

Sea Turtles of Bahia Magdalena, Baja California Sur, Mexico: Demand and Supply of an Endangered Species

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Abstract.

Sea turtles have historically been a primary resource for many of the coastal inhabitants of Bahia Magdalena, Baja California Sur, Mexico. Despite their endangered status and the implementation in 1990 of Mexican laws prohibiting the harvest of sea turtles, the demand for and the supply of these animals has persisted to some degree. To determine the current demand for sea turtles 122 surveys and 56 interviews were conducted (June 12th-30th, 1999) throughout the Bahia Magdalena region. Through a generalized least squares (GLS) analysis it was estimated that 35.7% of the variation in demand was explained by six independent variables. The GLS model shows that the family size, special occasions of consumption such as birthdays, and the decline in sea turtle populations positively affect the demand function. The person's occupation, monthly income, and the 1990 ban on sea turtle harvest negatively affect this demand. Ninety-four surveys and seventy interviews conducted in the region (July 24th-August 1st, 1999) were used to describe a supply function. The GLS estimation indicates that 27.8% of the variation in the supply of sea turtles in the bay is influenced by nine variables. Age, level of education, fishing practices, number of dependents, availability of sea turtles, and culture significantly affect the supply of sea turtles in the Bahia Magdalena region.

Keywords: Demand, Supply, Sea Turtles, Endangered Species.

1. INTRODUCTION.

Five of the world's seven sea turtle species occur along the Pacific coast of Mexico. The former makes this region very important from a biological and socioeconomic point of view. In addition, the peninsula of Baja California is extremely important as a feeding ground and as a developmental area for sea turtles. Since the early 1400s the Seri Indians, a group native to Baja California, often relied on sea turtles for both food and clothing. The Seri developed a strong cultural connection with the sea turtles, which became part of their culture through song, poetry, mythology, and chants, some of which are still in existence today. For example, when catching a leatherback sea turtle, one of the more rare species, the Seri Indians immediately initiated a ceremony that lasted for four days. This indigenous group used all parts of the sea turtle. For instance, the stomach of the sea turtle was often removed and used as a bag, the shell was used as a sled for children, and both the eggs and sea turtle meat were for human consumption (Caldwell 1962; Felger 1987). Sea turtles have historically been a primary resource for many of the coastal inhabitants of Bahia Magdalena, Baja California Sur, Mexico (Figure 1). In the bay the East Pacific green turtle, commonly known as the black turtle (*Chelonia mydas*) and the Pacific loggerhead (*Caretta caretta*) are the species most commonly seen. Turtles have long been used for such things as food, medicine and household items (Ernst and Barbour, 1989).

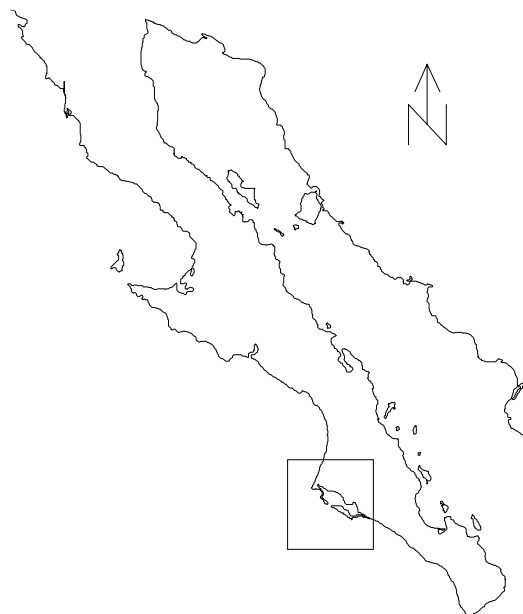


Figure 1. Peninsula of Baja California, selected area comprises the lagoon system Bahia Magdalena-Almejas.

Still considered part of tradition today sea turtles are served at weddings, Christmas, Mother's Day, Sundays, and most commonly for Easter. Other uses include extracting the oil from the fat to aid children suffering from respiratory problems and drinking of sea turtle blood as a cure for anemia (Caldwell 1962; Felger 1987). In the 1960s humans

had basically destroyed all reproductive efforts of this species by consuming large numbers of mature turtles as well as their eggs. In the early 1970s, sea turtle populations crashed due to the fact that they were unable to reproduce fast enough to keep up with the demand (Cliffton et al., 1979). Due to this situation the Mexican government implemented a recovery program in 1978 and closed nesting beaches, prohibiting the harvest of sea turtle eggs. In 1980, a quota limiting the number of sea turtles that could be taken per month was introduced as a way to control the exploitation of the sea turtles (INP 1990). The legal framework to protect sea turtles includes an executive order issued by the Mexican Ministry of Fisheries and the Mexican Ministry of Urban Development and Ecology on May 31st, 1990. Under this scheme, the Mexican Federal Government strictly prohibits the extraction, capture, and pursuit of all species of sea turtle in federal waters or from beaches within national territory. In addition, the specimen of any species of sea turtle incidentally captured during the operations of any commercial fishery shall be returned to the sea, independently of its physical state, dead or alive (DOF 1996; DOF 1992; DOF 1990; DOF 1988). However, some species are not recovering after the implementation of the ban. For instance, tagging experiments and consumption estimation of green turtles show that capture of 25% of the marked organisms occurs in approximately two years (Nichols, unpub. data). The former situation has caused a decrease of eighty to ninety percent of the green turtle population since 1990. Before a plan can be outlined to conserve sea turtles in the region, it is necessary to gain a better understanding of the extent of turtle harvest. Only upon characterizing the problem and identifying its sources can an effective management plan be implemented. To date, demand and supply levels are presently lower than they were during the peak of the sea turtle trade. For example, in the 1960's there was a sea turtle slaughterhouse in Puerto Magdalena, which processed between 150 and 250 turtles per week. Despite their endangered status (INP 1990; NMFS 1985) and the implementation of the ban the demand for (Figure 2) and

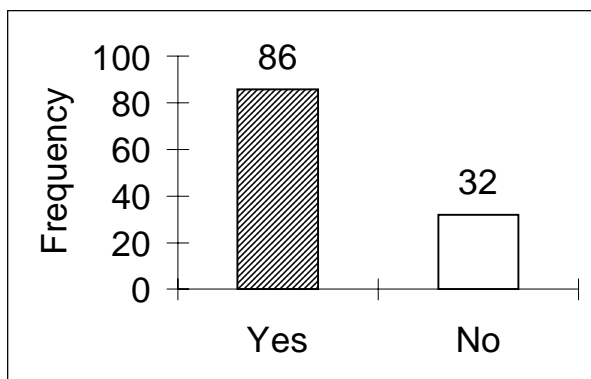


Figure 2. Answers to the question “Do you believe that sea turtles are in high demand?”

the supply (Figure 3) of these animals has persisted to some degree in Bahia Magdalena.

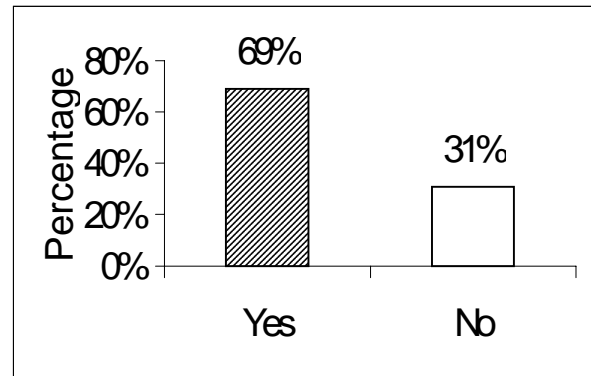


Figure 3. Percentage of answers to the question “Is a sea turtle consumed if captured incidentally?”

Therefore, the objective of this study was to estimate the demand and supply of sea turtles in the Bahia Magdalena region in order to gain a better understanding of the socioeconomic factors that influence the consumption and the capture of these organisms.

2. METHODOLOGY

To assess the demand and the supply for sea turtles in the region, surveys and interviews were performed randomly in some communities of the bay. From June 12th to June 30th, 1999, 122 surveys and 56 interviews related to the demand for sea turtles were conducted in Puerto San Carlos and Puerto Magdalena Island. In order to assess their supply 95 surveys and 70 interviews were conducted in Puerto Magdalena, Puerto San Carlos, and at Punta Arenas from July 24th to August 1st, 1999. The demand and supply functions were determined through a generalized least squares, GLS, method (Bohrstedt and Knoke, 1991; Griffiths et al., 1993; Menz and Mullen, 1981) to assess the socioeconomic factors that influence these functions. Demand was defined as the number of sea turtles the respondents were willing to consume while supply was the number of sea turtles captured by an individual.

3. RESULTS AND DISCUSSION

3.1. Demand

It was found that 35.7% of the variation in the demand for sea turtles (D_t) could be explained by six variables used to estimate the following equation:

$$D_t = 0.1801 - 0.2196OCCU - 0.0599INC + 0.1819FAM + 0.0926OCCA - 0.0533FA + 0.0809POP + \epsilon ; R^2 = 0.357$$

The occupations of the respondents had a significant negative effect on demand. As expected, if a person's occupation was anything but a fisher, then the demand decreased. It stands to reason that fishers have greater access to sea turtles than the average person does. Income negatively affected the demand because the more money a person earns the less their demand for sea turtle while the larger the family the greater the demand. Eighty-two percent of families in Puerto San Carlos earn less than 5,000 pesos (US\$500) per month and 62% have an average family size of four to six members. These two variables increased the demand for sea turtles significantly. The predominant religion of the people of Puerto San Carlos is Catholicism and Easter was found to be the occasion when most people consume sea turtle. These organisms have become a good substitute for red meat. However, sea turtles are available to fishers in the bay and the majority of the respondents indicated that they like its taste more than fish, chicken, or shellfish. The 1990 ban was the most significant factor that decreased the demand of sea turtles despite the occasional lack of enforcement. In addition, the lower numbers (or availability) of sea turtles in the Bahia Magdalena region negatively influenced demand (Table I).

Table I. List of variables used in demand function, their symbols, coefficient estimates, and p-values.

Description	Symbol	Estimate	p-value
Occupation	OCCU	-0.2196	≤ 0.05
Monthly income	INC	-0.0599	≤ 0.05
Family size	FAM	0.1819	≤ 0.05
Occasions on which turtle was consumed	OCCA	0.0926	> 0.05
Factors affecting consumption	FA	-0.0533	≤ 0.05
Population decrease of turtles in the bay	POP	0.0809	> 0.05

3.2. Supply

Twenty eight percent of the variation of the supply for sea turtles (S_t) was explained by the nine variables of the following equation:

$$S_t = - 0.5464 + 0.2225AGE + 0.1513EDU + 0.2214FIN + 0.1937DEP + 0.3883CUL + 0.1022EAS - 0.1516WEEK - 0.4043CONS + 0.1188GOVT + \epsilon; R^2 = 0.28$$

It was determined that age has a significant positive effect on the supply of sea turtles harvested because older fisherman have been catching sea turtles for much longer than younger fisherman and are less likely to alter their practices even when facing a declining sea turtle population.

The low level of education of the respondents surveyed significantly increased the supply of sea turtles. The majority of people in this area have only a basic level of education and it is expected that with a higher level of completed education there is a lower incidence of sea turtle harvest. It was also determined that finfishing practices significantly increased the supply because fishermen typically use gill nets that are known to catch non-target species such as sea turtles. In addition, the number of economic dependents increased the supply of sea turtles significantly. Thus, the more economic dependents an individual has, the more probable it is that he will supply a sea turtle to his family. Culture increased the supply of sea turtles significantly because the people who perceive sea turtles as an important part of their culture may consume turtle occasionally. Easter had a positive, but not significant influence on supply. Low availability of turtles per week also had a significant negative impact on supply. Because those more interested in conservation are less likely to harvest sea turtles there was a negative influence on their supply, but not significant. However, proclaiming an interest in conservation is not equivalent with a willingness to stop harvesting turtles. For instance, it was found that if the government allowed the harvest of sea turtles the majority of respondents would capture them and thus increase, not significantly though, their supply (Table II).

Table II. List of variables used in supply function, their symbols, coefficient estimates, and p-values.

Description	Symbol	Estimate	p-value
Age	AGE	0.222586	≤ 0.05
Level of education	EDU	0.151386	≤ 0.05
Finfish fishing	FIN	0.221484	≤ 0.05
Number of dependents	DEP	0.193796	≤ 0.05
Turtle important to culture	CUL	0.388399	≤ 0.05
Is turtle used on Easter?	EAS	0.102250	> 0.05
Low availability/week	WEEK	-0.151615	≤ 0.05
Interested in conservation	CONS	-0.404374	> 0.05
Government permission	GOVT	0.118821	> 0.05

4. CONCLUSIONS

Sea turtles have proved to be a sufficient, and sometimes necessary, meal for many families in the Bahia Magdalena region. The opportunity cost of a fisher to return a sea turtle to the sea is great because it's often more valuable for him to feed his family than to preserve biodiversity. Focussing management efforts on the enforcement of the law is not enough to conserve sea turtles. The lack of success of the ban implemented by the government is an example of the need to implement other strategies. As long as people are

unaware of the global and local consequences of insufficient protection of the sea turtle populations, they will not assume conservation culturally, and no law can change this. By working with the community in devising a co-management strategy, involving the input of local fishers as well as the government, laws would be better understood and therefore people would follow them. With respect and better enforcement, turtle conservation strategies could be highly successful. However, it is evident that there is a difficult transition between cultural needs and conservation. People are concerned that sea turtles may not exist forever in Bahía Magdalena, but many families hope for a future where sea turtles could be legally caught in order to benefit themselves, whether to use them for personal consumption or to sell them.

ACKNOWLEDGEMENTS

The School for Field Studies, Center for Coastal Studies provided logistical and financial support for this study. Marshall Foundation provided a fellowship for J. W. Nichols to conduct his research in the region. Special thanks to Kristin Bird for all her help in the application of the surveys and interviews. Thank you to the Center for Coastal Studies students Leys Bostrom, Ellie Craig, Emily Donlou, Chip Fong, Chris Forst, Arturo García-de Leon Ferrer, Amalia Smith, Michael Chuang, Todd Deck, Sarah Fulkerson, Jean Hamilton, Alexis Kuney, Erica Roy, and Catalina Wang for the collection and preliminary analysis of data during Summer 1999. Our thanks to the communities of Bahía Magdalena for their cooperation during the application of the surveys and interviews.

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