, and 1998. To reduce the amount of error from limited memory, individuals who stated that they hunted a certain number of times per week or month throughout the year were asked questions on hunting pressure in terms of weeks or months, as was relevant.

To understand the importance of game meat in their diet, ejido residents were surveyed on the value of game and domestic meat. Specifically, individuals were asked how often they ate meat, and how many kilograms of various domestic meats and game meat (as a whole) were purchased per month. Information given in weeks was converted to months.

Contingent valuation information was used to determine the feasibility of using sport hunting as a community development tool. Responses revealed the willingness of sport hunters to pay an entrance fee and to hire local helpers. The section also measured the willingness of ejido residents to accept an entrance fee in exchange for sport hunter access to the wildlife resources on their lands. It was explained that entrance fees would be paid by each hunter each time he came to hunt, and that the tags for each animal hunted were a separate charge. Employment serving as an incentive to decrease hunting pressure was tested.

The knowledge and perceptions section evaluated the effectiveness of SEMARNAP's communication about the UMA program, and dissemination of information concerning the new wildlife law. This section also identified the effectiveness of current hunting enforcement by the government agency and the ejido leaders. In addition, perceptions about the other main user group measured compatibility between ejido residents and sport hunters. Individuals were also asked about their perceptions of the benefits of sport hunting at the personal and community levels.

The section on travel and associated costs measured sport hunters' costs incurred by hunting. This section was based on the principles of the travel cost method, which states that the more money, time and effort one spends on an activity, the more the activity is valued (Milon and Johns, 1982, King and Mazzotta, 2000; Layman et al., 1996). Data in this section measured the recreational importance of sport hunting to the individual based on the amount spent on the activity as a percentage the individual's annual income. The three questionnaires are shown in Appendix C.

The surveys were tested in a small community in Campeche located near the Calakmul Biosphere reserve. Pilot surveys were conducted on 5 individuals. Based on the responses from the pilot surveys and consultation with experts, questionnaires were redesigned to reduce bias.

Permission was obtained from the president of the sport hunting clubs to interview sport hunters. Sport hunters were contacted by phone, or personally for an appointment. At the end of each interview, the sport hunters were requested for one or more names and contacts for the next interview. All sport hunters were interviewed in person, except for two who were interviewed over the telephone.

## Statistical Analysis

The statistical package used for data analysis was SPSS version 9.0 for Windows.

### Part 1: Background Information

Cross tabulations and chi-square tests were used to compare groups on the basis of origin, ejido residency, occupation, and annual income categories. Means comparisons and analysis of variance were used to compare groups based on years of residency, age, years of education, and number of individuals in the household.

Percentages calculated for origin, ejido residency, occupation, and income category were taken from original group size, unless specified otherwise. Group sizes are as follows: Chetumal sport hunter n=31, Campeche sport hunter n=30, Tres Garantias hunter n=41, Tres Garantias non-hunter n=32, Caobas hunter n=64, Caobas non-hunter n=40, Xbonil hunter n=22, and Xbonil non-hunter n=22.

Income categories to which each sport hunter belonged were recorded. Categories started at 10,000 pesos (\$1038 USD) or below, and went up in intervals of ten thousand pesos. The ejido residents were asked how much they earned per month. If they did not know, their earnings were calculated based on their daily wage and the number of days they worked per month. Monthly wages were extrapolated to obtain annual income. Income from *Procampo* subsidies and timber sale earnings, and other sources were included. *Procampo* earnings were based on 450 pesos (\$47 USD) per ha of traditional crops planted (the limit for the subsidy is ten ha). Timber sale earnings varied between timber working groups in the ejido. To compare sport hunter income with that of ejido residents, the median sport hunter income was calculated to obtain a discrete value. A new frequency distribution was run to include all respondents' annual incomes. Based on the frequency distribution, new income categories were created after

converting the pesos into dollars based on the average exchange rate for the time period (9.63 pesos per dollar in 2000).

## **Part 2: Sport Hunting as a Wildlife Conservation Tool**

Analysis of hunting tradition consisted of asking hunters if the father, grandfather, and/or other family members hunted. Percentages reported for tradition, reasons for hunting, and for not hunting were based on the number of people who answered the question in each group. Tradition, motivation to hunt, and not to hunt were tested using cross tabulation and chi-square tests.

Hunting costs for sport hunters were computed using the equation: trip cost (includes gas, food, etc.) + annual expenditure on bullet purchases + tag/permit cost (total expenditure in 1999) + entrance fee (into a hunting area; not common) + sport cost. Sport cost was derived from club fee + arms registration and permit (125 pesos) + sport hunter identification card (255 pesos). Club fees in Chetumal totaled 5600 pesos (\$582 USD) and in Campeche 3100 pesos (\$322 USD).

Due to the skewed distribution of hunting frequencies, the Kruskal-Wallis non-parametric test was used to compare differences between groups.

Percentages calculated for wildlife use were based on the number of responses per group. For hunting pressure in 1998, percentages were based on the number of responses of the total size of a particular hunting group.

Hunting pressure, income during 1999 from wild meat sales in the ejidos, annual consumption frequency of game meat, and annual meat consumption by weight were not normally distributed, causing a large variation within groups and the standard deviation to be larger than the mean. To solve this problem the Kruskal-Wallis non-parametric test was used to compare groups.

Means were used to compare species value based on hunting pressure, revenue gained, and consumption frequency/ amount within groups, because Kruskal-Wallis rankings are done on a per-species, not on a per-group basis.

For ranking the importance of species uses, the group having a majority response relative to the number of responses on a high-ranking use is considered having the most need for the species.

All groups were asked which species they preferred most. Within each group, the species with the most “votes” as first choice was the preferred species for the group. The species with the second most “votes” as first choice was classified as the second choice species for the group, likewise for the third choice species. Percent response for group size indicates the amount of representation the rank holds for the species by the group interviewed. This information aids understanding of the importance of a particular species to a group.

Cross tabulations and chi-square tests were used to test sustainable hunting practices, wildlife population decline, perceived ownership of wildlife, effectiveness of government communication about the UMA program and the new wildlife law to the main stakeholder groups, and the effectiveness of hunting restriction enforcement.

Percentages were calculated based on number of responses, unless specified otherwise.

### **Part 3: Sport hunting as a Tool for Sustainable Development**

Cross tabulations and chi-square tests were used to test criteria for economic feasibility and group compatibility. Percentages are based on number of responses, unless specified otherwise. The most “popular prices” in the contingent valuation section were based on the mode.

### **Document Review**

Game population density and hunting pressure data for Tres Garantias and Caobas was provided by Gilberto Avila and Francisco Quinto from the *Sociedad de Productores Forestales Ejidales de Quintana Roo, A.C.* of Chetumal. Population density data for Xbonil was from Reyna et al. (1999). SEMARNAP provided copies of official documents that authorize the quantity of permitted species to be hunted.



## CHAPTER 3

### RESULTS

This chapter quantitatively analyzes the success of Mexico's SUMA program in Quintana Roo and Campeche that offers sport hunting as one wildlife use option. It also provides evidence to support or reject the hypothesis that sport hunting can be used as an effective tool for wildlife conservation and sustainable development in southern Mexico. The results are divided into four sections. Part 1 reviews group profiles to give general background information on the individuals surveyed. Part 2 focuses on sport hunting as a tool for wildlife conservation. Part 3 analyzes sport hunting as a tool for sustainable community development. Part 4 shows the results of the document review on game population size, hunting pressure, and authorized bag limits.

#### **Group Profiles**

Group profiles give the socio-economic status represented in each user group. Place of origin differed significantly between groups ( $X^2=570.83$ ,  $p \leq 0.001$ ) (Table 1). Out of 253 responses, the states most individuals claimed as their place of origin include Veracruz (34%), Campeche (17%), and Yucatan (16%). Based on total responses, 58% of Chetumal sport hunters are from Quintana Roo; 69% of Campeche sport hunters and 64% of Xbonil hunters are from Campeche; 26% of Tres Garantias hunters and 33% of Tres Garantias non-hunters came from Yucatan; and 52% Caobas hunters, 42% of Caobas non-hunters and 41% of Xbonil non-hunters are from Veracruz.

Table 1. States that respondents claim as their place of origin\*

STATE	Chetumal Sport Hunter	Campeche Sport Hunter	Tres Garantias Hunter	Tres Garantias NON-hunter	Caobas Hunter	Caobas NON-hunter	Xbonil Hunter	Xbonil NON-hunter	TOTAL
Campeche	1	20	5	3	2	1	14	7	43
Caobas									13
Chiapas		1	8	1	4	2			16
Coahuila	1								1
Guerrero			2	1					3
Hidalgo					4	1			5
Jalisco								1	1
Merida	5		1						6
Mexico DF		3							3
Michuacana				1		1			2
Morelia		1							1
Morelos					1				1
Oaxaca					1	1	1		3
Puebla						2			2
Quintana Roo	18	1	2	1	5	9			2
Tabasco	1		5	6	4	1	1	4	22
Tamaulipas	1								1
Veracruz	1	2	5	6	33	16	5	9	77
Xbonil									10
Yucatan	3	1	10	10	10	4	1	1	40
Zacatecas				1					1
TOTAL	31	29	38	30	64	38	22	22	253
Group Size	31	30	41	32	64	40	22	22	282

\*Sig.  $\leq 0.001$

The majority of ejido residents interviewed were *ejidatarios* (Table 2). They composed the following percentages of the sample: 46% of Tres Garantias hunters, 47% of Tres Garantias non-hunters, 73% of Caobas hunters, 48% of Caobas non-hunters, and 95% of Xbonil hunters and non-hunters ( $X^2 = 54.8$ ,  $p \leq 0.001$ ).

Table 2. Residency status of individuals living in ejidos. Ejidatarios have greater influence on the decisions made in the community than pobladores. \*

	Ejidatario	Poblador	N
Tres Garantias Hunter	19	22	41
Tres Garantias NON-hunter	15	17	32
Caobas Hunter	47	17	64
Caobas NON-hunter	19	21	40
Xbonil Hunter	21	1	22
Xbonil NON-hunter	21	1	22

\*Sig.  $\leq 0.001$

The mean number of years as a resident in one of the study sites varied between groups ( $F = 17.6$ ,  $p \leq 0.001$ ). Tres Garantias non-hunters had the lowest mean of 18.2 years (S.D.= 9.4), whereas Campeche Sport hunters had the highest with a mean of 40.4 years (S.D.= 15.1) (Table 3).

Mean ages between groups varied significantly ( $F = 2.5$ ,  $p = 0.018$ ) (Table 4). Of all the groups studied, Tres Garantias non-hunters had the highest mean age of 47.6 years (S.D.= 19.8), and Tres Garantias hunters had the lowest mean age of 37.8 years (S.D.= 13.5). Age ranged from a minimum of 17 years old (Tres Garantias hunter) to a maximum of 83 years old (Caobas hunter).

Table 3. Mean number of years as a resident of the five corresponding sites, including Chetumal, Campeche, Tres Garantias, Caobas, and Xbonil\*

	N	Mean	S.D.	Min	Max
Chetumal Sport Hunter	30	34.6	10.5	18	56
Campeche Sport Hunter	30	40.4	15.1	7	61
Tres Garantias Hunter	41	20.9	10.3	1	53
Tres Garantias NON-hunter	32	18.2	9.4	0.4	30
Caobas Hunter	64	24.4	8.5	4	48
Caobas NON-hunter	40	20.2	10.2	2	47
Xbonil Hunter	22	26	10.7	7	50
Xbonil NON-hunter	22	20.5	9.5	5	40

\*Sig.  $\leq 0.001$

Table 4. Mean age of individuals interviewed per group\*

	N	Mean	S.D.	Min	Max
Chetumal Sport Hunter	31	43	11.4	20	75
Campeche Sport Hunter	30	45.5	10.1	26	61
Tres Garantias Hunter	41	37.8	13.5	17	73
Tres Garantias NON-hunter	29	47.6	19.8	16	79
Caobas Hunter	63	47.4	15.6	20	83
Caobas NON-hunter	39	41.6	15.8	19	78
Xbonil Hunter	22	38.3	11.6	22	59
Xbonil NON-hunter	22	42.3	13.4	23	70

\*Sig.= 0.018

Chetumal and Campeche sport hunting groups had the highest mean years of education (mean= 12.9, S.D.= 4 and 4.4 respectively), while Caobas hunters had the lowest at 2.2 years (S.D.= 2.6) ( $F= 50.8$ ,  $p \leq 0.001$ ). The minimum education for sport hunters was through the sixth grade, and for ejido residents was no school (Table 5). Chetumal sport hunters had the most educated people with 18 years of schooling,

followed by a Campeche sport hunter, a Caobas non-hunter, and an Xbonil hunter, all of them with 17 years of education.

Table 5. Average number of years of education by group\*

	N	Mean	S.D.	Min	Max
Chetumal Sport Hunter	31	12.9	4	6	18
Campeche Sport Hunter	30	12.9	4.4	6	17
Tres Garantias Hunter	41	4.1	3.2	0	9
Tres Garantias NON-hunter	29	4	2.7	0	9
Caobas Hunter	63	2.2	2.6	0	9
Caobas NON-hunter	40	5	4.2	0	17
Xbonil Hunter	22	3.5	4	0	17
Xbonil NON-hunter	22	4.3	3.3	0	12

\*Sig.  $\leq 0.001$

Farming was reported most frequently as respondents' occupation and comprised 62% of 278 responses (Table 6). Farmers were principally composed of ejido residents including 83% of hunters and 53% of non-hunters in Tres Garantias, 81% of hunters and 63% non-hunters in Caobas, and 100% of hunters and 77% non-hunters in Xbonil. Sport hunters had significantly different responses about their occupation ( $X^2=357.7$ ,  $p \leq 0.001$ ). Thirty-two percent of Chetumal and 20% of Campeche sport hunters said they were businessmen. Twenty percent of Campeche respondents stated that they were in the tech-repair, mechanic or the key smith professions.

Table 6. Primary occupation held by individuals by group\*

	Chetumal Sport Hunter	Campeche Sport Hunter	Tres Garantias Hunter	Tres Garantias NON- hunter	Caobas Hunter	Caobas NON- hunter	Xbonil Hunter	Xbonil NON- hunter	TOTAL
Business	10	6							16
Doctor/Dentist	3	5							8
Farmer	4		34	17	52	25	22	17	171
Farmer & Business			1	5	1	3			10
Farmer & Ejido Official				1		1		1	3
Farmer & Other <sup>1</sup>			5	2	10	2		4	23
Forester/Agronomist		1				2			3
Gov. worker/ Police/ Military	3	2	1						6
Hunting Operator/ Tourism		3							3
Lawyer	2								2
Notary/ Public contractor/ Accountant		4							4
Student/ Retired		2				1			3
Tailor/ Carpenter				2		2			4
Teacher/ School Supervisor	2	1							3
Tech-repair/ Mechanic/ Key smith	7	6		1		2			16
Number in each group	31	30	41	32	64	40	22	22	

\*Sig.  $\leq 0.001$ <sup>1</sup>Other includes woodsman, guide or beekeeper.

Mean household size varied significantly between groups ( $F= 4.75$ ,  $df=4$ ,  $p\leq 0.001$ ). Campeche sport hunters had the fewest individuals per household, (mean= 3.7, S.D.= 1.4) and Xbonil hunters had the most (mean= 5.2, S.D.= 2.7) (Table 7).

Approximately 52.5% of all sport hunters earned an annual income between \$5,711 and \$12,460 USD (Table 8). The majority of all ejido groups earned between \$519 and \$1,557 USD a year. Twenty-eight percent of non-hunters in Tres Garantias and 33% in Caobas earned between \$1,557 and \$2,595 USD. Among ejido groups, Caobas had the most individuals in the lowest economic bracket between \$93 and \$519 annually. The highest economic bracket occupied by an ejido resident was between \$12,461 and \$18,691. Differences among groups were statistically significant ( $X^2 = 321.02$ ,  $p\leq 0.001$ ).

Table 7. Average number of individuals in per household by group\*

	N	Mean	S.D.	Min	Max
Chetumal Sport Hunter	31	3.9	1.3	1	6
Campeche Sport Hunter	30	3.7	1.4	1	6
Tres Garantias	73	4.7	2.3	1	12
Caobas	103	5.3	2.6	1	12
Xbonil	44	5.2	2.7	1	14

\*Sig.  $\leq 0.001$

Table 8. Annual income profiles in USD\*

	Chetumal Sport Hunters	Campeche Sport Hunters	Tres Garantias NON- hunters	Tres Garantias Hunters	Caobas NON- hunters	Caobas Hunters	Xbonil NON- hunters	Xbonil Hunters	TOTAL
94.50 - 519.10	0	0	4	0	3	20	2	2	31
519.20 - 1,557.50	0	0	10	8	14	28	12	15	87
1,557.60 - 2,596.00	0	0	9	2	13	6	5	3	38
2,596.10 - 3,634.40	0	0	3	0	7	1	1	1	13
3,634.50 - 4,672.80	0	0	3	1	1	0	2	1	8
4,672.90 - 5,711.20	0	0	1	0	1	3	0	0	5
5,711.30 - 12,461.00	16	16	0	0	1	1	0	0	34
12,461.10 - 18,691.50	8	10	1	0	0	0	0	0	19
18,691.60 - 24,922.00	4	2	0	0	0	0	0	0	6
24,922.10 - 31,152.50	0	2	0	0	0	0	0	0	2
31,152.60 - 37,383.10	2	0	0	0	0	0	0	0	2
37,383.20 - 43,613.60	0	0	0	0	0	0	0	0	0
43,613.70 - 49,844.10	0	0	0	0	0	0	0	0	0
49,844.20 +	1	0	0	0	0	0	0	0	1
N Responses	31	30	31	11	40	59	22	22	246
Group Size	31	30	32	41	40	64	22	22	282

\*Sig.  $\leq 0.001$



### **Sport Hunting as a Wildlife Conservation Tool**

Analysis of sport hunting as a wildlife conservation tool is divided into seven sections. Sections 1-5 fall under stakeholder dynamics and consist of: 1) hunting importance, 2) game species value, 3) resource access, 4) effectiveness of agency communication to user groups about the UMA, and 5) enforcement of hunting restrictions. Section 6 evaluates current hunting practices, and includes targets on sex, age group, and months of harvest. Finally, section 7 reveals local perceptions on population dynamics.

### **Importance of Hunting as an Activity**

#### **Hunting tradition**

Hunting as a tradition in the family is one indication of the importance of the activity not only to the individual hunter, but also in the community. For all the groups sampled, more people had fathers who hunted than any other family member (Table 9). Of 234 individuals interviewed, 44% had fathers who hunted. Most Chetumal sport hunters had both fathers and grandfathers who hunted (11 out of 24), followed by fathers only (10 of 24). Campeche sport hunters had 64% of fathers who hunted. Most hunters and non-hunters in Tres Garantias had fathers and grandfathers as hunters (53% and 45%, respectively). Sixty-four percent of Caobas hunters had fathers who hunted, whereas non-hunter responses were closely divided between "father", "both father and grandfather", and "no one in immediate family" categories. "Father" was the most frequent response for both hunter and non-hunters in Xbonil. Over all, hunting has strong traditional ties for all groups, although non-hunters were the only groups to have "no one in the immediate family" who hunted ( $X^2 = 86.5$ ,  $p \leq 0.001$ ). Percent response of hunters

who had a father, grandfather, or both as hunters was 100% for Campeche and Caobas, 91% for Chetumal and Tres Garantias and 89% for Xbonil.

Table 9. Hunting Tradition in the Family. Groups having a high proportion of fathers and/or grandfathers who hunt signify that hunting is a strong tradition for the group\*

	N	Father	Grandfather	Both Father & Grandfather	Other Family Member	No one in immediate family
Chetumal Sport Hunter	24	10	2	11	1	0
Campeche Sport Hunter	25	16	2	7	0	0
Tres Garantias Hunter	32	8	4	17	3	0
Tres Garantias NON-hunter	29	9	3	13	0	4
Caobas Hunter	45	29	4	12	0	0
Caobas NON-hunter	38	12	1	13	0	12
Xbonil Hunter	19	12	0	5	3	0
Xbonil NON-hunter	22	8	1	5	0	8
<b>TOTAL</b>	<b>234</b>	<b>104</b>	<b>17</b>	<b>83</b>	<b>6</b>	<b>24</b>

\*Sig.  $\leq 0.001$

### Reasons for hunting

An individual's motivation to hunt is an indication of the importance of the activity to the person. Hunting for food was the primary reason for hunters living in ejidos (63% in Tres Garantias, 72% in Caobas, and 77% in Xbonil). Conversely, hunting for "sport and fun" was the most frequent reason stated among sport hunters (55% in Chetumal, and 70% in Campeche) ( $X^2 = 197.85$ ,  $p \leq 0.001$ ). Combining "food & money" with "need for food" as the two most need-based motivations, 77% of Xbonil, 75% of Caobas, and 66% of Tres Garantias' responses fell in this category. Other popular

reasons to hunt include “food, fun and tradition” as well as “food and milpa defense”

(Table 10). Overall, subsistence hunters have a stronger need to hunt than sport hunters.

Table 10. Primary reasons that motivate individuals of each group to hunt \*

	Chetumal Sport Hunter	Campeche Sport Hunter	Tres Garantias Hunter	Caobas Hunter	Xbonil Hunter	Total
Food & Money	0	0	1	2	0	3
Need for Food	0	0	26	46	17	89
Food & Milpa						
Defense	0	0	6	3	5	14
Milpa Defense	0	0	0	7	0	7
Tradition	1	4	0	1	0	6
Food & Fun/						
Tradition	7	1	8	4	0	20
Fun	6	4	0	1	0	11
Sport & Fun	17	21	0	0	0	38
N	31	30	41	64	22	188

\*Sig.  $\leq 0.001$

### Reasons for not hunting

Dislike of hunting was the principal reason given by ejido residents for not hunting. Fifty percent of Tres Garantias and Xbonil, and 53% of Caobas non-hunters gave this reason. Lack of time was the second most frequently stated reason for not hunting. Results were not significantly different.

### Annual hunting frequency

Since the standard deviations are very large due to the variance within groups, mean rank values provide a better comparison among groups. Mean rank figures indicate that per year, Xbonil hunters have the highest adjusted average hunting frequency (99.66) and Tres Garantias hunters have the lowest (78.71) of all the hunting groups, although there was no significant difference between groups (Table 11).

Table 11. Comparison of average frequency of hunting per year for each group

	N Responses	Average	Std. Deviation	Mean Rank
Chetumal Sport Hunter	30	35.7	33.8	97.78
Campeche Sport Hunter	30	32.3	32.4	90.67
Tres Garantias Hunter	41	27.7	33	78.71
Caobas Hunter	61	46.5	60.9	97.49
Xbonil Hunter	22	43.4	43.5	99.66

### **Annual hunting costs as a percentage of annual income**

Sport hunters from Chetumal spent an average 6.4% of their annual income and sport hunters from Campeche spent 5.4%. There was no statistically significant difference between the two groups.

### **Importance of Wild Game Species**

#### **Species use**

The use of a game species is an indicator of the degree of importance the species has to the individual. It also indicates how flexible a group is to compromise based on the degree of need. The greater the need, the less flexible the group may be. Use varied considerably between groups and by species ( $X^2 = 292.62$ ,  $p \leq 0.001$ ) (Tables 12-14).

Most Chetumal sport hunters (65%) used white-tailed deer for food and trophy.

Surprisingly, Campeche sport hunters along with Tres Garantias hunters, and all the non-hunters in the ejidos used white-tailed deer primarily for food. Fifty-two percent of all Caobas hunters interviewed ate and sold the meat. Xbonil hunters were evenly divided between consuming the meat, and consuming and selling it. Therefore, Caobas and Xbonil hunters have the most need for the species, and Chetumal sport hunters have the least need. All groups principally ate collared peccary, white-lipped peccary, and agouti

paca except for Caobas hunters, who not only ate but also sold the meat ( $X^2 = 120.72$ ;  $X^2 = 170.97$ ;  $X^2 = 57.42$  respectively,  $p \leq 0.001$ ). Again, Caobas hunters demonstrate the most need. All groups used the ocellated turkey principally for food, although it was a valued trophy item for many sport hunters from both states ( $X^2 = 75.51$ ,  $p \leq 0.001$ ). Of all the groups sampled, 93% use the curassow primarily for food. Campeche sport hunters were the only group that differed by having one hunter only selling the game meat ( $X^2 = 209.26$ ,  $p \leq 0.001$ ).

Overall, the primary use of brocket deer is consumption (73%). Chetumal hunters were almost evenly divided between using the game solely for food, and for food and trophy. Sixty-three percent of Campeche hunters used the species for food and trophy ( $X^2 = 229.30$ ,  $p \leq 0.001$ ). Most Caobas hunters preferred to consume and sell the game meat (61%). Thus, Caobas hunters demonstrate the most need and Campeche sport hunters demonstrate the least.

Table 12. Comparison of the various uses of deer species between groups

	N <sup>1</sup>	Food	Trophy	Sell	Food & Sell	Food & Trophy	Food, Trophy & Sell
<b>White-Tailed Deer*</b>							
Chetumal Sport Hunter	31	6	1	0	1	20	1
Campeche Sport Hunter	30	11	0	2	0	9	0
Tres Garantias Hunter	41	34	0	0	0	0	0
Caobas Hunter	64	19	0	0	33	0	0
Xbonil Hunter	22	8	0	0	8	0	0
Tres Garantias NON-hunter	32	29	0	0	0	0	0
Caobas NON-hunter	40	31	0	0	0	0	0
Xbonil NON-hunter	22	19	0	0	0	0	0
Species Totals	282	157	1	2	42	29	1
<b>Brocket Deer*</b>							
Chetumal Sport Hunter	25	12	0	0	0	12	1
Campeche Sport Hunter	19	7	0	0	0	12	0
Tres Garantias Hunter	36	36	0	0	0	0	0
Caobas Hunter	49	19	0	0	30	0	0
Xbonil Hunter	18	11	0	0	7	0	0
Tres Garantias NON-hunter	28	28	0	0	0	0	0
Caobas NON-hunter	35	35	0	0	0	0	0
Xbonil NON-hunter	18	18	0	0	0	0	0
Species Totals	228	166	0	0	37	24	1

\*Sig.  $\leq 0.001$ <sup>1</sup>N= number of responses

Table 13. Comparison of the various uses of peccary species between groups. Peccaries have significant food value and little trophy value.

		N <sup>1</sup>	Food	Trophy	Sell	Food & Sell	Food & Trophy	Food, Trophy & Sell
<b>White-Lipped Peccary*</b>	Chetumal Sport Hunter	9	8	0	0	0	1	0
	Campeche Sport Hunter	1	0	0	1	0	0	0
	Tres Garantias Hunter	24	24	0	0	0	0	0
	Caobas Hunter	20	9	0	0	11	0	0
	Xbonil Hunter	8	3	0	0	5	0	0
	Tres Garantias NON-hunter	20	20	0	0	0	0	0
	Caobas NON-hunter	16	16	0	0	0	0	0
	Xbonil NON-hunter	9	9	0	0	0	0	0
	Species Totals	107	89	0	1	16	1	0
<b>Collared Peccary*</b>	Chetumal Sport Hunter	25	23	1	0	0	1	0
	Campeche Sport Hunter	13	10	0	0	0	3	0
	Tres Garantias Hunter	33	33	0	0	0	0	0
	Caobas Hunter	56	24	1	0	31	0	0
	Xbonil Hunter	13	9	0	0	4	0	0
	Tres Garantias NON-hunter	24	24	0	0	0	0	0
	Caobas NON-hunter	26	26	0	0	0	0	0
	Xbonil NON-hunter	14	13	0	0	1	0	0
	Species Totals	204	162	2	0	36	4	0

\*Sig.  $\leq 0.001$

<sup>1</sup>N= number of responses

Table 14. Comparison of the various uses of game birds and agouti paca between groups

							Food, Trophy
					Food & Sell	Food & Trophy	
Ocellated Turkey*	N	Food	Trophy	Sell	Sell	Trophy	& Sell
Chetumal Sport Hunter	22	12	0	0	0	10	0
Campeche Sport Hunter	22	13	0	0	0	9	0
Tres Garantias Hunter	14	14	0	0	0	0	0
Caobas Hunter	19	18	0	0	1	0	0
Xbonil Hunter	19	15	1	0	3	0	0
Tres Garantias NON-hunter	19	19	0	0	0	0	0
Caobas NON-hunter	17	17	0	0	0	0	0
Xbonil NON-hunter	19	19	0	0	0	0	0
Species Totals	151	127	1	0	4	19	0
Curassow*							
Chetumal Sport Hunter	13	11	0	0	0	2	0
Campeche Sport Hunter	1	0	0	1	0	0	0
Tres Garantias Hunter	34	34	0	0	0	0	0
Caobas Hunter	40	35	0	0	5	0	0
Xbonil Hunter	17	13	0	0	4	0	0
Tres Garantias NON-hunter	22	22	0	0	0	0	0
Caobas NON-hunter	23	23	0	0	0	0	0
Xbonil NON-hunter	15	15	0	0	0	0	0
Species Totals	165	153	0	1	9	2	0
Agouti Paca*							
Chetumal Sport Hunter	19	18	0	0	1	0	0
Campeche Sport Hunter	14	14	0	0	0	0	0
Tres Garantias Hunter	36	36	0	0	0	0	0
Caobas Hunter	58	37	0	0	21	0	0
Xbonil Hunter	8	8	0	0	0	0	0
Tres Garantias NON-hunter	28	28	0	0	0	0	0
Caobas NON-hunter	36	36	0	0	0	0	0
Xbonil NON-hunter	12	12	0	0	0	0	0
Species Totals	211	189	0	0	22	0	0

\*Sig.  $\leq 0.001$



## Hunting pressure

From January through July 2000, Campeche sport hunters harvested the most white-tailed deer (97 animals), ocellated turkey (81 birds), and brocket deer (77 total) compared to any other group (Appendix A-1). Caobas hunters harvested the most collared peccary (119) and agouti paca (238) of all the groups. Tres Garantias hunters hunted the most white-lipped peccary (22) and curassow (114).

In 1999, Caobas hunters were the group responsible for putting the highest pressure on the white-tailed deer (246), collared peccary (326), agouti paca (604), and brocket deer (298) of all the groups (Appendix A-2). Tres Garantias hunters harvested the most white-lipped peccary (75) and curassow (256). Campeche sport hunters put the most pressure on the ocellated turkey (98).

In 1998, only 18 of 31 Campeche sport hunters hunted the most white-tailed deer (459), 19 of 31 hunted the most ocellated turkey (97), and 53% hunted the most brocket deer (109) (Appendix A-3). Only 8% of the Caobas hunters were responsible for putting the most pressure on the collared peccary (110) and agouti paca (184) than any other group. Only 3 of 64 Caobas residents hunted the most white-lipped peccary (87). Tres Garantias and Caobas hunters put the highest pressure on the curassow by hunting 30 birds per group.

The mean rank values derived from the Kruskal-Wallis non-parametric test compensate for large variances within groups and reveal any statistically significant differences between groups on a per species basis. Results were significant for the brocket deer in 2000 ( $X^2 = 13.3$ ,  $p = 0.01$ ) and 1999 ( $X^2 = 17.0$ ,  $p = 0.002$ ). In 1998, results were significant for the collared peccary ( $X^2 = 11.4$ ,  $p = 0.02$ ) and agouti paca ( $X^2 = 10.6$ ,  $p = 0.03$ ).

Average harvesting rates indicate the ranking importance of each game species for each group. In 2000, Chetumal sport hunters harvested the most agouti paca on average followed by white-tailed deer and ocellated turkey. In 1999 and 1998, white-tailed deer had the highest average for this group, followed by agouti paca and curassow in 1999, and ocellated turkey and brocket deer in 1998. Campeche sport hunters harvested the most white-tailed deer on average, followed by brocket deer and ocellated turkey for the three consecutive years. Caobas was equally consistent with the agouti paca holding the highest average for three years, followed by the curassow in 2000, the brocket deer in 1999, and the white-lipped peccary in 1998. Xbonil held the highest average for the ocellated turkey for the three years, followed by the white-tailed deer. Tres Garantias was not as consistent. Agouti paca held the highest average for 2000 and 1999, while the brocket deer held it during 1998. The curassow was consistently the second most hunted species by this group for the three years.

Age was negatively correlated with hunting frequency ( $r = -0.195$ ,  $p < 0.05$ ) and hunting pressure on white-tailed deer ( $r = -0.175$ ,  $r = -0.160$ ,  $p < 0.05$ ) and curassow ( $r = -0.203$ ,  $-0.216$ ,  $p < 0.05$ ) during 1999 and 2000 respectively. Younger hunters hunted more agouti paca in 1999 ( $r = -0.198$ ,  $p < 0.05$ ). In 2000, younger hunters put higher pressure on the white-lipped peccary ( $r = -0.3$ ,  $p < 0.05$ ) and ocellated turkey ( $r = -0.203$ ,  $p < 0.05$ ). Hunting pressure on collared peccary was the only game not to be significantly correlated with hunters' age.

### **1999 income generated from selling wild meat by ejidos**

The amount of income earned from selling game meat is an important element of the value of the species for the individual and the community. Caobas hunters made the most total revenue from selling white-tailed deer (\$18,946 USD), collared peccary

(\$5,699 USD), agouti paca (\$1,891 USD), curassow (\$390 USD), and brocket deer (\$5,839 USD) than any other group (Tables 15-17). Consequently, Caobas earned the highest revenue for 1999, totaling \$33, 874. Tres Garantias earned a total of \$4,541, and Xbonil totaled \$790 in wild meat sales for the year. Small sample sizes may be a factor for values that were not statistically significant. Only a few hunters in each group sell game meat, causing large standard deviations within groups. The Kruskal-Wallis nonparametric test gives a more accurate comparison between groups when there are large variations within groups. The Kruskal-Wallis non-parametric test indicated no significant difference between groups for the amount earned for each species' meat sold.

Based on average earnings, the top three income generating species for Tres Garantias in 1999 were the white-lipped peccary (\$768), collared peccary (\$387), and the agouti paca (\$248). The top three species for Caobas were the white-tailed deer (\$631), brocket deer (\$216), and the collared peccary (\$190). Finally, the top three income generating species for Xbonil are the white-tailed deer (\$62), brocket deer (\$25), and the white-lipped peccary (\$12).

Table 15. Amount of income gained (USD) by selling artiodactyls by ejido hunters in 1999

<b>White-Tailed Deer</b>		N	Total	Avg.	S.D.	Mean Rank
	Tres Garantias Hunter	4	\$138.37	\$34.59	\$41.13	20.38
	Caobas Hunter	30	\$18,946.97	\$631.57	\$2,272.70	20.48
	Xbonil Hunter	8	\$498.44	\$62.31	\$50.38	25.88
	Species Totals	42	\$1,929.76	\$466.28	\$1,929.76	
<b>Brocket Deer</b>						
	Tres Garantias Hunter	5	\$503.25	\$100.65	\$127.19	18.20
	Caobas Hunter	27	\$5,839.41	\$216.27	\$532.94	21.30
	Xbonil Hunter	6	\$153.69	\$25.61	\$40.97	12.50
	Species Totals	38	\$6,496.34	\$170.96	\$455.14	
<b>Collared Peccary</b>						
	Tres Garantias Hunter	4	\$1,549.84	\$387.46	\$442.51	26.00
	Caobas Hunter	30	\$5,699.69	\$189.99	\$310.56	19.13
	Xbonil Hunter	3	\$23.36	\$7.79	\$7.79	8.33
	Species Totals	37	\$7,272.90	\$196.56	\$317.91	
<b>White-Lipped Peccary</b>						
	Tres Garantias Hunter	2	\$1,536.86	\$768.43	\$675.53	16.00
	Caobas Hunter	10	\$1,106.44	\$110.64	\$190.09	8.90
	Xbonil Hunter	5	\$64.38	\$12.88	\$19.60	6.40
	Species Totals	17	\$2,707.68	\$159.28	\$321.72	

Table 16. Amount of income gained (USD) by selling game birds and agouti paca by ejido hunters in 1999

		<b>N</b>	<b>Total</b>	<b>Avg.</b>	<b>S.D.</b>	<b>Mean Rank</b>
<b>Ocellated Turkey</b>	Tres Garantias Hunter	0	\$0.00	\$0.00	\$0.00	0.00
	Caobas Hunter	1	\$0.00	\$0.00	\$0.00	1.00
	Xbonil Hunter	4	\$36.86	\$9.22	\$11.33	3.50
	Species Totals	5	\$36.86	\$7.37	\$10.64	
<b>Curassow</b>	Tres Garantias Hunter	1	\$66.46	\$66.46	\$0.00	5.00
	Caobas Hunter	4	\$390.03	\$97.51	\$56.72	6.25
	Xbonil Hunter	3	\$13.50	\$4.50	\$5.33	2.00
	Species Totals	8	\$469.99	\$58.75	\$59.29	
<b>Agouti Paca</b>	Tres Garantias Hunter	3	746	249	237	14
	Caobas Hunter	16	1891	118	187	9
	Xbonil Hunter	0	0	0	0	0
	Species Totals	19	2637	139	194	

Table 17. Total revenue gained by selling all game meat

	<b>N</b>	<b>Total</b>	<b>Avg.</b>	<b>S.D.</b>	<b>Mean Rank</b>
Tres Garantias Hunter	19	\$4,541.15	\$229.48	\$273.74	41.55
Caobas Hunter	64	\$33,874.02	\$194.89	\$204.78	52.39
Xbonil Hunter	16	\$790.24	\$17.47	\$21.34	50.47
Species Totals	99	\$39,205.41	\$441.84	\$499.86	

### Annual consumption frequency of game meat

The purpose of this analysis is to identify which species carries the most dietary importance of wild meat to each group, and to determine which group is responsible for the highest consumption rate of a particular species. All groups were asked how many meals (in terms of sittings) one ate of each game species in this study. Answers given in weeks or months were extrapolated to a year.

All groups consumed white-tailed deer most frequently, followed by brocket deer, agouti paca, collared peccary, curassow, ocellated turkey, and white-lipped peccary (Appendix A-4).

Based on mean consumption frequency, the three most consumed species by Chetumal sport hunters are white-tailed deer, collared peccary, and curassow. Campeche sport hunters also consume white-tailed deer the most frequently followed by brocket deer and white-lipped peccary. Non-hunters in Tres Garantias consume most often white-tailed deer, white-lipped peccary, and collared peccary, respectively. The hunters in the ejido consumed more often brocket deer, white-tailed deer, followed by agouti paca. Caobas non-hunters ate collared peccary, white-tailed deer, and brocket deer most often, whereas the hunters in the ejido consumed white-tailed deer, followed by agouti paca, and brocket deer most often. Like other groups, Xbonil non-hunters and hunters consumed white-tailed deer most frequently. Non-hunters consumed ocellated turkey and curassow frequently, while the hunters ate brocket deer and collared peccary the second and third most frequently.

According to the Kruskal-Wallis non-parametric test, there was a significant difference between groups putting the highest pressure on all species (white-tailed deer  $X^2 = 24.6$ ; collared peccary  $X^2 = 16.9$ ; white-lipped peccary  $X^2 = 26.3$ ; agouti paca  $X^2 = 45.5$ ; ocellated turkey  $X^2 = 17.8$ ; brocket deer  $X^2 = 32.8$ , all  $p \leq 0.02$ ), except for the curassow. Overall, the group that consumed white-tailed deer and ocellated turkey most often was the Xbonil hunters. Caobas hunters consumed collared peccary more than any other group. Campeche sport hunters consumed white-lipped peccary and brocket deer more often than any other group. Tres Garantias hunters ate agouti paca most often.

Table 18. Comparison of annual domestic and game meat consumption (Kg) in Ejidos.

<b>Chicken*</b>		N	Average	S.D.	Total
<b>Chicken*</b>	Tres Garantias NON-hunter	32	149.25	109.85	4776
	Tres Garantias Hunter	12	129.33	81.22	4423
	Caobas NON-hunter	39	99.38	94.37	3975
	Caobas Hunter	61	98.46	67.68	6303
	Xbonil NON-hunter	22	76.91	39.65	1692
	Xbonil Hunter	22	88.36	74.65	1944
	Species Totals	188	105.56	83.6	29152
<b>Beef</b>					
<b>Beef</b>	Tres Garantias NON-hunter	32	28.13	17.2	900
	Tres Garantias Hunter	12	27.83	28.6	3205
	Caobas NON-hunter	39	40.62	43.06	1299
	Caobas Hunter	59	19.63	18.37	1653
	Xbonil NON-hunter	22	23.18	18.91	510
	Xbonil Hunter	22	34.91	55.91	672
	Species Totals	186	28.25	32.32	14278
<b>Pork*</b>					
<b>Pork*</b>	Tres Garantias NON-hunter	32	50.44	39.09	1614
	Tres Garantias Hunter	12	40.33	36.67	484
	Caobas NON-hunter	39	34.77	35.53	1356
	Caobas Hunter	58	26.69	21.48	1548
	Xbonil NON-hunter	22	28.36	36.58	624
	Xbonil Hunter	22	39	40.98	858
	Species Totals	185	35.05	34.03	6484
<b>Wild Meat*</b>					
<b>Wild Meat*</b>	Tres Garantias NON-hunter	30	43.7	37.59	1311
	Tres Garantias Hunter	12	17.33	31.28	208
	Caobas NON-hunter	37	25.51	30.9	944
	Caobas Hunter	54	11.78	19.92	636
	Xbonil NON-hunter	19	22.81	21.24	433
	Xbonil Hunter	22	11.45	15.59	252
	Species Totals	174	21.75	28.78	3784

\*Sig.  $\leq 0.01$

### **Annual meat consumption by weight (Kg)**

This section compares the amount of wild meat consumed with that of domestic meat among the ejido groups interviewed. Overall, chicken was the most consumed meat, followed by beef, pork, and wild meat (Table 18). The amount of chicken consumed annually by all ejido groups combined totaled 29,152 kg. Beef totaled 14,278 kg. The amount of pork consumed was 6,484 kg. Consumption of all wild meat combined amounted to 3,784 kg a year. Based on average kilograms meat, all ejido residents consume chicken the most and wild meat the least except for Tres Garantias non-hunters who consume beef the least.

The Kruskal-Wallis test indicates that consumption patterns differed significantly between groups concerning chicken, pork, and wild meat ( $X^2 = 46.6$ ,  $X^2 = 11.0$ ,  $X^2 = 36.6$  respectively, all  $p \leq 0.05$ ). Tres Garantias hunters consumed the most chicken (mean rank= 117.82). Tres Garantias non-hunters consumed the most pork (mean rank= 118.22), and wild meat (mean rank= 122.35) of all ejido groups.

### **Wild Game Preference**

Species preference indicates the perceived value of one species over the others. Differences between groups on preference ranks were not statistically significant.

White-tailed deer was the first choice for all groups except for Campeche sport hunters who preferred the ocellated turkey. Collared peccary was the second favorite for Chetumal sport hunters, whereas Campeche sport hunters “voted” white-tailed deer as their second choice.

Species preference often differed between hunters and non-hunters in the same ejido. Hunters and non-hunters in Caobas were the only two groups in the same ejido



who agreed on agouti paca as their second choice. Brocket deer was the favored second choice for Tres Garantias and Xbonil non-hunters.

After the white-tailed deer, the brocket deer, agouti paca, and ocellated turkey were indicated as the three most frequent choices among all groups. The curassow and the white-lipped peccary were the least preferred species by all the groups.

Of all the groups, more Chetumal sport hunters chose the collared peccary as the most preferred species. Chetumal sport hunters along with Campeche sport hunters, Tres Garantias hunters, Caobas hunters and non-hunters chose the collared peccary as their third favorite.

The white-lipped peccary had the highest score as a favored third between two hunting groups. Only four out of sixty-four hunters in Caobas ranked the species, and all four chose it as a third favorite. Four out of six hunters who ranked the white-lipped peccary in Xbonil also ranked it as a third favorite.

Of the individuals in each group ranking the ocellated turkey, Campeche had the most people choosing the species as their first choice. The ocellated turkey was a popular third favorite among Tres Garantias non-hunters and Caobas residents. Xbonil residents were divided on the ranking order for this bird.

Brocket deer was the most popular as a second choice species among the groups interviewed. Of those who ranked the species, 67% of Chetumal Sport hunters, 55% of Tres Garantias hunters, 57% of Caobas hunters, and 73% of Xbonil Hunters selected the brocket deer as second choice.

Results showed that there was no significant difference between groups. The highest percentages of all the groups chose white-tailed deer as their most favored species.

Interestingly, species preference was significantly correlated to consumption frequency for agouti paca ( $r = 0.180$ ,  $p = 0.012$ ), and to hunting pressure during the year 2000 for brocket deer ( $r = 0.185$ ,  $p = 0.024$ ). No other species consumed was significantly correlated with preference.

In summary, species importance for each group is based on use, rank, average consumption frequency, average hunting pressure (for two or more years), and revenue gain (where relevant). The most valued species for Chetumal and Campeche sport hunters, Tres Garantias non-hunters, and Caobas and Xbonil residents was the white-tailed deer. Agouti paca and brocket deer were equally important for Tres Garantias hunters.

#### **Perceptions on Resource Access: Perceptions on Wildlife Ownership on Ejido Lands**

Forty percent of all ejido responses claim that wildlife belongs to no one, whereas 64% of all sport hunter responses state that wildlife belongs to all citizens. Thirty-six percent of all respondents ( $X^2 = 82.64$ ,  $p \leq 0.001$ ) believed that no one owns the wildlife on ejido lands (Table 19). The highest group responses were in the following categories: 53% of Chetumal and 73% of Campeche sport hunters believe that the wildlife belongs to everyone; Tres Garantias hunters were divided evenly (37% each) between wildlife belonging to the ejido and belonging to no one; 41% of Tres Garantias non-hunters and Caobas hunters, and 38% of Caobas non-hunters chose “no one”; and 45% of Xbonil hunters and non-hunters believed that wildlife belonged to no one. Combining the two open access categories, “all” and “no one,” more ejido residents perceive that wildlife is

an open access resource. Combining all responses, 27% claim that wildlife belongs to the ejido and that wildlife belongs to all citizens.

Table 19. Comparison of group perceptions on ownership of wildlife found on ejido lands\*

	Ejido	All	No One	Me	Government	N
Chetumal Sport Hunter	4	17	8	0	2	31
Campeche Sport Hunter	1	22	5	2	0	30
Tres Garantias Hunters	15	7	15	0	4	41
Tres Garantias NON-hunters	11	5	13	0	3	32
Caobas Hunter	22	8	25	1	5	61
Caobas NON-hunter	7	11	15	0	7	40
Xbonil Hunter	9	2	10	0	1	22
Xbonil NON-hunter	7	4	10	0	1	22
<b>TOTAL</b>	<b>76</b>	<b>76</b>	<b>101</b>	<b>3</b>	<b>23</b>	<b>279</b>

\*Sig.  $\leq 0.001$

When ejido residents were asked to whom the wildlife belonged to on their personal parcel of land, 66% responded that the wildlife was theirs (Table 20).

Responses did not significantly differ between groups.

Table 20. Ejido responses to the question “To whom does the wildlife belong when an animal is on your parcel of land?”

	Ejido	All	No One	Me	Government	N
Tres Garantias Hunters	2	0	0	5	0	7
Tres Garantias NON-hunters	1	1	2	9	1	14
Caobas Hunter	5	0	1	21	0	27
Caobas NON-hunter	3	2	5	6	0	16
Xbonil Hunter	3	0	3	16	0	22
Xbonil NON-hunter	1	2	5	14	0	22
<b>TOTAL</b>	<b>15</b>	<b>5</b>	<b>16</b>	<b>71</b>	<b>1</b>	<b>108</b>

### Distribution of Information (Knowledge)

Eighty-nine percent of all ejido residents did not know the meaning of UMA ( $X^2 = 28.45$ ,  $p \leq 0.001$ ) (Table 21). All sport hunters were assumed to be aware of the meaning of “UMA” because the new system directly affected the number of tags of each species the hunter was able to purchase.

Table 21. Ejido responses to the question: “Do you know what an UMA is?” Responses indicate the level of knowledge ejido residents have about wildlife management on their land.\*

	Yes	No	N
Tres Garantias Hunters	4	37	41
Tres Garantias NON-hunters	1	31	32
Caobas Hunter	2	58	60
Caobas NON-hunter	2	38	40
Xbonil Hunter	8	14	22
Xbonil NON-hunter	6	16	22
TOTAL	23	194	217

\*Sig.  $\leq 0.001$

Forty-five percent of Chetumal and 50% of Campeche sport hunters stated that they held an average knowledge of the wildlife law (Table 22). On the other hand, 90% of all ejido residents did not know the law at all ( $X^2 = 203.27$ ,  $p \leq 0.001$ ).

Eighty-two percent of sport hunters who responded were aware of how much hunting was permitted each year, while only 21% of ejido residents who responded had knowledge about this ( $X^2 = 88.61$ ,  $p \leq 0.001$ ) (Table 23). Considerably more ejido hunters (26%) knew about the legal hunting limit than non-hunters (15%).

Table 22. Responses to the question: “Do you know about the law concerning wildlife?” Responses indicate the effectiveness of SEMARNAP communicating policies that directly impact sport hunters and ejidos.\*

	Very Well	Well	Avg.	Not Well	Not At All	N
Chetumal Sport Hunter	4	8	14	4	1	31
Campeche Sport Hunter	4	9	15	1	1	30
Tres Garantias Hunters	0	3	2	3	33	41
Tres Garantias NON-hunters	3	0	0	0	29	32
Caobas Hunter	0	2	2	0	57	61
Caobas NON-hunter	3	0	0	0	37	40
Xbonil Hunter	0	1	1	0	20	22
Xbonil NON-hunter	0	0	1	0	21	22
TOTAL	14	23	35	8	199	279

\*Sig.  $\leq 0.001$

Table 23. Responses to the question: “Are you aware of how much hunting is permitted?” Responses indicate the level of knowledge individuals have on hunting bag limits.\*

	Yes	No	N
Chetumal Sport Hunter	20	10	30
Campeche Sport Hunter	29	1	30
Tres Garantias Hunters	10	30	40
Tres Garantias NON-hunters	5	27	32
Caobas Hunter	18	43	61
Caobas NON-hunter	3	37	40
Xbonil Hunter	4	18	22
Xbonil NON-hunter	6	16	22
TOTAL	95	182	277

\*Sig.  $\leq 0.001$

Seventy-four percent of all groups combined were not aware that subsistence hunting was legally permitted under the UMA plan (Table 24). More Tres Garantias residents, and Caobas and Xbonil hunters answered correctly than both groups of sport hunters ( $X^2 = 13.89$ ,  $p \leq 0.05$ ).

Table 24. Responses to the question: “Do you know if subsistence hunting is permitted?” \*

	Yes	No	N
Chetumal Sport Hunter	6	25	31
Campeche Sport Hunter	2	27	29
Tres Garantias Hunters	14	26	40
Tres Garantias NON-hunters	12	20	32
Caobas Hunter	20	41	61
Caobas NON-hunter	7	33	40
Xbonil Hunter	6	16	22
Xbonil NON-hunter	4	18	22
<b>TOTAL</b>	<b>71</b>	<b>206</b>	<b>277</b>

\*Sig.  $\leq 0.05$

Eighty-four percent of all respondents were not aware that wildlife commercialization was permitted under the approved management plan according to the new wildlife law (Table 25). More Campeche sport hunters were informed about this aspect of the management plan than Chetumal sport hunters, and more hunters appeared to be informed than non-hunters in the ejidos ( $X^2 = 27.43$ ,  $p \leq 0.001$ ).

Table 25. Responses to the question: “Do you know if wildlife commercialization is permitted?” Responses indicate knowledge of wildlife uses that are legal under the UMA strategy.\*

	Yes	No	N
Chetumal Sport Hunter	0	31	31
Campeche Sport Hunter	5	24	29
Tres Garantias Hunters	7	33	40
Tres Garantias NON-hunters	5	27	32
Caobas Hunter	21	40	61
Caobas NON-hunter	6	34	40
Xbonil Hunter	0	22	22
Xbonil NON-hunter	1	21	22
<b>TOTAL</b>	<b>45</b>	<b>232</b>	<b>277</b>

\*Sig.  $\leq 0.001$

### Law Enforcement

Opinions on the quality of government enforcement of hunting regulations varied significantly between groups ( $X^2 = 95.45$ ,  $p \leq 0.001$ ) (Table 26). Thirty-two percent of sport hunters and 42% of Tres Garantias residents who responded believed that the government did a very poor job. Lack of resources and concern, as well as corruption were the reasons most often given. Thirty-six percent of Caobas residents thought that the government was doing an average job. Sixty-nine percent of Xbonil residents, on the other hand, stated that the government was doing a good job.

Table 26. Perceptions on the quality of government enforcement of wildlife hunting regulations\*

	Very Well	Well	Avg.	Badly	Very Badly	N
Chetumal Sport Hunter	3	3	9	5	10	30
Campeche Sport Hunter	3	2	8	8	9	30
Tres Garantias Hunters	0	2	4	0	5	11
Tres Garantias NON-hunters	0	9	10	0	13	32
Caobas Hunter	0	12	17	14	14	57
Caobas NON-hunter	0	8	18	5	9	40
Xbonil Hunter	1	17	3	0	0	21
Xbonil NON-hunter	0	12	2	6	1	21
<b>TOTAL</b>	<b>7</b>	<b>65</b>	<b>71</b>	<b>38</b>	<b>61</b>	<b>242</b>

\*Sig.  $\leq 0.001$ 

Ejido responses varied considerably on the quality of enforcement by ejido leaders of the hunting restrictions ( $X^2=50.23$ ,  $p \leq 0.001$ ) (Table 27). Thirty-six percent of Caobas residents claimed that the ejido was doing an average job. Fifty-one percent of Xbonil residents and 34% of Tres Garantias hunters said that their ejidos were doing a good job, while 34% of Tres Garantias non-hunters stated that their ejido was doing a very poor job of enforcing the hunting restrictions.

Table 27. Ejido perceptions on the quality of enforcement of local hunting restrictions by ejido leaders

	Very Well	Well	Avg.	Badly	Very Badly	N
Tres Garantias Hunters	0	14	12	6	9	41
Tres Garantias NON-hunters	1	8	10	2	11	32
Caobas Hunter	0	12	19	11	17	59
Caobas NON-hunter	0	6	16	3	14	39
Xbonil Hunter	3	12	5	0	1	21
Xbonil NON-hunter	0	9	5	4	2	20
<b>TOTAL</b>	<b>4</b>	<b>61</b>	<b>67</b>	<b>26</b>	<b>54</b>	<b>212</b>

\*Sig.  $\leq 0.001$



## **Current Hunting Practices**

### **Sex selection**

The following analysis deals with the sustainability of harvesting practices. In general, a population has a higher chance of persisting if the males are sought rather than the females. No cases of seeking female game were specifically reported. The largest effort to discriminate males of a game species was found with the white-tailed deer (Table 28). Sport hunters claimed to make a concerted effort to hunt only males whereas the majority of subsistence hunters in Tres Garantias and Caobas did not discriminate between sexes ( $X^2=10.18$ ,  $p \leq 0.05$ ). Xbonil hunters were evenly divided.

As in the case with the white-tailed deer, most sport hunters selected male brocket deer, whereas more subsistence hunters did not discriminate sex ( $X^2=10.06$ ,  $p \leq 0.05$ ) (Table 28).

Campeche sport hunters were the only group to hunt only male curassow ( $X^2=9.54$ ,  $p \leq 0.05$ ) (Table 29). These statistics should be interpreted with caution since only one of thirty individuals responded to the question, and may not be an adequate representation of the entire group. All the hunting groups did not distinguish sex when harvesting collared peccary, white-lipped peccary, agouti paca, and ocellated turkey (Tables 28-29).

Table 28. Comparison of group hunting practices of discriminating sex of Artiodactyls. No individuals claimed to seek out females.

<b>White-Tailed Deer*</b>		Male	No Preference	N
	Chetumal Sport Hunter	19	10	29
	Campeche Sport Hunter	16	6	22
	Tres Garantias Hunter	16	18	34
	Caobas Hunter	19	31	50
	Xbonil Hunter	8	8	16
	Species Totals	78	73	151
<b>Brocket Deer*</b>				
	Chetumal Sport Hunter	15	10	25
	Campeche Sport Hunter	15	5	20
	Tres Garantias Hunter	15	21	36
	Caobas Hunter	18	30	48
	Xbonil Hunter	8	10	18
	Species Totals	71	76	147
<b>Collared Peccary</b>				
	Chetumal Sport Hunter	5	19	24
	Campeche Sport Hunter	0	13	13
	Tres Garantias Hunter	5	28	33
	Caobas Hunter	4	54	58
	Xbonil Hunter	1	12	13
	Species Totals	15	126	141
<b>White-Lipped Peccary</b>				
	Chetumal Sport Hunter	0	8	8
	Campeche Sport Hunter	0	1	1
	Tres Garantias Hunter	3	21	24
	Caobas Hunter	4	15	19
	Xbonil Hunter	0	8	8
	Species Totals	7	53	60

\*Sig.  $\leq 0.05$

Table 29. Comparison of group hunting practices of discriminating sex of Agouti Paca and Game Birds. No individuals claimed to seek out females.

<b>Agouti Paca</b>	Male	No Preference	N
Chetumal Sport Hunter	0	19	19
Campeche Sport Hunter	0	14	14
Tres Garantias Hunter	1	34	35
Caobas Hunter	2	56	58
Xbonil Hunter	1	7	8
Species Totals	4	130	134
<b>Ocellated Turkey</b>			
Chetumal Sport Hunter	6	15	21
Campeche Sport Hunter	3	19	22
Tres Garantias Hunter	2	12	14
Caobas Hunter	2	17	19
Xbonil Hunter	8	11	19
Species Totals	21	74	95
<b>Curassow*</b>			
Chetumal Sport Hunter	3	10	13
Campeche Sport Hunter	1	0	1
Tres Garantias Hunter	11	23	34
Caobas Hunter	6	34	40
Xbonil Hunter	8	9	17
Species Totals	29	76	105

\*Sig.  $\leq 0.05$

### Age selection

Discriminating an animal's age when hunting is important in exercising sustainable harvesting practices. In general, a population stands a better chance of persisting when the young are conserved and allowed to reproduce in the future. Overall, more hunters claimed to hunt only adult individuals of all the species in this study

(Tables 30-31). Reports on white-tailed deer ( $X^2=10.65$ ), collared peccary ( $X^2=14.17$ ), agouti paca ( $X^2=10.76$ ), ocellated turkey ( $X^2=13.69$ ), and curassow ( $X^2=10.02$ ) had statistically significant at the 0.05 level or below. Sport hunters generally had a higher percentage response in selecting for adults compared to subsistence hunters.

Table 30. Comparison of group hunting practices of discriminating age class of Artiodactyls. No individuals claimed to seek out juveniles.

<b>White-Tailed Deer*</b>		Adult	No Preference	N
	Chetumal Sport Hunter	25	4	29
	Campeche Sport Hunter	21	1	22
	Tres Garantias Hunter	24	10	34
	Caobas Hunter	33	17	50
	Xbonil Hunter	10	6	16
	Species Totals	113	38	151
<b>Brocket Deer</b>				
	Chetumal Sport Hunter	21	4	25
	Campeche Sport Hunter	17	3	20
	Tres Garantias Hunter	29	7	36
	Caobas Hunter	31	17	48
	Xbonil Hunter	10	8	18
	Species Totals	108	39	147
<b>Collared Peccary*</b>				
	Chetumal Sport Hunter	21	3	24
	Campeche Sport Hunter	11	2	13
	Tres Garantias Hunter	27	6	33
	Caobas Hunter	34	24	58
	Xbonil Hunter	6	7	13
	Species Totals	99	42	141
<b>White-Lipped Peccary</b>				
	Chetumal Sport Hunter	5	3	8
	Campeche Sport Hunter	1	0	1
	Tres Garantias Hunter	17	7	24
	Caobas Hunter	12	7	19
	Xbonil Hunter	5	3	8
	Species Totals	40	20	60

\*Sig.  $\leq 0.05$

Table 31. Comparison of group hunting practices of discriminating age class of Agouti Paca and Game Birds. No individuals claimed to seek out juveniles.

<b>Agouti Paca*</b>	Adult	No Preference	N
Chetumal Sport Hunter	16	3	19
Campeche Sport Hunter	12	2	14
Tres Garantias Hunter	26	9	35
Caobas Hunter	31	27	58
Xbonil Hunter	6	2	8
Species Totals	91	43	134
<b>Ocellated Turkey*</b>			
Chetumal Sport Hunter	20	1	21
Campeche Sport Hunter	20	2	22
Tres Garantias Hunter	10	4	14
Caobas Hunter	13	6	19
Xbonil Hunter	10	9	19
Species Totals	73	22	95
<b>Curassow*</b>			
Chetumal Sport Hunter	11	2	13
Campeche Sport Hunter	1	0	1
Tres Garantias Hunter	28	6	34
Caobas Hunter	24	16	40
Xbonil Hunter	8	9	17
Species Totals	72	33	105

\*Sig.  $\leq 0.05$

### Months of game harvest

This analysis determines times of year when game populations experience the highest hunting pressure and the existence of temporal overlap between sport hunters and subsistence hunters. If sport hunters hunt in the same relative area and during similar months as subsistence hunters, then these two groups will be competing for the same resource.

Table 32. Comparison of hunting periods of White-Tailed Deer among groups\*

	Chetumal	Campeche	Tres Garantias	Caobas	Xbonil	TOTAL
All Year	5	5	13	29	6	58
Jan-May	0	0	0	1	0	1
Mar-May	0	0	0	0	1	1
Mar-Jun	0	0	0	0	1	1
Mar-Jul	0	0	0	2	0	2
Apr	0	0	0	1	0	1
Apr-May	0	1	0	0	0	1
May-Jun	0	0	1	2	0	3
May-Jul	0	0	0	1	0	1
May-Aug	0	0	0	3	0	3
May-Sep	1	0	0	0	0	1
Jun-Jul	0	0	0	2	1	3
Jun-Aug	0	0	1	3	0	4
Jul	0	0	0	0	1	1
Aug-Sep	0	1	0	0	1	2
Aug-Dec	0	1	0	0	1	2
Sep-May	1	0	0	0	0	1
Sep-Oct	0	1	0	0	0	1
Oct	1	0	0	1	0	2
Oct-May	1	0	0	0	0	1
Oct-Nov	1	0	0	1	1	3
Oct-Jan	2	0	0	0	0	2
Nov-Dec	2	7	0	1	0	10
Nov-Jan	0	1	0	0	0	1
Dec	0	4	0	0	0	4
Dec-Mar	0	0	0	1	0	1
Dec-May	1	0	0	0	0	1
N	15	21	15	48	13	112

\*Sig.  $\leq 0.001$ 

Most hunters harvested all species year-round rather than during a particular time period (Table 32-38). Caobas had the highest number of hunters who harvested the white-tailed deer year round ( $X^2=173.39$ ,  $p \leq 0.001$ ) (Table 32). Campeche was the only hunting group to have the largest percentage of hunters who hunted white-tailed deer in November through December. All groups except Campeche hunted the collared peccary throughout the year. Campeche's activities were scattered across a number of months

( $X^2=155.96$ ,  $p \leq 0.001$ ) (Table 33). All the ejido communities hunted the ocellated turkey (no significance) and curassow ( $X^2=112.32$ ,  $p \leq 0.001$ ) year round while the sport hunters had scattered responses (Table 34-35). A significantly high percentage of the ejido communities harvested the brocket deer year-round, followed by Chetumal and Campeche ( $X^2=123.51$ ,  $p= 0.016$ ) (Table 36). Tres Garantias and Caobas hunters were the two groups having the highest percentage of hunters harvesting the white-lipped peccary all year-round ( $X^2=147.49$ ,  $p \leq 0.001$ ) (Table 37). The majority of all groups hunted the agouti paca year-round (Table 38).

Overall, the few occasions when a specific time period was selected by a high percentage of individuals in a group, the number of responses was small and not necessarily representative of the group. Considering this and the fact that most groups hunt species year-round, there is not enough evidence to support the claim that one group is directly competing with another for a species.

Table 33. Months of Collared Peccary Hunts\*

	Chetumal	Campeche	Tres Garantias	Caobas	Xbonil	TOTAL
All Year	5	2	9	39	5	60
Jan	0	1	0	0	0	1
Feb	0	1	0	0	0	1
Mar	0	0	0	1	0	1
Mar-Apr	0	1	0	0	0	1
Mar-May	1	0	0	0	0	1
Apr	0	1	1	0	0	2
Apr-May	0	0	2	1	0	3
Apr-Aug	1	0	0	0	0	1
Sep	0	0	0	0	2	2
Sep-Oct	0	1	0	3	0	4
Sep-May	1	0	0	0	0	1
Oct	1	0	0	2	0	3
Oct-Nov	1	0	0	1	0	2
Oct-Jan	1	0	0	0	0	1
Oct-May	1	0	0	0	0	1
Nov-Dec	1	1	0	1	0	3
Dec	0	2	0	0	0	2
Dec-Jan	0	1	0	0	0	1
N	13	11	12	48	7	91

\*Sig.  $\leq 0.001$



Table 34. Months of Ocellated Turkey Hunts

	Chetumal	Campeche	Tres Garantias	Caobas	Xbonil	TOTAL
All Year	3	1	6	12	7	29
Jan	0	0	0	0	1	1
Jan-Feb	0	1	0	0	1	2
Jan-May	1	0	1	0	0	2
Feb-Apr	0	1	0	0	0	1
Mar	0	1	0	0	0	1
Mar-Apr	3	4	0	0	1	8
Mar-May	0	0	0	1	1	2
Mar-Jun	0	0	1	0	0	1
Apr	2	3	0	0	0	5
Apr-May	0	1	1	1	1	4
Apr-Jun	0	1	0	0	0	1
Apr-Jul	0	0	0	0	1	1
May	0	1	0	1	2	4
Aug-Sep	0	0	0	1	0	1
Sep-Oct	0	0	0	1	0	1
Sep-May	1	0	0	0	0	1
Oct	1	0	0	0	0	1
Oct-Nov	1	0	0	0	0	1
Nov	0	1	0	0	0	1
Nov-Dec	0	2	0	0	0	2
Nov-Jan	0	1	0	0	0	1
Nov-May	0	1	0	0	0	1
Dec	0	1	0	0	0	1
Dec-Jan	1	0	0	1	0	2
N	13	20	9	18	15	75

Table 35. Months of Curassow Hunts\*

	Chetumal	Campeche	Tres Garantias	Caobas	Xbonil	TOTAL
All Year	1	0	9	28	9	47
Jan-Feb	0	0	0	1	1	2
Jan-May	1	0	1	0	0	2
Mar	0	0	1	0	0	1
Mar-Apr	1	0	0	0	0	1
Mar-May	0	0	1	1	0	2
Mar-Jul	0	0	1	0	0	1
Apr	0	1	1	0	0	2
Apr-May	0	0	1	4	1	6
May	0	0	1	1	2	4
May-Jun	0	0	0	1	0	1
May-Jul	0	0	0	1	0	1
May-Sep	1	0	0	0	0	1
Sep-Oct	0	0	0	1	0	1
Oct	1	0	0	0	0	1
Oct-Nov	1	0	0	0	0	1
Dec-Jan	0	0	0	1	0	1
N	6	1	16	39	13	75

\*Sig.  $\leq 0.001$

Table 36. Months of Brocket Deer Hunts\*

	Chetumal	Campeche	Tres Garantias	Caobas	Xbonil	TOTAL
All Year	5	6	15	32	13	71
Jan-May	0	0	0	1	0	1
Feb	0	2	0	0	0	2
Feb-Mar	1	1	0	0	0	2
Mar	0	1	0	0	0	1
Mar-Apr	1	5	0	0	0	6
Mar-Jul	0	0	0	2	0	2
Mar-Dec	0	1	0	0	0	1
Apr	1	1	1	0	0	3
Apr-May	0	0	0	0	1	1
May	0	0	1	0	0	1
May-Jun	0	0	1	2	0	3
May-Jul	0	0	0	1	0	1
May-Sep	1	0	0	0	0	1
Jun-Aug	0	0	0	3	0	3
Jun-Sep	0	0	0	1	0	1
Jul-Aug	0	0	0	1	0	1
Aug-Sep	0	0	0	1	0	1
Sep-Nov	0	1	0	0	0	1
Sep-May	1	0	0	0	0	1
Oct	0	0	0	1	0	1
Oct-May	1	0	0	0	0	1
Dec-Mar	0	0	0	1	0	1
N	11	18	18	46	14	107

\*Sig.  $\leq 0.05$

Table 37. Months of White-Lipped Peccary Hunts\*

	Chetumal	Campeche	Tres Garantias	Caobas	Xbonil	TOTAL
All Year	1	0	5	12	2	20
Mar-May	0	0	0	1	0	1
Apr	0	0	1	0	0	1
Apr-May	0	1	2	0	3	6
Jun-Aug	0	0	0	1	0	1
Sep	0	0	0	0	2	2
Oct-Nov	0	0	1	1	0	2
Oct-May	1	0	0	0	0	1
Nov	0	0	1	0	0	1
Nov-Dec	0	0	0	1	0	1
N	2	1	10	16	7	36

\*Sig.  $\leq 0.001$ 

Table 38. Months of Agouti Paca Hunts

	Chetumal	Campeche	Tres Garantias	Caobas	Xbonil	TOTAL
All Year	5	4	14	40	4	67
Jan-Feb	0	2	0	0	0	2
Feb	0	0	0	2	0	2
Feb-Mar	0	0	0	1	0	1
Mar-Apr	1	0	1	3	0	5
Mar-Jul	0	1	0	0	0	1
Apr	0	1	1	0	0	2
Apr-May	0	0	0	1	0	1
Apr-Jun	0	0	0	1	0	1
May	0	0	1	1	1	3
May-Jun	0	1	0	0	0	1
May-Aug	0	0	0	1	0	1
Sep-Oct	0	0	0	3	0	3
Sep-Mar	0	1	0	0	0	1
Sep-May	1	0	0	0	0	1
Oct	0	0	0	1	0	1
Oct-Nov	0	0	0	1	0	1
Oct-May	1	0	0	0	0	1
Nov-Dec	2	2	0	1	0	5
Dec	0	0	1	0	0	1
N	10	12	18	56	5	101

## **Hunting locations**

To determine if two or more groups are in competition for the same resource, along with species selection and time of harvest, location is an important consideration. The majority of all ejido hunters stated that they hunted strictly within their ejidos. Most sport hunters hunted mainly within their state. Areas named as the most frequented hunting sites are shown in Fig. B-1 and Fig. B-2 in Appendix B. A total of 18 sport hunters from Chetumal hunted in Tres Garantias at least once. Sixteen sport hunters from Chetumal said that they hunted in Caobas at least once. Only 7 sport hunters from Campeche hunted in Xbonil. Choice sport hunting sites mentioned often were not in proximity to the UMA study sites. Very few sport hunters have hunted in the UMAs in the study. Only 4 sport hunters from Chetumal and 8 from Campeche stated that they had hunted in an UMA.

## **Population Dynamics**

### **Perceived change in population size**

Many hunters and ejido non-hunters are well acquainted with game habitat and population dynamics through frequent contact. Therefore, their perception on population dynamics is considered seriously. Perceptions in population size differed significantly between groups for white-tailed deer ( $X^2=47.20$ ,  $p \leq 0.001$ ), collared peccary ( $X^2=40.42$ ,  $p \leq 0.001$ ), agouti paca ( $X^2=27.25$ ,  $p= 0.018$ ), ocellated turkey ( $X^2=62.31$ ,  $p \leq 0.001$ ), and brocket deer ( $X^2=39.78$ ,  $p \leq 0.001$ ) (Table 39-40). For all groups combined, 56% of the people believed that there were less white-tailed deer; 53% believed that there were less collared peccary; 65% stated that there were less white-lipped peccary; 56% believed there were less agouti paca and brocket deer; and 61% said there were less ocellated turkey and curassow. In general, all species are perceived to be declining.

Table 39. Comparison of perceived change in population size of Artiodactyls among groups

	White-tailed Deer*				Brocket Deer*			
	Less	More	Same	Total	Less	More	Same	Total
Chetumal Sport Hunters	16	6	6	28	17	2	6	25
Campeche Sport Hunters	7	9	6	22	7	5	8	20
Tres Garantias Hunters	11	11	10	32	13	11	11	35
Tres Garantias NON-hunters	22	3	3	28	24	1	2	27
Caobas Hunter	33	5	10	48	30	8	9	47
Caobas NON-hunter	24	4	2	30	24	3	7	34
Xbonil Hunter	2	6	8	16	4	6	8	18
Xbonil NON-hunter	9	1	7	17	6	3	7	16
<b>TOTAL</b>	<b>124</b>	<b>45</b>	<b>52</b>	<b>221</b>	<b>125</b>	<b>39</b>	<b>58</b>	<b>222</b>

\*Sig.  $\leq 0.001$ 

	Collared Peccary*				White-lipped Peccary			
	Less	More	Same	Total	Less	More	Same	Total
Chetumal Sport Hunters	10	8	7	25	5	1	1	7
Campeche Sport Hunters	8	0	5	13	1	0	0	1
Tres Garantias Hunters	8	13	11	32	11	4	8	23
Tres Garantias NON-hunters	17	1	5	23	15	1	3	19
Caobas Hunter	31	8	16	55	16	1	1	18
Caobas NON-hunter	20	3	2	25	12	1	2	15
Xbonil Hunter	4	3	5	12	2	2	4	8
Xbonil NON-hunter	6	0	7	13	3	2	4	9
<b>TOTAL</b>	<b>104</b>	<b>36</b>	<b>58</b>	<b>198</b>	<b>65</b>	<b>12</b>	<b>23</b>	<b>100</b>

\*Sig.  $\leq 0.001$

Table 40. Comparison of perceived change in population size of game birds and agouti paca among groups.

	Ocellated Turkey*				Curassow			
	Less	More	Same	Total	Less	More	Same	Total
Chetumal Sport Hunters	17	1	3	21	11	1	1	13
Campeche Sport Hunters	7	9	6	22	1	0	0	1
Tres Garantias Hunters	8	1	5	14	16	7	10	33
Tres Garantias NON-hunters	18	0	0	18	15	1	5	21
Caobas Hunter	11	1	7	19	23	3	11	37
Caobas NON-hunter	15	1	0	16	18	2	2	22
Xbonil Hunter	4	7	8	19	5	5	7	17
Xbonil NON-hunter	9	0	9	18	8	4	2	14
<b>TOTAL</b>	<b>89</b>	<b>20</b>	<b>38</b>	<b>147</b>	<b>97</b>	<b>23</b>	<b>38</b>	<b>158</b>

\*Sig.  $\leq 0.001$

	Agouti Paca*			
	Less	More	Same	Total
Chetumal Sport Hunters	7	3	8	18
Campeche Sport Hunters	5	1	7	13
Tres Garantias Hunters	11	10	13	34
Tres Garantias NON-hunters	18	2	7	27
Caobas Hunter	37	3	15	55
Caobas NON-hunter	25	4	6	35
Xbonil Hunter	3	2	3	8
Xbonil NON-hunter	7	1	3	11
<b>TOTAL</b>	<b>113</b>	<b>26</b>	<b>62</b>	<b>201</b>

\*Sig. = 0.018

### **Perceived change in population distance**

Population migration of game towards less developed habitat indicates that disturbance maybe significant in the area. The two major causes of population disturbance are habitat destruction and hunting pressure. Populations perceived to become more distant might also, but not necessarily be in decline.

Difference in responses to population distance from the center of town was statistically significant for white-tailed deer ( $X^2=49.69$ ,  $p \leq 0.001$ ), white-lipped peccary ( $X^2=30.75$ ,  $p= 0.006$ ), agouti paca ( $X^2=41.43$ ,  $p \leq 0.001$ ), ocellated turkey ( $X^2=25.93$ ,  $p= 0.026$ ), and brocket deer ( $X^2=26.67$ ,  $p= 0.021$ ) (Table 41-42). Considering all groups combined, 69% believe that white-tailed deer are found at a distance further than before, 76% believe that collared peccary have moved further, 80% believe that white-lipped peccary are more distant, 63% claim that agouti paca are more distant, 68% think that the ocellated turkey are more distant, 82% perceive that the curassow are more distant, and 75% perceive that brocket deer are more distant from the center of town than before.

The Pearson's Correlation Coefficient showed a significant negative correlation between perceived population size and perceived distance of the game population ( $p = 0.01$ ). For white-tailed deer,  $r= -0.322$ ; collared peccary  $r= -0.468$ ; white-lipped peccary  $r= -0.408$ ; agouti paca  $r= -0.434$ ; ocellated turkey  $r= -0.698$ ; curassow  $r= -0.536$ ; and brocket deer  $r= -0.549$ . Hence, the smaller the perceived population size, the farther the respondent's perceived distance of the game population from human settlement.



Table 41. Respondents' perceptions of Artiodactyl populations becoming more distant from the community

	White-tailed deer*				Brocket Deer*			
	Same	Far	Close	Total	Same	Far	Close	Total
Chetumal Sport Hunters	9	13	0	22	2	15	0	17
Campeche Sport Hunters	8	7	4	19	7	7	2	16
Tres Garantias Hunters	1	3	0	4	2	3	0	5
Tres Garantias NON-hunters	1	20	2	23	1	21	0	22
Caobas Hunter	4	28	2	34	4	26	2	32
Caobas NON-hunter	2	25	0	27	5	22	1	28
Xbonil Hunter	8	3	0	11	5	5	0	10
Xbonil NON-hunter	6	8	0	14	4	6	0	10
<b>TOTAL</b>	<b>39</b>	<b>107</b>	<b>8</b>	<b>154</b>	<b>30</b>	<b>105</b>	<b>5</b>	<b>140</b>

\*Sig.  $\leq 0.001$ \*Sig.  $\leq 0.05$ 

	White-lipped Peccary*				Collared Peccary			
	Same	Far	Close	Total	Same	Far	Close	Total
Chetumal Sport Hunters	0	5	0	5	2	13	0	15
Campeche Sport Hunters	0	1	0	1	3	8	0	11
Tres Garantias Hunters	1	0	0	1	0	0	0	0
Tres Garantias NON-hunters	0	12	2	14	1	15	1	17
Caobas Hunter	1	9	0	10	7	23	5	35
Caobas NON-hunter	0	9	0	9	3	17	0	20
Xbonil Hunter	4	2	0	6	4	3	0	7
Xbonil NON-hunter	2	2	0	4	1	6	0	7
<b>TOTAL</b>	<b>8</b>	<b>40</b>	<b>2</b>	<b>50</b>	<b>21</b>	<b>85</b>	<b>6</b>	<b>112</b>

\*Sig.  $\leq 0.05$

Table 42. Respondents' perceptions of game bird and agouti paca populations becoming more distant from the community

	Ocellated Turkey*				Curassow			
	Same	Far	Close	Total	Same	Far	Close	Total
Chetumal Sport Hunters	3	10	0	13	1	7	0	8
Campeche Sport Hunters	10	6	1	17	0	1	0	1
Tres Garantias Hunters	1	1	0	2	1	2	0	3
Tres Garantias NON-hunters	0	13	0	13	0	13	1	14
Caobas Hunter	2	8	0	10	3	18	0	21
Caobas NON-hunter	0	9	0	9	2	10	0	12
Xbonil Hunter	7	6	0	13	4	6	0	10
Xbonil NON-hunter	4	7	0	11	2	6	0	8
<b>TOTAL</b>	<b>27</b>	<b>60</b>	<b>1</b>	<b>88</b>	<b>13</b>	<b>63</b>	<b>1</b>	<b>77</b>

Results not statistically significant

\*Sig. = 0.026

	Agouti Paca*			
	Same	Far	Close	Total
Chetumal Sport Hunters	8	3	1	12
Campeche Sport Hunters	8	2	1	11
Tres Garantias Hunters	2	3	0	5
Tres Garantias NON-hunters	0	17	1	18
Caobas Hunter	4	23	6	33
Caobas NON-hunter	8	21	0	29
Xbonil Hunter	3	2	0	5
Xbonil NON-hunter	1	2	0	3
<b>TOTAL</b>	<b>34</b>	<b>73</b>	<b>9</b>	<b>116</b>

\*Sig.  $\leq 0.001$

## **Perceptions Towards Wildlife**

Sixty-one percent of all sport hunters believe that there is less wildlife than before. Ninety-nine percent of all individuals interviewed believe that wildlife should be conserved. These results were not statistically significant.

## **Sport Hunting as a Tool for Sustainable Development**

Analysis on sport hunting as a tool for sustainable development is divided into two sections. The first section evaluates economic feasibility using contingent valuation. Response agreement between sport hunters and ejido residents would indicate a high probability of economic feasibility. The second section tests group perceptions and compatibility to indicate if sport hunters and ejido residents can work together under the UMA system with minimal conflict.

### **Economic Feasibility: Contingent Valuation**

#### **Ejido responses**

This section helps determine if sport hunters and ejido residents can effectively work with each other to make the UMA system successful in the region. Hunter and non-hunter responses were combined in this section because both influence the decisions made in the ejido. Ninety-four percent of those interviewed in Tres Garantias and Caobas, and 95% of those interviewed in Xbonil would be willing to accept an entrance fee from sport hunters and use the money for wildlife management (Table 43). The minimum payment the ejidos were willing to accept from Mexican and foreign sport hunters differed significantly between groups ( $X^2 = 58.37$ ,  $p = 0.01$ ;  $X^2 = 71.27$ ,  $p = 0.01$  respectively). The most frequently mentioned price for Tres Garantias to charge Mexican sport hunters was 1500 pesos (\$156 USD) (Table 44). The most popular price cited in

Caobas was 500 pesos (\$52 USD). The two most popular prices in Xbonil were 200 pesos (\$21 USD) and 1000 pesos (\$104 USD). For foreign hunters, the most popular minimum price was 1500 pesos in Tres Garantias, 1000 pesos in Caobas, and 3000 pesos (\$313 USD) in Xbonil (Table 45).

Table 43. Ejido responses to the question relating to acceptance of a sport hunter entrance fee as wildlife management revenue

	Yes	No	N
Tres Garantias	67	4	71
Caobas	93	6	99
Xbonil	42	2	44
Total	202	12	214

Table 44. Comparison of ejido prices to charge as an entrance fee for Mexican sport hunters if revenue were to be invested in wildlife management\*

Mexican Hunters	Tres Garantias	Caobas	Xbonil	TOTAL
100	10	6	0	16
200	9	13	9	31
300	0	0	1	1
400	2	11	1	14
500	6	18	8	32
600	4	5	0	9
800	4	7	2	13
1000	10	13	9	32
1500	11	4	4	19
2000	10	2	4	16
2500	0	1	0	1
3000	1	3	2	6
4000	0	1	0	1
5000	0	0	2	2
>5000	0	1	0	1
N	67	85	42	194

\*Sig. = 0.01

Table 45. Comparison of ejido prices to charge as an entrance fee for foreign sport hunters if revenue were to be invested in wildlife management\*

Foreign Hunters	Tres Garantias	Caobas	Xbonil	TOTAL
100	3	1	0	4
200	8	5	2	15
400	3	10	4	17
500	5	6	3	14
600	4	5	0	9
800	2	8	1	11
1000	5	18	8	31
1200	3	4	1	8
1500	11	8	1	20
2000	9	12	7	28
2500	1	0	0	1
3000	10	1	10	21
3500	1	1	0	2
4000	2	2	1	5
4500	0	1	0	1
5000	0	2	3	5
10000	0	1	0	1
N	67	85	41	193

\*Sig. = 0.01

When asked if the ejido members would be willing to accept an entrance fee from sport hunters and the revenue would be used for the benefit of community through public works projects, most people in each community were willing to accept the fee (Table 46). Ejido responses on the minimum acceptable price to charge Mexican sport hunters differed significantly between groups ( $X^2=63.02$ ,  $p \leq 0.001$ ). The majority of Tres Garantias and Xbonil residents chose 1000 pesos as a minimum acceptable price from Mexican sport hunters, whereas 500 pesos was the most popular price in Caobas (Table 47). The most frequently mentioned minimum price to charge foreign sport hunters was 2000 pesos (\$208 USD) in Tres Garantias and 1000 pesos in Caobas ( $X^2=63.33$ ,  $p=$

0.01). Xbonil did not have a clear mode, but the prices chosen most often were 1000 pesos, followed by 2000 and 3000 pesos (Table 48).

Table 46. Ejido responses to the question relating to acceptance of a sport hunter entrance fee as community public works revenue

	Yes	No	N
Tres Garantias	69	2	71
Caobas	93	6	99
Xbonil	41	3	44
Total	203	11	214

Table 47. Comparison of ejido prices to charge as an entrance fee for Mexican sport hunters with revenue to be invested in community public works projects.\*

Mexican Hunters	Tres Garantias	Caobas	Xbonil	TOTAL
100	11	9	0	20
200	5	8	8	21
300	0	0	1	1
400	6	15	1	22
500	6	26	8	40
600	1	2	1	4
800	2	2	0	4
1000	18	12	13	43
1500	12	3	1	16
2000	7	4	5	16
2500	0	1	0	1
3000	1	2	2	5
4000	0	0	0	0
5000	0	1	1	2
>5000	0	0	0	0
N	69	85	41	195

\*Sig. = 0.01

Table 48. Comparison of ejido prices to charge as an entrance fee for foreign sport hunters with revenue to be invested in community public works projects.\*

Foreign Hunters	Tres Garantias	Caobas	Xbonil	TOTAL
100	4	1	0	5
200	8	7	2	17
400	3	10	3	16
500	6	8	3	17
600	3	4	0	7
800	2	4	2	8
1000	5	28	8	41
1200	3	1	0	4
1500	7	3	3	13
2000	16	9	7	32
2500	1	1	0	2
3000	9	4	7	20
3500	0	1	0	1
4000	2	1	2	5
4500	0	1	0	1
5000	0	0	3	3
10000	0	2	0	2
N	69	85	40	194

\*Sig. = 0.01

When asked if they would be willing to reduce the intensity they hunt if they were hired by sport hunters as guides, assistants, or cooks 39 hunters from Tres Garantias, 51 from Caobas and 19 from Xbonil answered affirmatively. On average, Tres Garantias was willing to reduce hunting pressure by 98%, Caobas by 88%, and Xbonil by 86%. Responses did not differ significantly among groups. Ninety percent of the hunters in Tres Garantias, 95% in Caobas, and 75% in Xbonil said they would like more sport hunters to visit their ejido if they were offered employment ( $X^2=6.37$ ,  $p=0.04$ ). Thirty-nine hunters from Tres Garantias, 59 from Caobas and 21 from Xbonil were willing to reduce their hunting pressure on a species that was noticeably in decline. On an average,

Tres Garantias and Caobas hunters were willing to reduce their hunting pressure by 68% (S.D.= 32 and 27 respectively) and Xbonil by 72% (S.D.= 21) for no compensation to avoid causing the extinction of a species. Results were not statistically significant.

### **Sport hunter responses**

Eighty-seven percent of Chetumal sport hunters and 80% of Campeche sport hunters were willing to pay an entrance fee to ejidos if the revenue would be used for wildlife management. The maximum price they are willing to pay that was most often chosen by both sport hunting groups was 200 pesos (Table 49). When asked if they were willing to pay an entrance fee to ejidos if the revenue would be used for community public works projects, 68% of Chetumal sport hunters and 60% of Campeche sport hunters agreed. The most popular maximum price sport hunters were willing to pay from Chetumal was 100 pesos, and in Campeche 500 pesos (Table 50). There was no statistically significant difference in responses between groups on entrance fee prices in either case.

Table 49. Amount sport hunters are willing to pay as an UMA entrance fee to an ejido if the money were used for wildlife management

Willing Price	Chetumal Sport Hunters	Campeche Sport Hunters	TOTAL
0	2	0	2
15	0	1	1
20	0	1	1
25	2	0	2
50	1	0	1
100	6	1	7
200	8	9	17
300	1	0	1
400	1	1	2
500	2	8	10
800	0	2	2
1000	3	1	4



Table 50. Amount sport hunters are willing to pay as an UMA entrance fee to an ejido if the money were used for community benefit

Willing Price	Chetumal Sport Hunters	Campeche Sport Hunters	TOTAL
50	2	0	2
100	6	2	8
200	5	3	8
300	0	2	2
400	2	0	2
500	3	8	11
600	0	1	1
1000	3	2	5

Sport hunters were asked if they would be willing to hire a guide or cook from the ejido where they hunt in order to determine if subsistence hunters could benefit directly from sport hunters visiting their ejido. Ten out of eighteen Chetumal sport hunters and twelve out of nineteen Campeche sport hunters were willing to hire one ejido resident per group of four if the employment would decrease ejido hunting pressure. Only six Chetumal hunters and five Campeche sport hunters were willing to hire a cook when hunting overnight.

#### **Price overlap on potential revenue for wildlife management**

The potential entrance fee that was suggested most frequently between Xbonil residents and Campeche sport hunters was 200 pesos (n= 9 for both groups), followed by 500 pesos (n= 8 for both groups) (Fig. 1). This should be interpreted with caution because only a small number of individuals from each group chose these prices. In Quintana Roo, the closest agreement of sport hunters with Tres Garantias residents was at the 200 pesos price, and with Caobas residents was at the 100 pesos value (Fig. 2). The number of responses was small in these cases and does not represent overall group

response. In general, sport hunter and ejido resident responses on prices of entrance fees used for wildlife management did not coincide (Fig. 3).

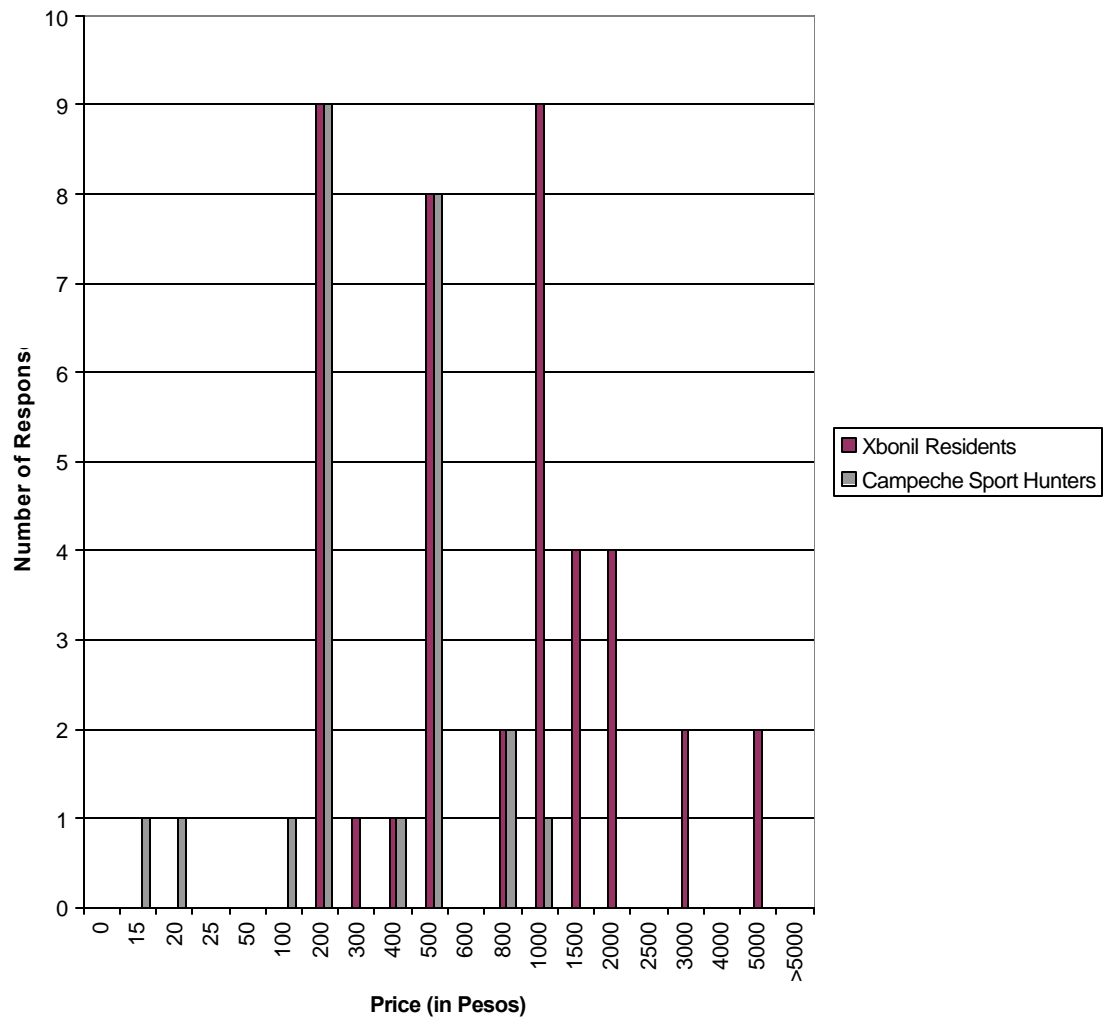


Figure 1. Compatibility of Stakeholder Responses in Campeche on Entrance Fees Used for Wildlife Management

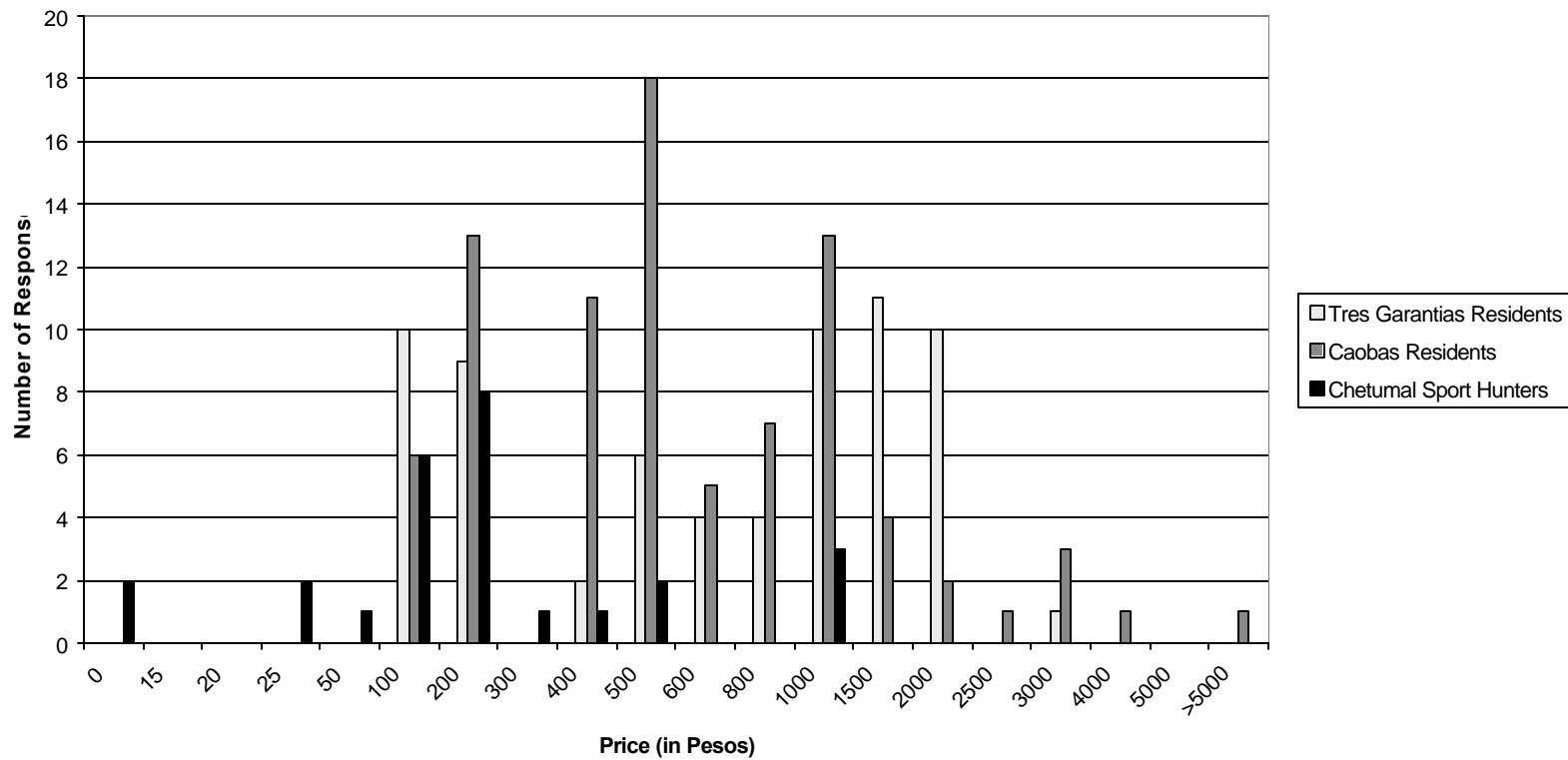


Figure 2. Compatibility of Stakeholder Responses in Quintana Roo on Entrance Fees Used for Wildlife Management

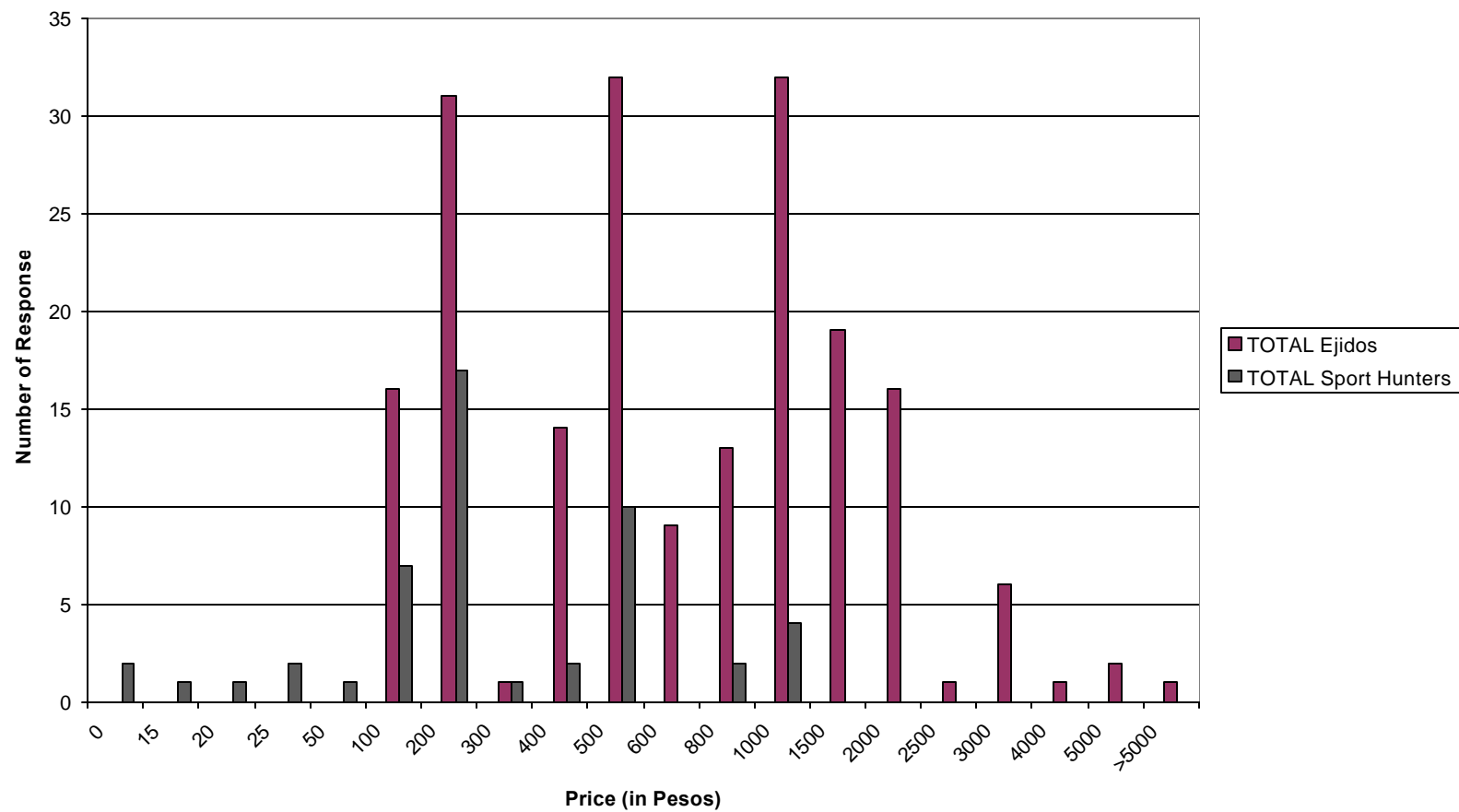


Figure 3. Compatibility of Total Sport Hunter and Ejido Responses on Entrance Fees Used for Wildlife Management

### Price overlap on potential revenue for community development

Responses from the state of Campeche on potential entrance fees coincided most at 500 pesos, but only eight people from Xbonil and Campeche chose this price (Fig. 4). In Quintana Roo, five Chetumal sport hunters and five Tres Garantias residents agreed on 200 pesos as the entrance fee (Fig. 5). Chetumal sport hunters and Caobas residents did not agree on a price in this case. Overall, sport hunters and ejido residents did not agree on an entrance fee price if the revenue generated would be directed to community development (Fig. 6).

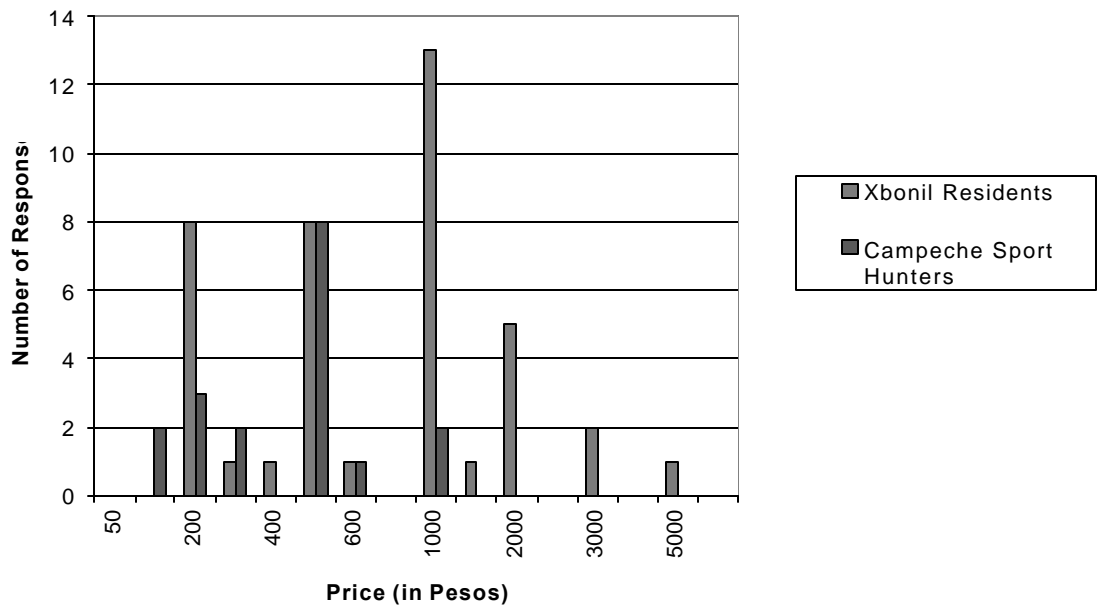


Figure 4. Compatibility of Sport hunters and Ejido Residents in Campeche on Entrance Fee Responses Used for Community Development

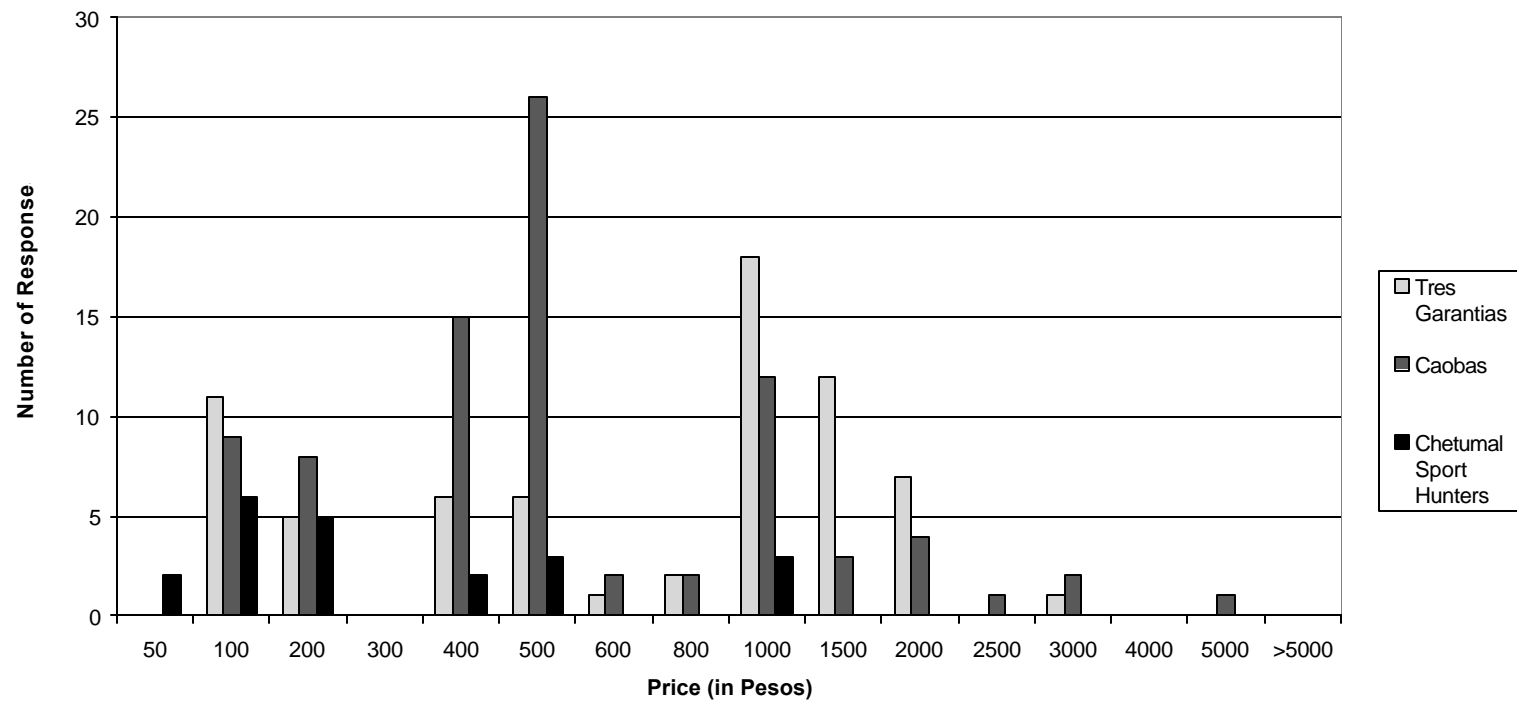


Figure 5. Compatibility of Sport Hunter and Ejido Responses in Quintana Roo on Entrance Fees Used for Community Development

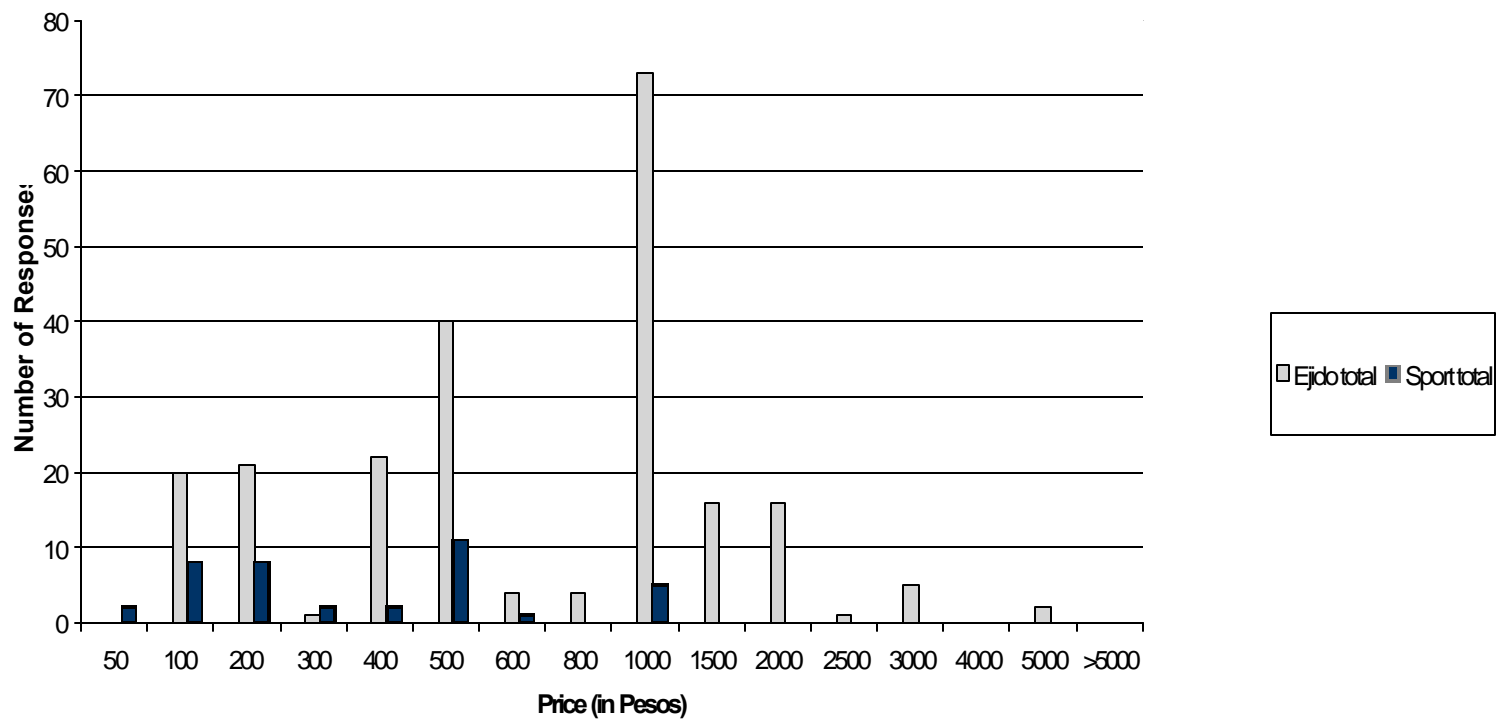


Figure 6. Compatibility of Total Sport Hunter and Ejido Responses on Entrance Fees used for Community Development

## Group Perceptions and Compatibility

### Group perceptions about other groups

This section attempts to assess the compatibility of sport hunters and subsistence hunters. Positive or neutral perceptions about other hunting groups would facilitate the groups to work together under Mexico's UMA system.

Fifty percent of all responses state that they get along well with the ejido hunters ( $X^2=6.03$ ,  $p= 0.049$ ) (Table 51). Seventy percent of sport hunters believe that subsistence hunters harvest moderately ( $X^2=8.21$ ,  $p= 0.017$ ) (Table 52). Ninety-eight percent of all sport hunters believe that sport hunting helps wildlife conservation.

Table 51. Sport hunter responses to the question: "How do you get along with ejido residents?"\*

	Very Well	Well	Average	Not Well	Very Badly	N
Chetumal Sport Hunter	17	10	2	0	0	29
Campeche Sport Hunter	8	19	2	0	0	29
Total	25	29	4	0	0	58

\*Sig.  $\leq 0.05$

Table 52. Sport hunter responses to the question: "How much hunting pressure do you think ejido hunters are responsible of?"\*

	Too Much & Threaten	Significantly but Not Threaten	Moderately	Not Much At All	N
Chetumal Sport Hunter	8	4	19	0	31
Campeche Sport Hunter	11	11	8	0	30
Total	19	15	27	0	61

\*Sig.  $\leq 0.05$



Table 53 reveals that sixty-nine percent of ejido respondents said that they get along well with Mexican sport hunters ( $X^2=36.10$ ,  $p= 0.015$ ). Table 54 shows that 72% of all ejido responses like United States sport hunters hunting in their ejidos ( $X^2=25.19$ ,  $p= 0.005$ ). The majority of every ejido grouped interviewed believed that sport hunters did not over hunt (Table 55). Sixty-one percent of subsistence hunters believe that sport hunting does not benefit them personally ( $X^2=27.40$ ,  $p \leq 0.001$ ) (Table 56). On the other hand, 77% believe that sport hunting economically benefits the ejido community ( $X^2=10.96$ ,  $p \leq 0.05$ ) (Table 57).

Table 53. Ejido responses to the question: “How do you get along with Mexican sport hunters?\*

	Very well	Well	Average	Not well	Very badly	N
Tres Garantias Hunters	1	29	6	0	1	37
Tres Garantias NON-hunters	7	16	5	1	0	29
Caobas Hunter	1	45	11	4	0	61
Caobas NON-hunter	1	22	12	3	0	38
Xbonil Hunter	2	16	4	0	0	22
Xbonil NON-hunter	0	16	4	1	0	21
TOTAL	12	144	42	9	1	208

\*Sig.  $\leq 0.05$

Table 54. Ejido responses to the question: “Do you like United States hunters hunting in your ejido?\*

	Yes	No	No Matter	N
Tres Garantias Hunters	32	2	7	41
Tres Garantias NON-hunters	25	2	5	32
Caobas Hunter	52	3	7	62
Caobas NON-hunter	19	9	12	40
Xbonil Hunter	14	1	7	22
Xbonil NON-hunter	16	4	2	22
TOTAL	158	21	40	219

\*Sig.  $\leq 0.01$

Table 55. Ejido responses to the question: “Do you think sport hunters over hunt?”

	No	Yes	N
Tres Garantias Hunters	7	4	11
Tres Garantias NON-hunters	21	11	32
Caobas Hunter	48	13	61
Caobas NON-hunter	21	19	40
Xbonil Hunter	12	10	22
Xbonil NON-hunter	12	10	22
TOTAL	121	67	188

Table 56. Ejido responses to the question: Does sport hunting benefit you personally?\*\*\*

	No	Yes	N
Tres Garantias Hunters	24	17	41
Tres Garantias NON-hunters	28	4	32
Caobas Hunter	37	24	61
Caobas NON-hunter	29	11	40
Xbonil Hunter	7	15	22
Xbonil NON-hunter	7	15	22
TOTAL	132	86	218

\*Sig.  $\leq 0.001$ 

Table 57. Ejido responses to the question: “Do you think sport hunting benefits your community?”\*

	No	Yes	N
Tres Garantias Hunters	14	25	39
Tres Garantias NON-hunters	10	21	31
Caobas Hunter	12	47	59
Caobas NON-hunter	8	31	39
Xbonil Hunter	3	19	22
Xbonil NON-hunter	1	21	22
TOTAL	48	164	212

\*Sig.  $\leq 0.05$

## **Document Review**

### **Population Density**

The Sociedad de Productores Forestales Ejidales' 1999 report described the method used for collecting census data in Tres Garantias and Caobas. Three transects of 3 km each were used in each ejido. Transects were monitored twice a month, once in the morning and once in the evening. Animals were counted using the line-transect and fixed width transect method. It was not clear how the population density was estimated for each UMA. A technician or trained ejido member conducted the censuses. In 1999, species were counted in Caobas from April through October, and in Tres Garantias in September, October, and December.

In Tres Garantias, populations of collared peccary, white-lipped peccary, ocellated turkey and curassow appear to have increased since 1993 (Table 58). White-tailed deer, brocket deer, and agouti paca were declining. The 1999 ocellated turkey population estimate is very unusual and should be interpreted cautiously.

Table 58. Game Population Size in the 20,000 ha or 200 km<sup>2</sup> of the UMA in Tres Garantias<sup>1</sup>. Ranges are shown below the averages.

Species	1993	1994	1995	1996	1997	1998 <sup>2</sup>	1999 <sup>3</sup>
White-tailed Deer	2810 3120-2500	2346 2278-2414	1891 1786-1996	1661 1500-1822	871 678-1064	2007 1830-2185	--
Brocket Deer	1181 984-1378	764 580-940	1120 990-1250	1172 1000-1344	--	1067 815-1317	1065
Collared Peccary	1439 1182-1696	1090 908-1272	2430 2208-1326	1601 1392-1810	672 416-928	1473 1220-1726	--
White-lipped Peccary	499 474-524	709 684-734	1206 1152-1260	562 552-572	--	598 566-629	--
Agouti Paca	1181 872-1490	517 328-706	705 552-858	904 714-1094	332 260-404	967 626-1308	473
Ocellated Turkey	52 22-82	350 284-416	320 292-348	652 626-678	--	166 64-269	1657
Curassow	784 736-834	917 730-1104	1362 1348-1376	1456 1358-1554	1225 834-1616	1061 940-1182	1065

<sup>1</sup>Population size was calculated by taking the average density (indiv/ km<sup>2</sup>) and multiplying it by 200 km<sup>2</sup>. Average density was derived from averaging the values from the line transect and fixed width transect methods reported in Avila 1998a.

<sup>2</sup>Source: Avila 1998b

<sup>3</sup>Source: Unpublished 1999 report by Sociedad de Productores Forestales Ejidales de Quintana Roo, A.C. Ranges were not provided in this report.

Estimated 1999 population densities in the UMA of Caobas were: 2,381 brocket deer; 1,042 ocellated turkeys; 1,161 curassow and 2,113 agouti pacas. Observations were not reported on white-tailed deer, or the two peccary species in either ejido.

In 1999, Reyna et al. calculated population densities in Xbonil and extrapolated population sizes for the 20,000 ha UMA. Reyna et al (1999) estimated 800-10,000 ocellated turkeys, 193 white-tailed deer, 313 brocket deer, 188-282 collared peccaries, and 500-2,500 white-lipped peccaries. The estimated number of groups was first presented for the peccary species, due to the difficulty of estimating the number of individuals. Collared peccary group size varies from 2 to 20 individuals, whereas white-lipped peccary groups range from 20 to over 100 individuals (Reyna et al. 1999). Curassows were not spotted and no information was reported on agouti paca. Based on the maximum sustainable yield model (MSY), Reyna et al. (1999) recommended that only 22 ocellated turkeys, 8 brocket deer, 5 white-tailed deer, and 5 collared peccary be permitted for hunting during 1999. They recommended that white-lipped peccary be protected from being harvested that year.

## Hunting Pressure

Table 59. Annual hunting pressure in Tres Garantias

<b>Species</b>	<b>1993</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>
White-tailed Deer	58	48	62	50	59
Brocket Deer	15	10	1	4	21
Collared Peccary	81	48	84	50	30
White-lipped Peccary	16	24	18	19	29
Agouti Paca	40	30	47	45	56
Ocellated Turkey	4	0	0	0	0
Curassow	17	29	24	41	26

Source: Avila, 1998b

Table 60. Total number of animals hunted, eaten, and sold in Caobas in 1997

<b>Species</b>	<b>Total Hunted</b>	<b>Number Eaten</b>	<b>Number Sold</b>
White-tailed Deer	54	1	53
Brocket Deer	58	5	53
Collared Peccary	61	7	54
White-lipped Peccary	20	0	20
Agouti Paca	39	18	21
Ocellated Turkey	2	0	2
Curassow	33	6	21

Source: Avila, 1998b

Table 61. Highest hunting pressure in 1995, 1996, and 1997 by month in Caobas

<b>Species</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>
White-tailed Deer	Aug	Jan, Apr, Jul	Jun & Jul
Brocket Deer	Apr	Mar	May
Collared Peccary	Aug-Sep & Nov-Dec	Jan & Sep	Apr & Sep
White-lipped Peccary	Feb & Nov	Nov	Feb & Apr
Agouti Paca	May-Jun	Mar & Oct	May- Jun
Ocellated Turkey	---	---	---
Curassow	Mar & Nov-Dec	Jan	Jan & May

Source: Avila, 1998b

Unfortunately, the number of hunters harvesting the game was not provided in this reported.

### **Authorized Harvest**

Table 62. Authorized harvest in Tres Garantias in 2000

<b>Species</b>	<b>Subsistence</b>	<b>Sport</b>	<b>Commercial</b>	<b>Total</b>
White-tailed Deer	25	0	25	50
Brocket Deer	8	113	7	128
Collared Peccary	12	0	13	25
White-lipped Peccary	20	10	18	48
Agouti Paca	20	0	13	33
Ocellated Turkey	0	166	0	166
Curassow	0	0	0	0

Report issued by SEMARNAP on March 6, 2000.

Table 63. Authorized harvest in Caobas in 1999

Species	Subsistence	Sport	Commercial	Total
White-tailed Deer	3	1	1	5
Brocket Deer	25	12	13	50
Collared Peccary	2	3	3	8
White-lipped Peccary	0	0	0	0
Agouti Paca	0	20	50	70
Ocellated Turkey	0	2	0	2
Curassow	0	3	6	9

Report issued by SEMARNAP on October 26, 1999.

In 2000, SEMARNAP authorized a total of 233 brocket deer, 104 ocellated turkeys, and 116 curassows to be harvested in Caobas. Amounts for specific uses were not indicated.

SEMARNAP authorized the following quantities of game for harvest in the UMA of Xbonil. Quantities were not divided for specified uses.

Table 64. Authorized harvest in Xbonil in 1999 and 2000

Species	1999	2000
White-tailed Deer	0	0
Brocket Deer	3	14
Collared Peccary	0	0
White-lipped Peccary	2	10
Agouti Paca	0	0
Ocellated Turkey	0	35
Curassow	0	15

Source: Reyna et al. 1999



## CHAPTER 4 DISCUSSION

Mexico's new wildlife management program legalizes multiple sustainable uses of wildlife while providing economic opportunities for the local inhabitants. The SUMA program is structured to facilitate community-based co-management of wildlife on ejido lands.

This study evaluates the current success and future potential for sport hunting UMAs on ejido lands in the southern states of Quintana Roo and Campeche. Stakeholder dynamics, current use practices, and trends in focal game populations provided a basis for analysis of the current success and future potential for the main wildlife user groups to collaborate in this program. Examining the economic feasibility of sport hunting in UMAs and the willingness of the stakeholders to support the activity, were key factors for determining the success of this wildlife management strategy in the south of the country.

### **Demographics**

The majority of residents of the study sites were immigrants from southern Mexico. Veracruz, Campeche and Yucatan were most frequently reported as states of origin. Since the average length of residency was over 20 years for all groups, all individuals have invested many years in the area where they live, contributing to their influence on their communities.

Decision makers in the ejidos had a strong representation in the study. More hunters were ejidatarios than non-hunters, except in Xbonil where there were equal numbers of ejidatarios and pobladores.

On average, the main wildlife users in the study were middle-aged individuals. Yet, in all the groups younger hunters tended to hunt more animals more often than older individuals.

Educational level and annual income were considerably higher among sport hunters than among ejido residents. Hence, decision makers wanting to diffuse information and gain collaboration of wildlife user groups in this region of the country should reach out to the younger generation and be sensitive to the large disparity in educational level and annual income between sport and subsistence hunters.

### **Sport Hunting as a Tool for Wildlife Conservation**

#### **Stakeholder Analysis**

Analysis of stakeholder dynamics accomplished four tasks. First, it identified common beliefs about the importance of hunting and wildlife among the sport hunters and ejido residents. Second, perceptions of resource ownership added to the understanding of current incentives for conservation. Third, it evaluated SEMARNAP's ability to disseminate information about the government's new wildlife management strategy to the principle users. Fourth, the analysis determined the effectiveness of government and local enforcement of hunting restrictions.

Overall, tradition and motivation were the only statistically significant bases for determining the importance of hunting among groups. Hunting has stronger ties for hunters than non-hunters, but tradition was rooted fairly equally between sport and

subsistence hunters. Hence, sport and subsistence hunters hold a common value of tradition, although motivation to hunt differed between the two groups. There is evidence that subsistence hunters harvested more out of need than sport hunters, and thus may have less flexibility for compromise under a management strategy. The value sport hunters have for hunting is equally important, but is less necessary for their well being. Sport hunters, therefore, have more room for negotiation in a community-based wildlife co-management plan.

Analyzing game importance identifies competition among groups for the same resource and common ground among users. This study measured game importance on the basis of use and preference. Use was defined by reasons for reliance, degree of hunting pressure, amount of revenue gained from commerce, and consumption frequency.

As revealed in previous studies in Mexico, such as Leopold (1959), Escamilla et al. (2000), Jorgenson (1993), Quijano (1999), and Reyna et al. (1999), most individuals in this study relied on wild game principally for food. Commerce and recreation were also important uses for subsistence and sport hunters respectively. Of the ejido groups, Caobas hunters had the highest response to the “food and sell” category. All the non-hunters living in the ejidos only ate the game species except for one respondent from Xbonil who also sold collared peccary meat. Of the subsistence hunters, only two individuals used the collared peccary and ocellated turkey solely for trophy. White-tailed deer, followed by brocket deer and ocellated turkey were the most popular trophy species among the sport hunters.

Identifying the groups that place the highest hunting pressure on specific species can help direct conservation and management efforts. Since over-zealous hunters carry a negative stigma, hunting pressure data in this study was conservatively estimated. Indeed, some hunters were found to report less game than they actually captured. The group placing the greatest pressure on the collared peccary and agouti paca for three consecutive years was Caobas, on the turkey was Campeche, and on the curassow was Tres Garantias. Campeche exerted the highest pressure on the white-tailed and brocket deer during 2000 and 1998. Caobas placed the highest pressure on both deer species in 1999. Results based on the 1998 data should be cautiously interpreted because the numbers of hunter responses were very low and may not represent the entire group. Based on hunting pressure, Chetumal sport hunters, Tres Garantias and Caobas hunters all strongly value the agouti paca. White-tailed deer is highly valued by hunters in the state of Campeche and by sport hunters in Chetumal.

Data for hunting pressure differed from that recorded by Avila in his 1998 study. For Tres Garantias, white-tailed deer, collared peccary, white-lipped peccary, and agouti paca hunted in 1998 were fewer than those reported by Avila. Hunting pressure data for Caobas for 1998 was higher than Avila's 1997 estimates for all species but the curassow. Tres Garantias and Caobas hunting pressure data for 1999 for all species was considerably higher than in previous years reported in Avila's study. The number of interviews conducted in Tres Garantias and Caobas in this study was approximately twice the number of interviews in Avila's study (Avila, pers. com.). This may be a significant factor for the discrepancy. In addition, Avila was known to work with a local

organization involved with the ejidos. Non-affiliation with any local private, civil, or government organization may also have influenced responses in this study.

Hunting pressure data in this study is also considerably higher than what Jorgenson found during his 1993 study in the Mayan ejido of X-Hazel in Quintana Roo. Over 17 months of interviews with 86 hunters, he recorded a total of 385 hunted mammals. Study design and the approach to data collection may explain this difference. For example, Jorgenson offered economic incentives to gain local participation in his inventory, which may have biased his results (Escamilla et al., 2000).

Revenue from game meat was reported only by a small percentage of the subsistence hunter respondents. Since commerce of wildlife and its products are seen as illegal, fear may have biased the responses. From personal observation and conversations with key informants, it is apparent that data for this study under-estimates the small-scale clandestine commerce of these game meats. Caobas made the most money from meat sales. Total average revenue indicates that white-tailed deer is most important economically for Caobas and Xbonil, whereas white-lipped peccary was the principal revenue earner for Tres Garantias. Since the results based on commerce were not significant and do not adequately represent the ejido groups, there is not clear evidence that one group depends more on a particular species than another.

Respondents in Quintana Roo and Campeche do not rely solely on game meat as a protein source. Chicken and other domestic meats are the most important protein source for all groups studied. Wild meat complements the diet and is generally eaten less frequently. White-tailed deer is the most frequently consumed game for all groups except for Tres Garantias hunters who consumed more brocket deer and Caobas hunters who ate

more collard peccary. Even though a resource is not consumed in high quantities, it may still be very important to a group. The resource may either be in short supply or not easily accessible. Hence, chicken is the most important protein source in the daily diet for all groups because it is accessible and affordable. Wild meat is generally consumed in the least amount not necessarily because it is the least valued, but due to its high cost in terms of effort and money.

Preference for a particular game species did not significantly differ among groups. White-tailed deer was the most preferred species by all groups except for Campeche sport hunters who strongly favored the ocellated turkey.

In sum, white-tailed deer, followed by agouti paca and brocket deer are among the most important species to the wildlife users in this study and can serve as a basis for common ground. Finding common ground can help identify incentives for various stakeholder groups to work together to sustainably manage wildlife populations.

Perception of resource ownership is one of the most important factors influencing an individual's motivation to conserve (Hardin 1968; and Freese, 1998). The SUMA program changed wildlife from an open access resource to a limited access resource. The UMA owners and managers theoretically control wildlife access of others outside the UMA. It appears that this policy change has not yet influenced the perceptions of wildlife ownership of many people. This study revealed that most sport hunters in southern Mexico believe that wildlife belongs to everyone. As a result, they may have little incentive to conserve. In addition, wildlife access is not limited within the ejido in the UMA system. Many subsistence hunters felt that if they do not hunt game, their neighbors would, which leads to Hardin's (1968) tragedy of the commons within the

ejido. Nevertheless, a majority of ejido residents believed that wildlife belongs to them when on their parcel of land. This perception may offer an incentive to conserve because ejido residents maybe inclined to defend a valued game species from being taken from their parcel of land. However, economic and social limitations complicate wildlife enforcement.

The distribution of information on wildlife policies has not improved in over fifty years. Leopold (1959) found that subsistence hunters were ignorant of hunting restrictions in the late 1950's. Results of this study reveal that relevant information about the new wildlife program has not been effectively distributed to the rural sector. Sport hunters were fairly well informed about bag limits for game because hunting calendars containing bag limit information are issued to each sport hunter who buys a license. Since hunting calendars or other information sources are not distributed in ejidos, the respondents were not aware of hunting limits. The fact that sport hunters were much more knowledgeable about UMAs and the laws concerning wildlife emphasizes the need for more communication by policy makers with ejido residents. Overall, most urban and rural individuals were not aware that subsistence hunting and commercialization were permitted (under a management plan). Support for the SUMA program and sustainable use of wildlife cannot be achieved if principal stakeholder groups are not informed.

The majority of respondents felt that government enforcement of hunting restrictions was average or not adequate. Sport hunters and ejido residents gave various reasons for their low opinion of government enforcement. Many said that enforcement was inadequate because the law enforcement body did not have sufficient resources. These results concur with Leopold's findings in 1950s that "[locals] showed little regard

for law enforcement because it was virtually nonexistent” (p. 66). The local enforcement body in Chetumal, PROFEPA, confirmed that insufficient resources were available. For example, only two agents are in charge of enforcing hunting restrictions for the entire state of Quintana Roo. As a result, monitoring in each ejido is infrequent and not thorough. PROFEPA does receive support from the military when travelers pass through military checkpoints. However, the military are not properly trained to carry out enforcement measures. Higher turnover rate of soldiers at a particular post and bribery are well known obstacles. Poor enforcement was also attributed by respondents to corruption and to a lack of concern for wildlife.

Xbonil residents believed that enforcement was adequate. Their responses may have been influenced by recent acts of enforcement in their region.

Ejido residents explained their reasons behind their low opinion of local enforcement by ejidatarios. Residents were fearful of reporting an armed neighbor for poaching. As the enforcement leader in the ejido, the *comisariado* explained that a poacher receives two warnings before the general assembly decides whether to handle the incident internally or to turn it over to the state authorities. This time lag allows for conflict between those that attempt to protect the resource and the armed poachers.

### **Current Hunting Practices**

Along with stakeholder analysis, the understanding of current use practices is important for maintaining game populations at a viable level for the long-term success of the UMA program. Understanding hunting practices that do not discriminate species sex or age class helps decision makers improve their management strategies. In many cases, male game-direct hunts do not threaten the viability of the species population (Bodmer et al. 1997).



This study showed that hunters tended to select male game of species that exhibit sexual dimorphism such as the white-tailed deer and brocket deer. Further, sport hunters distinguished male species more often than subsistence hunters. The trophy value of male deer and ocellated turkey may influence sport hunter's preferences. Sex selection rarely occurred for the peccary species, agouti paca, and curassow due to the difficulty of telling apart males from females. Interestingly, not one sport hunter distinguished the sex of white-lipped peccary or agouti paca. Hence, sport hunter education programs focused on identifying species' sex class are an option to address this deficiency in urban areas. Extension workers and technicians advising the ejido communities in developing their UMA management plan should explain the importance of conserving female game species to ensure that the populations exist in the future.

Timing of hunts not only impacts the viability of the game populations, but also competition among hunting groups. Hunting year-round potentially disrupts reproduction and periods of rearing young. Different hunting groups harvesting the same species in the same area during the same months of the year compete with each other for the resource. More people reported hunting year-round as opposed to hunting during a particular month or season, although the number of responses from each group was fairly low and may not be representative of group tendencies.

Hunting areas frequented by sport hunters and subsistence hunters did not appear to overlap significantly. Hunted game populations may, however, come from the same source areas. Competition between two or more groups may still occur since wildlife is mobile and all groups tend to use the same species, and the use overlaps during months of

harvest. Additional enforcement and economic incentives during species' reproductive periods are options in addressing the problem of consistent hunting pressure.

Comparing authorized species' bag limits with hunting pressure data is strong evidence to determine population threats from over-hunting. SEMARNAP assigns bag limits following Robinson and Redford's model (1991) of 20% of the maximum population production as a general rule. Considering the bag limits authorized by SEMARNAP for Caobas in 1999, all species were severely over-hunted. Only three species were authorized for use in Caobas in 2000, and all species in this study except brocket deer and ocellated turkey had been over hunted in the span of 7 months.

Comparing SEMARNAP's approval limits and actual hunting pressure for Tres Garantias, the agouti paca and curassow were severely over-hunted in the span of 7 months during the year 2000.

Tres Garantias and Caobas residents were discouraged from hunting ocellated turkeys because of the potential of the bird to attract foreign tourist revenue. A later section discusses the U.S. sport hunting events focused on the ocellated turkey in the two ejidos.

Population data that dictates bag limits set by SEMARNAP should be interpreted cautiously. Conversations with wildlife technicians about the process of collecting wildlife census data in Quintana Roo, suggested an over-estimation of population sizes. As a result, some bag limits may be set too high and raise false expectations for the wildlife users, particularly sport hunters. Setting a standard, species-specific method for wildlife population census by *certified* technicians could help resolve this problem.

### **Population Dynamics**

According to Avila (1998), white-tailed deer and agouti paca populations declined from 1993 to 1998. White-lipped peccary, ocellated turkey and curassow populations increased slightly; and the brocket deer and collared peccary populations were fairly steady. These density estimates should be treated with considerable caution and are meant to give only a general idea of the game population tendencies.

In this study, there was general agreement among all users that wildlife populations are not only in decline but are becoming more distant. Over half of all respondents perceive that the game populations in this study are in decline. The most common reason offered was “over hunting.” Almost everyone agreed that wildlife should be conserved.

### **Sport Hunting as a Tool for Sustainable Development**

Since conservation often involves making compromises, many experts advocate that local resource needs must be addressed for conservation efforts to be successful (Bodmer et al. 1997; Robinson, 1993; and Freese, 1998). The SUMA strategy provides a structure allowing local communities to benefit economically from domestic business, but this has not yet been accomplished in Quintana Roo and Campeche. This study attempts to identify sources of agreement between Mexican sport hunters and ejido residents concerning the economic benefits of sport hunting to foster partnerships for the success of the UMA program. Following the CAMPFIRE models in Africa (Metcalf, 1994), entrance fees and direct economic benefits were explored as possible economic options.

The three ejidos were equally inclined to charge an entrance fee and use the revenue for wildlife management or community projects. Ejido residents tended to charge foreign sport hunters a higher price in both scenarios. For all scenarios, more people in Tres Garantias wanted to charge a higher price than those in Caobas. There was not a noticeable difference in ejidos charging a higher fee for wildlife management than for community development. Most respondents were uncomfortable with answering questions in this section because they had no experience or knowledge of financial matters of this magnitude. Most respondents offered guesses instead of stating a price with conviction.

Support for sport hunting and willingness to pay an entrance fee that would generate profits for the community is an essential component for the success of the sport hunting UMAs. More sport hunters were willing to pay an entrance fee if the money was used for wildlife management. Various sport hunters commented that municipals should hold responsibility for the community projects. More sport hunters from Chetumal were willing to pay a fee than those from Campeche. Informal conversations with Campeche club members suggested that a majority of the sport hunters were opposed to the UMA program. They had little faith that the revenue would be spent on intended purposes due to ignorance and corruption. Interestingly, although more Campeche sport hunters were opposed to paying an entrance fee, they were willing to spend more on the fee than sport hunters from Chetumal. In Campeche, the largest consensus on entrance fee price was at 200 pesos, followed by 500 pesos, if the revenue was directed to wildlife management. There was not a strong consensus in Quintana Roo. Apparently, Mexican sport hunters in Campeche and Chetumal have little faith in the UMA program. Sport hunters had little

confidence in entrance fees benefiting wildlife management and the sport hunting experience. If assured that the UMAs achieved their intended goals, sport hunters would be willing to support the program. Few sport hunters, however, were willing to pay a price that the ejidos would agree to. One reason often stated was that some sport hunters are against paying for a resource that belongs to everyone.

A high percentage of subsistence hunters were willing to reduce their hunting pressure by a significant percentage if offered a direct economic benefit for assisting the sport hunters on their hunts. Less than half the sport hunters, on the other hand, were willing to employ local guides, and much fewer were willing to hire a cook. A high percentage of subsistence hunters stated that they would be willing to reduce their hunting pressure on a noticeably declining resource even without gaining economic benefits. The fact that most subsistence hunters perceived a decline in game populations but continued to over-hunt, suggests that local needs must be met first before resources can be conserved. Subsistence hunters who were contracted as sport hunting guides for the U.S. sport hunting events were previously full-time hunters. All the guides interviewed said that they had reduced their hunting pressure (some as much as 100%) because of the economic benefits gained from working on sport hunting events. They expressed an interest in conserving wildlife so that sport hunters would continue doing business with them.

Besides agreeing on the proper price for an entrance fee, the community must ensure that this price covers the costs of maintaining the UMA. The two main UMA costs include building lodge facilities for the sport hunters, and hiring a wildlife technician. Caobas, for example, invested approximately \$2,700 USD for the

construction of the cabañas for sport hunters. The technician conducts the biological assessment and helps with the annual management plan. The cost of hiring a technician is approximately \$650 USD per year (Guerrero, pers. com.). To cover the costs of hiring a technician on an annual basis in Caobas, 31 sport hunters would have to visit at least once a year if the entrance fee was set at 200 pesos (about \$21.00 USD).

SEMARNAP's wildlife office in Campeche helped subsidize start-up costs for UMAs in the state. In 2000, SEMARNAP provided a total subsidy of \$70,212 USD for UMA programs in Campeche, of which \$6,230 were allotted to Xbonil (Guerrero, 2000c). Campeche was the only state in the south that offered such subsidies (Guerrero, pers. com.).

Stakeholder compatibility is important in fostering partnerships for achieving common goals. In this study, both sport and subsistence hunters held positive opinions about each other. Further, a majority of subsistence hunters would like U.S. sport hunting business. This indicates a potential for the main user groups to work together.

Identifying perceptions of sport and subsistence hunters have about each other's hunting intensities could help foster understanding and incentives for the groups to work together. Most sport hunters believed that sport hunting could help conserve wildlife. Over half of the sport hunters interviewed believe that subsistence hunters place a great deal of pressure on the wildlife, although a high proportion also thought that they only hunted moderately. Having Mexican sport hunters realize that they can offer economic benefits to subsistence hunters that would effectively reduce ejido hunting pressure may motivate sport hunters to support the UMA strategy. The majority of subsistence hunters, on the other hand, did not believe that sport hunters over-hunted. The majority of

subsistence hunters perceived no personal benefit from sport hunting, although they did feel that it benefits their community. Hence, few ejido residents are concerned about sport hunters depleting wildlife, and are open to having sport hunting in their UMAs.

### **U.S. Sport Hunting**

The sport hunting UMAs in this study have had limited experience with economic benefits from foreign sport hunters. Although sport hunting is lucrative, a market for it has not been maintained. The ejidos in this study realized the profitable potential of hosting U.S. sport hunters, but faced challenges maintaining the market. On several occasions, Tres Garantias and Caobas hosted U.S. sport hunters who were interested in hunting the ocellated turkey. In 1997, three hunters visited Tres Garantias with the possibility of expanding tourism operations in the future (Williams, pers. com.). Both ejidos hosted two sport hunting events in 1999, and one in 2000. A technician from the civil organization, *Sociedad de Productores Forestales Ejidales*, coordinated the hunts with the ejidos. Four hunters visited at a time. Each hunter was limited to hunting one ocellated turkey. In 1999, each sport hunter paid \$1000 for the sport hunting package plus \$250 if one ocellated turkey was bagged. The cost included lodging, transportation and food. In 2000, each U.S. sport hunter paid \$750 for the package plus \$500 for bagging an ocellated turkey (Quinto, pers. com.). Each sport hunter hired a guide from the local community. Two local cooks were also hired for the 4-day hunt. However, due to conflicts between the U.S. sport hunting outfitter and the technician from the civil organization, and due to the scarcity of species and unsuccessful hunts, U.S. sport hunters were not willing to hunt in Tres Garantias and Caobas in the future. The civil organization and the ejido members involved in the UMA do not have the contacts,

knowledge, or the resources to attract other sport hunters from the U.S. This incident created concern for the future viability of the UMA.

From a local perspective, the ejido residents did not see the money gained from the hunting operations. The technician reported that the net revenue was reinvested in the UMA project to maintain hunting paths and the wildlife museum in Tres Garantias. Ejido residents complained about not being informed about the foreign sport hunting operation. As a result, locals were not enthusiastic about the idea of hosting sport hunting activities in their ejido. This echoes the findings of Metcalfe (1994), and Gibson and Marks (1995) concerning the decision-making process and its impacts on local support for the sport hunting program in Zimbabwe and Zambia. It is essential to keep community members informed and allow them to participate in the wildlife management plan so that they may aid in its success.

The civil organization has coordinated all the sport hunting events for the UMAs in Caobas and Tres Garantias. Mexican sport hunters in Chetumal were asked by the civil organization to buy a set package in order to hunt in the UMAs. Although the package was half the cost charged to foreigners, the price was much higher than what they were willing to pay, and the package offered did not meet their interest. In addition, the set package did not allow the freedom of hunting without an overnight stay. Many Mexican sport hunters interviewed preferred setting their own schedules. Hence the UMAs of Tres Garantias and Caobas have not had “official” visits from sport hunters of Quintana Roo.

Xbonil also experienced a challenge in maintaining foreign sport hunting activities. A doctor from the city partnered with one ejido member from the community



to coordinate the foreign sport hunting events. The U.S. sport hunts in 1999 were not successful. Further, the community learned that the operation was being mismanaged and refused to allow the partners from participating in the UMA in the future. On the other hand, the revenue gained from the sport hunts was divided among all the ejidatarios. Since each member experienced the economic benefits of sport hunting in the ejido, the sport hunting UMA project had more support than in the ejidos of Quintana Roo.

### **Conclusions**

Overall, the sport hunting UMAs in Quintana Roo and Campeche have not been successful so far, but may exhibit potential for the future. The UMA system is structured so that communities can participate and benefit from the sustainable use of wildlife. To date, this is underdeveloped and calls for improvement. Obstacles for success in the regions follow:

1. Stakeholders are not well informed about the wildlife law, hunting restrictions, and the UMA program.
2. Lack of incentives to conserve based on perceptions of resource access.
3. Mexican sport hunters have not supported the UMA program to date.
4. A foreign sport hunting market has not been developed.
5. Only a few subsistence hunters have gained economically from sport hunting events.
6. Poor hunting enforcement exists on bag limits and hunting seasons.
7. UMAs are costly to maintain for ejido communities.
8. Game species are overexploited and are in decline.
9. The risk of reporting overestimated game populations leads to false expectations and decrease in business.

There is, however, great potential for success due to the following reasons:

1. Users are aware that game populations are declining and believe that wildlife should be conserved.
2. Users share common ground on the value of hunting and of important game species.
3. Negative perceptions between sport hunters and ejido residents do not predominate.
4. Most ejido residents believe that sport hunting can generate revenue to benefit their community.
5. Sport hunters would be willing to pay an entrance fee, particularly to support wildlife management, if assured that the revenue would be spent on intended purposes.

### **Recommendations**

Recommendations for improvement are modeled on the communal forestry project, *Plan Piloto Forestal*, based in Chetumal, Quintana Roo. Tres Garantias and Caobas have participated in this community-based program and have sustainably managed their forests since 1985 (Técnicos Solis and Chai, pers. com.). Interviews with local residents of Tres Garantias and Caobas, suggest that the communities highly value their forests and want to conserve them. Their motivation stems from being fully involved in the management process and gaining revenue from business with local buyers. Within each ejido, the *ejidatarios* are divided into smaller working groups that are involved in selecting, harvesting, processing and selling the timber. This lucrative operation grossed approximately \$120,000 USD in Caobas and \$309,900 USD in Tres Garantias for the year 2000. The net revenue is a principal component of annual income for the ejidatarios (ejido presidents, pers. com.).

The social organization of the UMA would be similar to that of the ejido. The UMA would have officers to oversee all of its operations, including an UMA president, vice president, secretary, and treasurer. The president would be responsible for organizing meetings to inform ejido residents periodically about current events and issues of the UMA. This individual would also work closely with the technician on developing a management plan that incorporates feedback from the meetings with the ejido residents. The vice president, like the *comisariado*, would be in charge of monitoring and enforcing the UMA management plan. The secretary would keep the hunting registers and work with the technician on the UMA annual reports for SEMARNAP. The treasurer could collect entrance fees from the sport hunters and spend the revenue on priorities established by the ejido. This could generate jobs and revenue for the communities. As in the *Plan Piloto Forestal*, ejido residents can divide management responsibilities between small working groups. The small working groups could 1) maintain hunting trails, 2) maintain lodging facilities, 3) monitor and protect game populations from poaching, and 4) monitor wildlife population dynamics using various techniques. To provide more accurate information, a certified census technique could be used in combination with surveys on perceived changes in game population size and distance from the community, hunting time, and distance traveled on hunts. As the communal forestry case exemplifies, this proposal can foster a stronger sense of ownership and value of the wildlife resource. SEMARNAP and local NGOs could take on key roles in the process by promoting the UMAs to national and international sport hunting enthusiasts. This recommendation is based on a community-based co-management

approach. It addresses the deficiencies and potential of current sport hunting UMA operations in Quintana Roo and Campeche.

Freese (1998) argues that economic incentives can only be used as an effective conservation tool if resource ownership is clearly defined and enforced. Enabling ejido residents to participate in the management of sport hunting entrance fees can lead to more perceived control over resource access. In turn, this could strengthen the perception of ownership and give ejido communities more incentive to conserve. Conversely, sport hunters may obtain a better hunting experience of well-managed game populations and services the ejido would be willing to provide.

In conclusion, the strengths and weaknesses of Mexico's wildlife management program add to the understanding of community-based wildlife co-management and conservation in the neotropics. Unlike the programs in Africa that focus on sport hunting, Mexico's UMAs address social needs and values of hunting and wildlife by incorporating subsistence and commercial uses. The program is meant to add a revenue stream that should compliment other economic activities in the ejidos. The cases of CAMPFIRE, AMADE, Tres Garantias and Caobas emphasize the importance of including locals in the wildlife management process to achieve conservation objectives. Wildlife conservation has the greatest chance for success when there is an incentive to conserve, when individual needs are met, when stakeholders are involved in the management process, and when use is sustainable (Robinson, 1993; Bodmer et al., 1997). Mexico's wildlife management experiences offer lessons learned on wildlife conservation, management and economic development of the rural sector that can be applied in other tropical countries.

APPENDIX A  
ANNUAL HUNTING PRESSURE AND CONSUMPTION FREQUENCY

Table A-1. Hunting Pressure by Groups in 2000<sup>1</sup>

	N	Total	Avg.	S.D.	Mean Rank
<b>White-Tailed Deer</b>					
Chetumal Sport Hunter	29	57	1.97	2.54	85.84
Campeche Sport Hunter	22	97	4.41	11.12	77.45
Tres Garantias Hunter	34	30	0.9	1.30	71.97
Caobas Hunter	52	74	1.4	2.70	72.60
Xbonil Hunter	16	28	1.8	2.10	85.34
Species Totals	153	286	1.9	4.80	
<b>Collared Peccary</b>					
Chetumal Sport Hunter	25	12	0.5	0.80	56.76
Campeche Sport Hunter	13	14	1.1	1.80	65.96
Tres Garantias Hunter	33	68	2.1	3.50	76.50
Caobas Hunter	58	119	2.1	3.40	77.61
Xbonil Hunter	13	12	0.9	1.30	65.42
Species Totals	142	225	1.6	2.90	
<b>White-Lipped Peccary</b>					
Chetumal Sport Hunter	9	2	0.2	0.70	25.56
Campeche Sport Hunter	1	0	0.0	0.00	22.00
Tres Garantias Hunter	24	22	0.9	1.50	33.94
Caobas Hunter	20	8	0.4	0.80	29.13
Xbonil Hunter	8	8	1.0	1.10	38.00
Species Totals	62	40	0.7	1.20	

Table A-1. Continued

	N	Total	Avg.	S.D.	Mean Rank
<b>Agouti Paca</b>					
Chetumal Sport Hunter	19	45	2.4	4.70	63.11
Campeche Sport Hunter	14	14	1.0	1.20	61.71
Tres Garantias Hunter	36	139	3.9	7.80	72.29
Caobas Hunter	58	238	4.1	9.10	69.28
Xbonil Hunter	8	10	1.3	2.10	62.06
Species Totals	135	446	3.3	7.50	
<b>Ocellated turkey</b>					
Chetumal Sport Hunter	22	21	1.0	1.40	45.84
Campeche Sport Hunter	22	81	3.7	5.60	55.52
Tres Garantias Hunter	14	15	1.1	2.60	43.11
Caobas Hunter	19	8	0.4	0.80	38.29
Xbonil Hunter	19	60	3.2	4.90	57.63
Species Totals	96	185	1.9	3.80	
<b>Curassow</b>					
Chetumal Sport Hunter	13	12	0.9	2.30	36.15
Campeche Sport Hunter	1	1	1.0	0.00	57.50
Tres Garantias Hunter	34	114	3.4	7.00	59.22
Caobas Hunter	40	98	2.5	4.20	53.89
Xbonil Hunter	17	25	1.5	1.90	51.09
Species Totals	105	250	2.4	4.90	
<b>Brocket Deer*</b>					
Chetumal Sport Hunter	25	7	0.3	0.60	53.06
Campeche Sport Hunter	20	77	3.9	5.70	91.43
Tres Garantias Hunter	36	43	1.2	1.40	83.18
Caobas Hunter	49	65	1.3	2.80	71.57
Xbonil Hunter	18	26	1.4	2.50	76.08
Species Totals	148	218	1.5	3.00	

\*Sig.  $\leq 0.01$  based on mean rank<sup>1</sup>Based on hunts from January through July 2000

Table A-2. Hunting Pressure by Groups in 1999

	N	Total	Avg.	S.D.	Mean Rank
<b>White-Tailed Deer</b>					
Chetumal Sport Hunter	29	124	4.28	4.56	85.62
Campeche Sport Hunter	22	201	9.14	25.21	77.77
Tres Garantias Hunter	34	117	3.44	5.53	77.26
Caobas Hunter	52	246	4.73	11.41	68.97
Xbonil Hunter	16	47	2.94	2.79	85.84
Species Totals	153	735	4.8	12.09	
<b>Collared Peccary</b>					
Chetumal Sport Hunter	25	25	1	1.26	52.32
Campeche Sport Hunter	13	27	2.08	2.22	71.65
Tres Garantias Hunter	33	175	5.3	11.86	71.14
Caobas Hunter	58	326	5.62	9.26	78.32
Xbonil Hunter	13	28	2.15	1.46	78.73
Species Totals	142	581	4.09	8.44	
<b>White-Lipped Peccary</b>					
Chetumal Sport Hunter	9	11	1.22	3.31	25.28
Campeche Sport Hunter	1	0	0	0.00	18.50
Tres Garantias Hunter	23	75	3.26	5.41	36.24
Caobas Hunter	20	13	0.65	1.18	26.27
Xbonil Hunter	8	13	1.63	1.77	35.75
Species Totals	61	112	1.84	3.79	

Table A-2-Continued

	N	Total	Avg.	S.D.	Mean Rank
<b>Agouti Paca</b>					
Chetumal Sport Hunter	19	68	3.58	6.99	60.18
Campeche Sport Hunter	14	27	1.93	2.34	59.11
Tres Garantias Hunter	36	349	9.69	17.92	78.58
Caobas Hunter	58	604	10.41	22.76	69.18
Xbonil Hunter	8	10	1.25	2.43	45.94
Species Totals	135	1058	7.84	18.00	
<b>Ocellated Turkey</b>					
Chetumal Sport Hunter	22	53	2.41	6.31	40.98
Campeche Sport Hunter	22	98	4.45	5.48	57.14
Tres Garantias Hunter	14	86	6.14	15.81	49.18
Caobas Hunter	19	32	1.68	3.06	38.76
Xbonil Hunter	19	70	3.68	4.01	56.45
Species Totals	96	339	3.53	7.53	
<b>Curassow</b>					
Chetumal Sport Hunter	13	36	2.77	3.96	50.04
Campeche Sport Hunter	1	1	1	0.00	47.50
Tres Garantias Hunter	34	256	7.53	16.00	58.59
Caobas Hunter	40	210	5.25	10.34	49.55
Xbonil Hunter	17	40	2.35	2.60	52.53
Species Totals	105	543	5.17	11.32	
<b>Brocket Deer*</b>					
Chetumal Sport Hunter	25	14	0.56	1.16	43.36
Campeche Sport Hunter	20	114	5.7	9.65	82.63
Tres Garantias Hunter	36	132	3.67	5.74	82.32
Caobas Hunter	49	298	6.08	15.09	79.90
Xbonil Hunter	18	44	2.44	2.99	78.39
Species Totals	148	602	4.07	9.98	

\*Sig. = 0.002 based on mean rank



Table A-3. Hunting Pressure By Groups in 1998

	N	Total	Avg.	S.D.	Mean Rank
<b>White-Tailed Deer</b>					
Chetumal Sport Hunter	20	153	7.65	14.34	23.40
Campeche Sport Hunter	18	459	25.5	89.65	24.14
Tres Garantias Hunter	4	16	4	2.94	26.88
Caobas Hunter	4	62	15.5	22.01	32.38
Xbonil Hunter	3	9	3	0.00	28.50
Species Totals	49	699	14.27	55.14	
<b>Collared Peccary*</b>					
Chetumal Sport Hunter	17	19	1.12	1.17	16.50
Campeche Sport Hunter	12	19	1.58	1.68	19.08
Tres Garantias Hunter	4	21	5.25	3.77	32.50
Caobas Hunter	5	110	22	33.29	32.60
Xbonil Hunter	4	9	2.25	1.50	25.13
Species Totals	42	178	4.24	12.48	
<b>White-Lipped Peccary</b>					
Chetumal Sport Hunter	5	4	0.8	1.30	5.60
Campeche Sport Hunter	1	1	1	0.00	7.50
Tres Garantias Hunter	2	7	3.5	4.95	7.75
Caobas Hunter	3	87	29	44.19	11.00
Xbonil Hunter	2	0	0	0.00	3.50
Species Totals	13	99	7.62	21.86	

Table A-3-Continued

	N	Total	Avg.	S.D.	Mean Rank
<b>Agouti Paca*</b>					
Chetumal Sport Hunter	12	7	0.58	0.67	12.25
Campeche Sport Hunter	12	21	1.75	1.66	18.08
Tres Garantias Hunter	4	24	6	4.97	25.13
Caobas Hunter	5	184	36.8	69.00	27.20
Xbonil Hunter	2	2	1	1.41	14.75
Species Totals	35	238	6.8	26.84	
<b>Ocellated Turkey</b>					
Chetumal Sport Hunter	13	86	6.62	13.29	22.35
Campeche Sport Hunter	19	97	5.11	6.44	22.11
Tres Garantias Hunter	3	7	2.33	3.21	16.17
Caobas Hunter	4	27	6.75	5.50	29.88
Xbonil Hunter	6	32	5.33	5.54	26.08
Species Totals	45	249	5.53	8.51	
<b>Curassow</b>					
Chetumal Sport Hunter	9	23	2.56	4.19	10.33
Campeche Sport Hunter	1	1	1	0.00	9.00
Tres Garantias Hunter	4	30	7.5	3.32	19.50
Caobas Hunter	5	30	6	3.81	18.00
Xbonil Hunter	6	13	2.17	3.92	9.17
Species Totals	25	97	3.88	4.21	
<b>Brocket Deer</b>					
Chetumal Sport Hunter	16	43	2.69	5.95	15.81
Campeche Sport Hunter	16	109	6.81	12.39	24.25
Tres Garantias Hunter	3	24	8	10.58	25.33
Caobas Hunter	5	63	12.6	19.84	30.90
Xbonil Hunter	3	9	3	2.00	24.83
Species Totals	43	248	5.77	11.00	

\*Sig.  $\leq 0.05$  based on mean rank

Table A-4. Annual Frequency of Wild Meat Consumption per Group

		N	Total	Avg.	S.D.	Mean Rank
<b>White-Tailed Deer*</b>	Chetumal Sport Hunter	26	683.00	26.27	40.96	107.48
	Campeche Sport Hunter	22	742.00	33.73	52.49	124.34
	Tres Garantias NON-hunter	29	586.50	20.22	17.54	122.24
	Tres Garantias Hunter	26	756.00	29.08	50.05	111.92
	Caobas NON-hunter	29	250.00	8.62	10.92	73.71
	Caobas Hunter	52	1359.40	26.14	39.25	115.31
	Xbonil NON-hunter	19	163.50	8.61	10.23	79.18
	Xbonil Hunter	16	759.00	47.44	48.21	154.19
	Species Totals	219	5299.40	24.20	37.91	
<b>Collared Peccary*</b>	Chetumal Sport Hunter	19	153.00	8.05	18.70	61.74
	Campeche Sport Hunter	13	93.00	7.15	8.44	71.85
	Tres Garantias NON-hunter	24	409.00	17.04	13.89	114.50
	Tres Garantias Hunter	25	530.00	21.20	38.74	101.14
	Caobas NON-hunter	22	256.00	11.64	13.48	84.45
	Caobas Hunter	58	990.00	17.07	19.31	103.41
	Xbonil NON-hunter	13	80.00	6.15	4.08	77.92
	Xbonil Hunter	13	276.00	21.23	31.64	101.96
	Species Totals	187	2787.00	14.90	21.96	
<b>White-Lipped Peccary*</b>	Chetumal Sport Hunter	5	6.00	1.20	0.84	20.70
	Campeche Sport Hunter	1	12.00	12.00	0.00	71.50
	Tres Garantias NON-hunter	20	362.00	18.10	17.36	63.80
	Tres Garantias Hunter	16	278.00	17.38	28.76	63.22
	Caobas NON-hunter	15	57.00	3.80	4.30	37.70
	Caobas Hunter	20	71.00	3.55	4.75	35.00
	Xbonil NON-hunter	9	35.00	3.89	4.20	37.22
	Xbonil Hunter	8	99.00	12.38	20.70	50.25
	Species Totals	94	920.00	9.79	16.82	

Table A-4-Continued

		N	Total	Avg.	S.D.	Mean Rank
<b>Agouti Paca*</b>	Chetumal Sport Hunter	17	89.00	5.24	5.14	71.56
	Campeche Sport Hunter	14	43.00	3.07	3.65	48.32
	Tres Garantias NON-hunter	28	457.00	16.32	17.40	113.09
	Tres Garantias Hunter	27	716.00	26.52	25.58	132.81
	Caobas NON-hunter	32	241.00	7.53	8.22	82.08
	Caobas Hunter	57	1284.00	22.53	29.05	116.15
	Xbonil NON-hunter	12	40.00	3.33	4.14	51.67
	Xbonil Hunter	8	47.00	5.88	7.72	74.69
	Species Totals	195	2917.00	14.96	21.57	
<b>Ocellated Turkey*</b>	Chetumal Sport Hunter	19	74.00	3.89	5.67	56.32
	Campeche Sport Hunter	22	192.00	8.73	14.02	77.11
	Tres Garantias NON-hunter	19	127.00	6.68	10.06	70.61
	Tres Garantias Hunter	12	79.00	6.58	8.65	74.50
	Caobas NON-hunter	15	45.00	3.00	3.74	51.87
	Caobas Hunter	19	122.00	6.42	10.96	62.63
	Xbonil NON-hunter	19	152.50	8.03	10.92	82.58
	Xbonil Hunter	19	182.00	9.58	10.45	100.05
	Species Totals	144	973.50	6.76	10.06	
<b>Curassow</b>	Chetumal Sport Hunter	11	76.00	6.91	10.62	60.50
	Campeche Sport Hunter	1	1.00	1.00	0.00	20.50
	Tres Garantias NON-hunter	22	217.00	9.86	11.58	75.82
	Tres Garantias Hunter	22	557.00	25.32	43.41	97.84
	Caobas NON-hunter	21	137.00	6.52	13.06	56.74
	Caobas Hunter	39	378.00	9.69	12.68	75.15
	Xbonil NON-hunter	15	119.50	7.98	10.11	71.17
	Xbonil Hunter	17	125.00	7.35	8.10	78.21
	Species Totals	148	1610.50	10.88	20.40	

Table A-4 Continued

		N	Total	Avg.	S.D.	Mean Rank
<b>Brocket Deer*</b>	Chetumal Sport Hunter	21	99.00	4.70	7.21	58.81
	Campeche Sport Hunter	20	632.00	31.60	54.96	128.25
	Tres Garantias NON-hunter	28	450.50	16.09	11.78	126.14
	Tres Garantias Hunter	29	896.00	30.90	50.24	128.12
	Caobas NON-hunter	31	263.00	8.48	11.73	77.97
	Caobas Hunter	47	1057.00	22.49	41.64	113.36
	Xbonil NON-hunter	18	142.50	7.92	9.30	86.58
	Xbonil Hunter	18	399.00	22.17	29.32	123.72
	Species Totals	212	3939.00	18.58	34.49	

\*Sig.  $\leq 0.05$  based on mean rank

APPENDIX B  
SPORT HUNTING MAPS OF QUINTANA ROO AND CAMPECHE

## Hunting Locations Frequented by Sport Hunters in Quintana Roo

Map donated by: SECRETARÍA DE MEDIO AMBIENTE, RECURSOS NATURALES Y PESCA  
DELEGACIÓN FEDERAL EN QUINTANA ROO, SUBDELEGACIÓN DE RECURSOS NATURALES

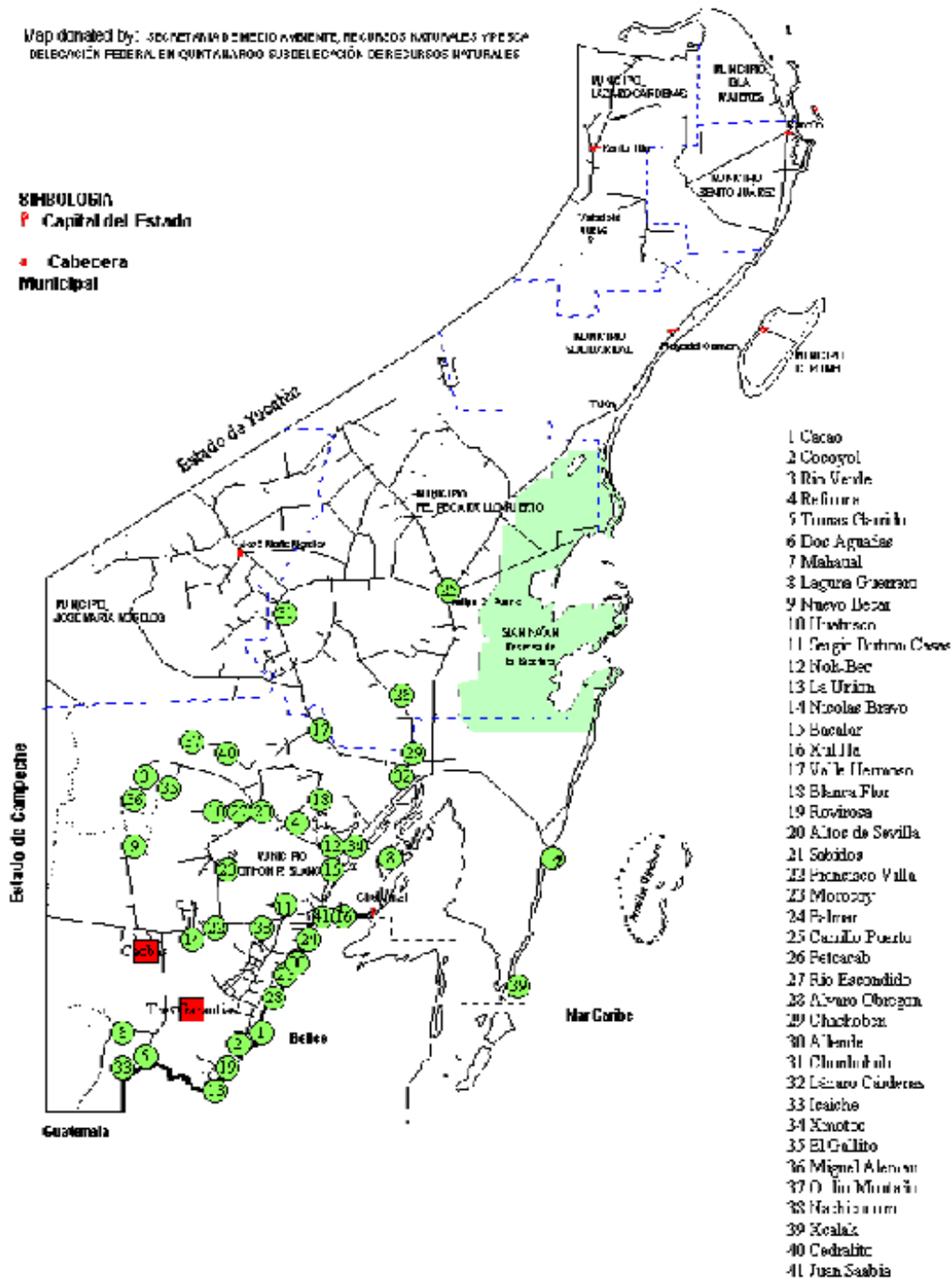


Fig. B-1. Sport hunting sites in Quintana Roo

### Hunting Area Frequented by Sport Hunters In Campeche

1 Pomuch  
2 Dzibachen  
3 Pich  
4 Uayamon  
5 Castamay  
6 Postunich  
7 Cano Cruz  
8 Nuevo Becal  
9 Chiná  
10 Silvituc  
11 Xkeulil  
12 Bonfil  
13 Ichek  
14 Kanki  
15 Nohalal  
16 Moquel  
17 Reforma Agraria  
18 Pueblo Nuevo  
19 Suc Tuc  
20 Tiquimal  
21 Hobomó  
22 Nohacal  
23 Nilchi  
24 Koben

Fig. B-2. Sport hunting sites in Campeche



APPENDIX C  
SURVEYS USED DURING INTERVIEWS WITH SPORT HUNTERS,  
SUBSISTENCE HUNTERS AND EJIDO NON-HUNTERS

1. Where are you from?
2. How many years have you lived here?
3. How many years have you hunted?
4. Does your father, grandfather or other family member hunt?
5. How often do you hunt? (Based on the response, the question maybe followed by: How many times a week/ month/ or year?)
6. Where do you hunt?

1. What is your primary reason for hunting? Tradition Food Sport/Recreation Other
2. What species do you hunt?
3. How do you use each species? Food Trophy Sell Other
4. Which species do you most prefer to hunt? Which is your second most preferred species? Third?
5. Do you hunt only males, only females, or do you not have a preference/ are not able to discern the sex?
6. Do you hunt only adults, only juveniles, or do you not have a preference?
7. How many animals of each species have you hunted this year (starting in January)? How many animals did you hunt last year (1999)? If you can remember, how many animals of each species did you hunt two years ago, in 1998?
8. During what months do you hunt each species?
9. In terms of the number of sittings, how often do you eat the meat of each species?
10. In your opinion, are there more, less, or the same number of animals of each species now, compared to the past?

11. In your perspective, are the animals of each species closer, farther away, or the same distance now compared to the past?

### **Travel and Associated Costs**

1. In total, how much did you spend on bullets last year?      Do you own your rifle or do you borrow it? If you borrow it, how do you repay the owner?
2. How much did you spend on tags last year?
3. How much did you spend on permits last year?
4. Do you hire guides for your hunts? If so, how many and how much do you pay each person?
5. Do you hire cooks for your hunts? If so, how many and how much do you pay each person?
6. Do you pay an entrance fee to hunt in an area? If so, how much and how often?

### **Group Perceptions**

1. How well do you get along with ejido residents?  
Very well      Well      Average      Not well      Very badly
2. Do you think the subsistence hunters living in the ejidos hunt:
  - A. Too much and threaten the viability of the game populations
  - B. A lot, but do not threaten the game populations
  - C. Moderately
  - D. Not too much
  - E. Very small amount

### **Contingent Valuation**

1. Suppose that the ejido residents were inclined to reduce their hunting pressure so that you would have more success on your hunts if they were economically compensated. Further, suppose that the money you pay for an entrance (not including what you would have to spend for tags, guides, lodging or other

services) would go towards wildlife management. That money would pay the salaries of local residents employed to maintain forest paths and surveillance, for example, so that you would have an enjoyable hunting experience in the ejido. Would you support this initiative? If so, what is the MAXIMUM that you are willing to pay as an entrance fee?

100    200    300    400    500    800    1000    Other \_\_\_\_

2. Use the same scenario as above, but in this case the revenue from the entrance fees would be used for community projects, such as a school or clinic. In this case the revenue would be used to improve the quality of life of the ejido residents, so that they would not have such a strong need to hunt. Would you support this initiative? If so, what is the MAXIMUM that you are willing to pay as an entrance fee?
3. Would you be willing to hire a local as a guide, if that economic benefit would serve as an incentive for the subsistence hunter to reduce his hunting pressure? If so, how many would you hire per group? Would you be willing to hire a cook? If so, how many?

### **Knowledge and Perceptions**

1. Who owns the wild animals?  
Me    Ejido    Government    Everyone    No One    I don't know
2. How well do you know the laws that regulate wildlife?  
Very well    Well    Somewhat    Not Well    Very Badly
3. How effective is the government enforcement of the hunting restrictions? Why?  
Very Effective    Effective    Average    Poor    Very Poorly
4. How effective is the ejido enforcement of the hunting restrictions?  
Very Effective    Effective    Average    Poor    Very Poorly

5. Do you know the bag limits for game species?
6. Do you know if there is an authorized amount of animals of permitted game species that may be harvested for subsistence purposes?
7. Do you know if there is an authorized amount of animals of permitted game species that may be harvested/ used for commercial purposes?

### **Demographic Information**

1. How old are you?
2. How many people live in your household?
3. What was the last year of you education?  
 Elementary (1-6)      Secondary (7-9)      Bachelor (10-12)      University (5)
4. What is your principle occupation?
5. In terms of monthly income, which economic bracket do you belong (in 1000 of pesos)?  

-10	10-15	15-20	20-25	25-30	30-35
	35-40	40+			

- ## Motivation and Preference

12. In your perspective, are the animals of each species closer, farther away, or the same distance now, compared to the past?

### **Economic Value**

1. How many kilograms of chicken do you buy per week? How much do you spend per week?
2. How many kilograms of beef do you buy per month? How much do you spend per month?
3. How many kilograms of pork do you buy per month? How much do you spend per month?
4. How many kilograms of game do you buy per month? How much do you spend per month?
5. Do you think that sport hunting can be an economic source for you? For your community? If so, how?
6. Have you ever worked for a sport hunter? If so, doing what? What was the total amount that you earned?

### **Contingent Valuation**

1. Imagine that the community put you in charge of regulating the sport hunting operation in the ejido. Suppose that the community decided to charge an entrance fee to each sport hunter, and the revenues would be used for community projects, for what ever the community would need, for example a new school, health center, etc... Not counting the number of animals he will hunt (that cost is separate), or what services he would seek (guide, cook, lodging... cost is also separate), would you support this initiative? If so, what is the MINIMUM amount that you would accept as an entrance fee from a MEXICAN sport hunter? For example would you charge:

100    200    300    400    500    600    800    1000    1500    2000    2500  
           3000    4000    5000    or other \_\_\_\_

2. Based on the same scenario as above, what is the **MINIMUM** you would accept from a **FOREIGN** (i.e.: U.S.) sport hunter?

100    200    300    400    500    600    800    1000    1500    2000    2500  
           3000    4000    5000    or other \_\_\_\_\_

3. Now imagine the same scenario, but this time the revenue from the entrance fees were used for wildlife management. This would mean that some of your neighbors could work to maintain the forest paths, count animals, etc... this would pay for the employment of these individuals so that your sport hunting operation would run smoothly and more sport hunters would want to visit as a result. Would you support this initiative? If so, what is the **MINIMUM** amount that you would accept as an entrance fee from a **MEXICAN** sport hunter? For example would you charge:

100    200    300    400    500    600    800    1000    1500    2000    2500  
           3000    4000    5000    or other \_\_\_\_\_

4. Considering the same case as before, what is the **MINIMUM** you would accept from a **FOREIGN** (i.e.: U.S.) sport hunter?

100    200    300    400    500    600    800    1000    1500    2000    2500  
           3000    4000    5000    or other \_\_\_\_\_

5. If you were to gain a direct economic benefit from the sport hunting operation, say, from working as a guide or a cook for example, would you agree to reduce the amount of animals you hunt and have more sport hunters hunt in your ejido? If so, how much hunting would you give up? Say that you hunt 10 animals from the species of your choice (based on the answer from the species preference section), of those ten, how many would you not hunt if you gained economically?
6. If you realize that the population of the species you hunt has diminished considerably, would you reduce your hunting pressure, even if you were not compensated economically?



### Knowledge and Perceptions

1. How well do you get along with sport hunters who enter your ejido?  
 Very Well    Well    Regular    Badly    Very Badly
  
2. How do you feel about sport hunters from the United States who hunt in your ejido?  
 I like it            I do not like it            I do not care
  
3. Who owns the wild animals?  
 Me    Ejido    Government    Everyone    No One    I don't know
  
4. Who owns the wild animals when they are found on your parcel of land?  
 Me    Ejido    Government    Everyone    No One    I don't know
  
5. Do you think that sport hunters are depleting the wildlife?
  
6. Do you know what an UMA is?
  
7. How well do you know the laws that regulate wildlife?  
 Very well    Well    Somewhat    Not Well    Very Badly
  
8. How effective is the government enforcement of the hunting restrictions?  
 Very Effective            Effective            Average            Poor    Very Poorly
  
9. How effective is the ejido enforcement of the hunting restrictions?  
 Very Effective            Effective            Average            Poor    Very Poorly
  
10. Do you know the bag limits for game species?

11. Do you know if there is an authorized amount of animals of permitted game species that may be harvested for subsistence purposes?
12. Do you know if there is an authorized amount of animals of permitted game species that may be harvested/ used for commercial purposes?

**Demographic Information**

1. How old are you?
2. How many people live in your household?
3. What was the last year of you education?  
Elementary (1-6)      Secondary (7-9)      Bachelor (10-12)      University (5)
4. What is your principle occupation?
5. How much do you earn per day? How many hectares do you have registered under Procampo? How much did you earn from your agricultural harvest sales last year? What other income sources do you have and how much to you earn?

## NON-Hunter Questionnaire

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### Introduction

1. Where are you from?
2. How many years have you lived here?
3. Are you an ejidatario or poblador?
4. Why do you not hunt?
5. Does your father, grandfather or other family member hunt? Who taught you how to hunt?

### Use and Preference

1. What species do you use?
2. How do you use each species?      Food      Sell      Other
3. If you sell the meat, what percentage of the meat do you keep and how much do you sell?
4. Which species do you most prefer to consume? Which is your second most preferred species? Third?
5. In terms of the number of sittings, how often do you eat the meat of each species?
6. In your opinion, are there more, less, or the same number of animals of each species you mentioned now, compared to the past?
7. In your perspective, are the animals of each species closer, farther away, or the same distance now compared to the past?
8. How many kilograms of chicken do you buy per week? How much do you spend per week?
9. How many kilograms of beef do you buy per month? How much do you spend per month?
10. How many kilograms of pork do you buy per month? How much do you spend per month?
11. How many kilograms of game do you buy per month? How much do you spend per month?

12. Do you think that sport hunting can be an economic source for you? For your community? If so, how?
13. Have you ever worked for a sport hunter? If so, doing what? How much did you earn total?

### **Contingent Valuation**

1. Imagine that the community put you in charge of regulating the sport hunting operation in the ejido. Suppose that the community decided to charge an entrance fee to each sport hunter, and the revenues would be used for community projects, for what ever the community would need, for example a new school, health center, etc... Not counting the number of animals he will hunt (that cost is separate), or what services he would seek (guide, cook, lodging... cost is also separate), would you support this initiative? If so, what is the MINIMUM amount that you would accept as an entrance fee from a MEXICAN sport hunter?

For example would you charge:

100    200    300    400    500    600    800    1000    1500    2000    2500  
           3000    4000    5000    or other \_\_\_\_\_

2. Based on the same scenario as above, what is the MINIMUM you would accept from a FOREIGN (i.e.: U.S.) sport hunter?

100    200    300    400    500    600    800    1000    1500    2000    2500  
           3000    4000    5000    or other \_\_\_\_\_

3. Now imagine the same scenario, but this time the revenue from the entrance fees were used for wildlife management. This would mean that some of your neighbors could work to maintain the forest paths, count animals, etc... this would pay for the employment of these individuals so that your sport hunting operation would run smoothly and more sport hunters would want to visit as a result. Would you support this initiative? If so, what is the MINIMUM amount that you would accept as an entrance fee from a MEXICAN sport hunter? For example would you charge:

100    200    300    400    500    600    800    1000    1500    2000    2500  
 3000    4000    5000    or other \_\_\_\_\_

4. Considering the same case as before, what is the MINIMUM you would accept from a FOREIGN (i.e.: U.S.) sport hunter?

100    200    300    400    500    600    800    1000    1500    2000    2500  
 3000    4000    5000    or other \_\_\_\_\_

### **Knowledge and Perceptions**

1. How well do you get along with sport hunters who enter your ejido?

Very Well    Well    Regular    Badly    Very Badly

2. How do you feel about sport hunters from the United States who hunt in your ejido?

I like it    I do not like it    I do not care

3. Who owns the wild animals?

Me    Ejido    Government    Everyone    No One    I don't know

4. Who owns the wild animals when they are found on your parcel of land?

Me    Ejido    Government    Everyone    No One    I don't know

5. Do you think sport hunters are depleting the wildlife?

6. Do you know what an UMA is?

7. How well do you know the laws that regulate wildlife?

Very well    Well    Somewhat    Not Well    Very Badly

8. How effective is the government enforcement of the hunting restrictions?

Very Effective    Effective    Average    Poor    Very Poorly

9. How effective is the ejido enforcement of the hunting restrictions?

Very Effective      Effective      Average      Poor      Very Poorly

10. Do you know the bag limits for game species?

11. Do you know if there is an authorized amount of animals of permitted game species that may be harvested for subsistence purposes?

12. Do you know if there is an authorized amount of animals of permitted game species that may be harvested/ used for commercial purposes?

### **Demographic Information**

1. How old are you?

2. How many people live in your household?

3. What was the last year of you education?

Elementary (1-6)      Secondary (7-9)      Bachelor (10-12)      University (5)

4. What is your principle occupation?

5. How much do you earn per day? How many hectares do you have registered under Procampo? How much did you earn from your agricultural harvest sales last year? What other income sources do you have and how much to you earn?

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Jennifer Lechuga was born in Mexico City and grew up in northern Virginia. She attended Tulane University for her Bachelor of Science Degree in ecology, evolution and organismal biology. After graduation, she served in the Peace Corps in Ecuador for two and a half years working as an environmental educator and agroforestry extensionist. She then worked with the National Wildlife Federation and the Senate Committee on Environment and Public Works.

Jen enrolled in the Interdisciplinary Ecology Master's Program in the College of Natural Resources and Environment at the University of Florida. She focused her studies in issues of sustainable resource use, conservation, and development. Upon completion of her requirements for a Master of Science, Jen would work with the National Oceanic and Atmospheric Administration in Washington, DC.