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Analysis

The value of whale watching to local communities in Baja, Mexico: A case study using applied economic rent theory

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ABSTRACT

Nature-based tourism can provide opportunities for local stewardship and create incentives to support habitat and conservation of marine species where there is pressure on local habitat. We investigate the local economic value of Eastern Pacific gray whales (*Eschrichtius robustus*) to two communities in Baja California Sur, Mexico, that benefit from nature-based tourism associated with the whales. Using a producer side approach and data for 2006, we estimate the economic rent associated with whale watching in 2006 and then examine the distribution of that rent among local stakeholders. We find a substantial local value associated with the presence of gray whales, with the largest share (two-thirds) going to the whale watching owner-operators. Our findings suggest that increasing the whale watching price in 2006 would have been a cost-effective strategy for increasing the rent captured locally from whale watching. Finally, we conclude with a brief assessment of developments since 2006.

1. Introduction

Loss of biodiversity is one of the most pressing environmental problems of our time. Many scientists agree that biodiversity is not only essential to the earth's ecosystems but also crucial for our own long-term survival (Gowdy, 1997). In light of this concern, the conservation of species, communities and habitats has become an issue demanding strategies at the global and local scales (MEA, 2003). Nature-based tourism may be helpful in this regard. Its advocates argue that nature-based tourism gives resource users motivation to protect local wildlife and ecosystems since this helps to attract visitors and the resulting economic activity benefits the community (Gössling, 1999). In contrast, detractors argue such indirect approaches to species conservation lack sufficient linkage between personal behavior and outcomes, thereby contributing to the failure of many community-based schemes (Ferraro and Kiss, 2002; Mansuri and Rao, 2004). Notwithstanding these concerns, efforts to value the benefits from nature-based tourism and communicating these values to resource managers and industry can help to spur these activities in support of conservation. However, too often valuation concerned with nature-based tourism concentrates on non-resident use and non-use values and does not take proper account of the benefits for local livelihoods (Martinez-Alier, 2002). As a result, conservation planning may not adequately quantify and include local values when evaluating potential conservation strategies (Wunder, 2000; Martinez-Alier, 2002).

Quantifying local values may be particularly important for migratory wildlife species, such as the Monarch butterfly, numerous waterfowl species and whale species such as the Eastern Pacific gray whale (*Eschrichtius robustus*). While gray whales are valued globally for their importance as a charismatic mammal species, their conservation depends in part upon preserving critical habitat at the local level. It is at the latter scale that conflicts related to conservation may be most acute and, consequently, where the need to recognize and support livelihood benefits may be most desirable. In this paper, we use economic rent theory to estimate the "asset" value of the Eastern Pacific gray whale to two Mexican communities on the Pacific coast of Baja, Mexico. Both Puerto Adolfo Lopez Mateos (PALM) and Puerto San Carlos (PSC) offer nature-based tourism relying on the local presence of this species. In addition to determining the size of the economic rent accruing to each community, we determine its distribution among the various local stakeholders, and conduct comprehensive sensitivity analysis. We find that the economic rent accruing locally from whale watching activities is quite substantial but that the results differ between the two communities due to heterogeneous situations.

Taking a total economic value perspective, the use values arising from nature-based tourism consist of the national or international recreational use values (as consumers) and the values generated for local livelihoods (as producers). Are both sets of values equally valid? The issue is one of standing and who should have it (Whittington and Mac Rae, 1986). In one sense, our research addresses the question of whose values should count and who can impose a particular language of valuation (Martinez-Alier, 2002). Quantifying the local value of

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charismatic species adds to a more pluralistic value perspective that not only includes monetary values at the global level, but also encourages recognition of local values and community ties with the natural environment. Of course, there are other values besides recreational values associated with the ecosystems, species and services more generally that are associated with the Eastern Pacific gray whale. For example, gray whales may provide a local non-consumptive use value for local communities and non-use (existence) benefits arise more distantly from their conservation. There is also a downside when local fishing operators have conflicts with whale conservationists over fishing access, which has occurred occasionally in southern Baja. However, in this paper we take a more narrow approach and focus on the local producer benefits from whale watching activities alone.

Non-market valuation associated with outdoor recreation usually relies on expressed preference methods such as the contingent valuation method or revealed preference methods such as the travel cost method (Loomis and Larson, 1994), or may be practiced using newer deliberative or discrete choice methods (Naidoo and Adamowicz, 2005). While these methods appear highly suitable for assessing non-local and non-consumptive use values associated with species conservation, production theory may offer a more valid context for measuring local livelihood values associated with the non-consumptive use of local wildlife (Barbier, 2000). In the case of nature-based tourism, local people are often the producers of wildlife viewing tours, so that the production function approach to valuation would seem particularly suitable. However, studies investigating the value of wildlife from a production or supplier perspective are rare.

A related concept for valuing an exploited natural resource is natural resource or economic rent. This concept is rooted in production theory, but recently it has gained traction as a measure of environmental income in the context of poverty alleviation (Sjaastad et al., 2005). Economic rent is the net income generated by natural resources and measured as the amount over and above what is required to compensate all factors of production at their opportunity cost prices (Ricardo, 1817). Natural resource rent is arguably an appropriate indicator of the contribution of natural resources to human welfare. Economic rent analysis is widely applied to investigate resource scarcity, effective taxation, and changes in management policies, and to quantify net social returns from the development or use of natural resources. In addition, distributional impacts of natural resource use can be assessed using rent theory (Griffin et al., 1976). While rent theory is commonly used in the analysis of consumptive natural resource activities such as fisheries or mining (Figueroa, 1999; Gunton, 2004), it can be useful when considering non-consumptive use of natural resources, particularly in the tourism context (Prieto-Rodriguez and Gonzalez-Diaz, 2008; Pazienza, 2011).

Eastern Pacific gray whales (*E. robustus*) offer a particularly interesting case for estimating values for a charismatic species at the local level. The whales migrate along the Pacific Coast between breeding lagoons in the state of Baja California Sur in north western Mexico to feeding grounds in the Arctic. This migration draws nature-based tourists from all over the world, making the gray whale an international whale watching icon. However, since 1999 Mexican law has required that all commercial whale watching in the Mexican portion of the range must be done with local tour operators. Thus, local livelihood benefits are significant.

Only a few economic studies measuring the welfare benefits associated with whales exist, as opposed to the economic or socio-economic impacts of whale watching activities.[2] For example, Loomis and Larson (1994) assess the consumer surplus arising from ocean-based and shore-based viewing of Eastern Pacific gray whales using the contingent valuation method, while Lyssenko and Martínez-Espiñeira (2012) also use contingent valuation to value the benefits from whale conservation in Eastern Canada, particularly in light of entanglements in fishing nets and substantive value to whale watchers. Both studies consider only consumer side values and, therefore, do not examine the producer aspect and the important benefits accruing to local suppliers of whale watching tours. More generally, Bulte and van Kooten (1999) focus on estimating marginal willingness-to-pay measures for existence value related to minke whales, again concentrating on consumer benefits. To our knowledge, no economic studies use economic rent theory to determine an “asset” value for whales involved in whale watching.

The objective of this paper is to determine the local value of gray whales directly associated with whale watching activities in Bahia Magdalena and using a novel economic rent theory approach. We disaggregate and further analyze this local use value, taking into account various stakeholders and the differences in resource characteristics of the two whale watching communities of Bahia Magdalena. This approach excludes economic impacts from accommodation facilities, food services, and other whale-related recreational activities, as well as cultural and other non-whale watching values, but adds important local community-based values to the international consumer values for Eastern Pacific gray whales measured previously. Finally, we suggest potential strategies for local people to increase their net benefits from whale watching activities.

2. Ecology of the Eastern Pacific Gray Whale

There are two remaining populations of gray whales in the northern Pacific Ocean. The larger eastern population experienced two intensive exploitation phases, one in the 1800s and a second in the early 1900s. In 1972, the International Whaling Commission (IWC) passed conservation measures that allowed the population to double by 1995 (Buckland and Breiwick, 2002). The most recent population counts in 2006/2007 yielded an abundance of approximately 19,000 whales, with the assessment that there is a high probability that the population is at “optimum sustainable population” size, as defined by the US Marine Mammal Protection Act (NOAA, 2015). However, at present further growth of the Eastern Pacific stock is unlikely. Under-nourishment, low recruitment, and declines in the primary food source in recent decades suggest that the eastern population has reached its carrying capacity (Le Boeuf et al., 2001; Moore et al., 2001; Perryman and Lynn, 2002). In contrast, the receding ice pack in the gray whales summer habitat, due to global climate change, appears to be having little influence on population growth of the Eastern Pacific gray whale (Brandon and Punt, 2013). Ultimately, the main threat to the eastern population may be the decline of its prey rather than any changes in environmental conditions influencing its habitat (Urbán et al., 2003).[3]

The eastern population has the longest migration route of all mammals, covering from 8000 to 10,000 km over the course of 2 months (Rugh et al., 2001). Between December and March, the whales use the shallow waters of the lagoons to bear and nurse their young, conserving energy for the long northern migration in spring. However, not all lagoons are equally important for calf production.[4] Whales enter the more northerly lagoons in the Baja California peninsula earlier and, consequently, reside there for longer periods than in the more southerly lagoons, such as Bahia Magdalena (Rugh et al., 2001). The Bahia

[2] For information about the economic impacts from whale tourism in Mexico and other Latin American countries, see Hoyt and Iñíguez (2008).

[3] In addition to the environmental factors that are influencing stock size, some small scale harvesting by aboriginal groups is taking place. Between 2003 and 2007, the IWC allowed a total catch of 620 Eastern Pacific gray whales with a maximum of 140 in any 1 year (IWC, 2004).

[4] In recent decades, Laguna Ojo de Liebre has been the most important breeding lagoon with 53% of all calves born, followed by the northern part of Bahia Magdalena (12%), Laguna San Ignacio (11%), Laguna Guerrero Negro (9%), and the middle and south part of Bahia Magdalena (5%) (Rice et al., 1981).

Magdalena lagoon complex consists of an extensive array of narrow mangrove channels and wide-open waterways, subdivided into three regions: the northern, middle, and southern regions (Rice et al., 1981). The majority of whales visiting Bahia Magdalena (about 200 whales at peak times) utilize the small but much more protected northern part, while a smaller sub-population (100 whales at peak times) visits the much larger middle part of the lagoon complex (Fig. 1).

Researchers categorize whales visiting the breeding lagoons into two groups. At Bahia Magdalena, cow-calf pairs enter the lagoons first whereas single adults and juveniles enter later, prompting the mothers and calves to move from the lagoon entrance to more protected nursing areas inside the lagoon (Norris et al., 1983; Gardner and Chavez-Rosales, 2000). While single whales stay on average 13 days, cow-calf-pairs remain for 22 days (Urbán et al., 2003). This visitation pattern means that whales persist at the lagoon entrance throughout the season, particularly at the beginning and end of the season, whereas they occupy areas of the lagoon located further away from the entrance more significantly during peak season. Whale watching can interfere with whale behavior in the more accessible parts of the bay and cause changes in surfacing and diving, tail slapping and beaching, change group size and cohesion, swimming speed and direction, and alter feeding and resting behavior (Parsons, 2012).

3. Local Livelihoods and Whale Watching

Of the two communities in Bahia Magdalena offering whale watching, PALM is located in the northern part of the lagoon complex, and PSC is situated in the middle part of the lagoon complex (Fig. 1). Both communities are connected to the regional road system by paved roads. Compared to other villages in the area, PALM and PSC have a well-developed network of social services and infrastructure, which enhances nature-based tourism development. As a result, PSC grew from about 3100 inhabitants in 1990 to approximately 11,600 in 1999, representing annual growth of 16%. Between 2000 and 2010, the population of PSC decreased to 5650 inhabitants following a trend of negative population growth also observed in other communities of the region (García-Martínez and Chávez-Ortiz, 2007; INEGI, 2011).

The economic benefits from whale watching are just one component in the larger livelihood system that has evolved in and around Bahia Magdalena. For example, PSC was established initially to serve as a port to export agricultural products nationally and internationally from the nearby Santo Domingo Valley (García-Martínez, 2005; Doloutskaia, 2002). Then the federal government encouraged migration to the region to exploit the fishing grounds and to solve economic problems in other parts of Mexico (Young, 1999). In contrast, PALM had the

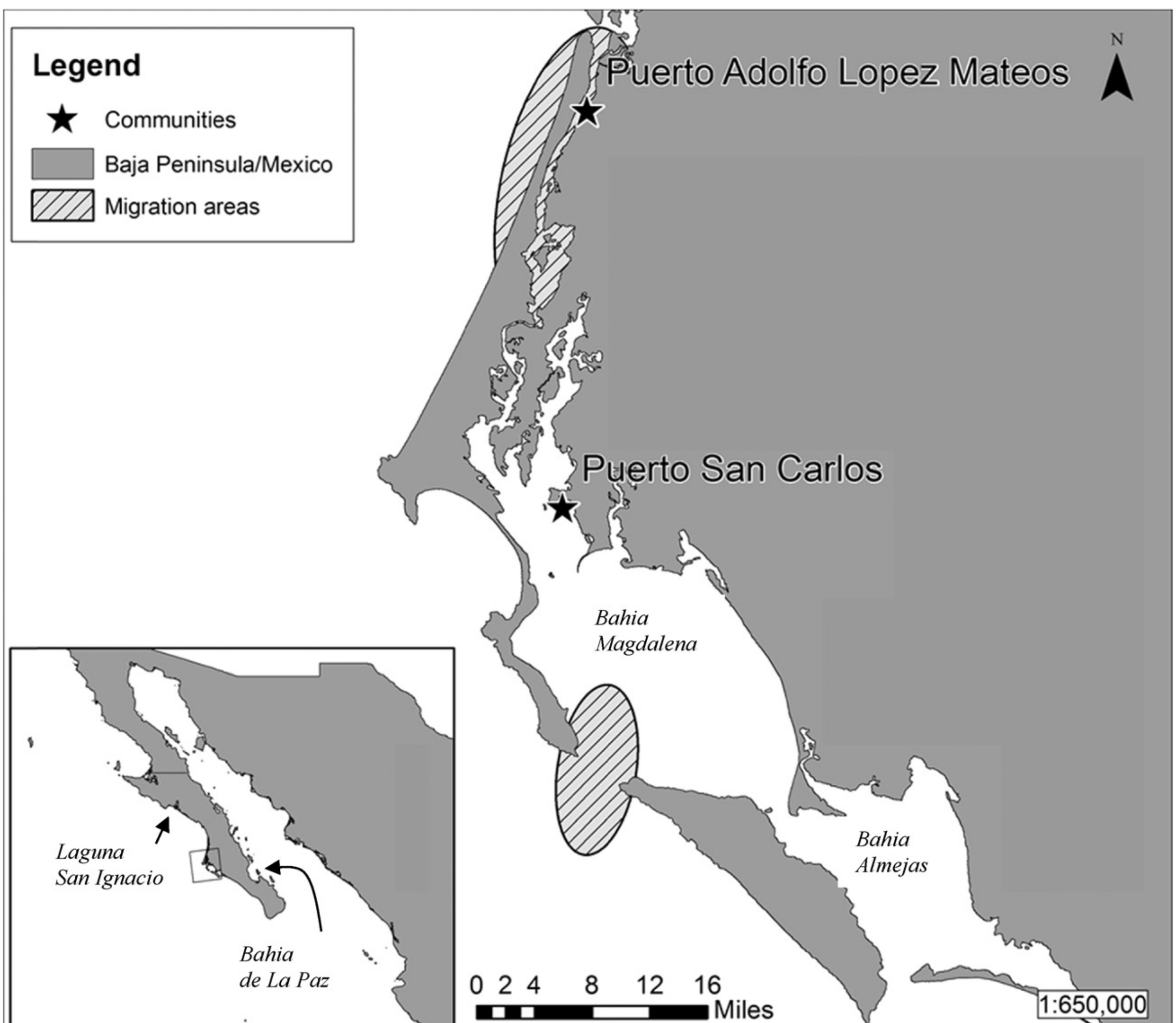

Fig. 1. Regions of the Bahía Magdalena lagoon complex, Baja California Sur, Mexico.

largest and most important government owned processing plant in the state during the 1970s (Young, 2001). However, the government privatized the plant in 1987 and approximately 50% of the workers were laid off, increasing the number of small-scale fishers in the Bay.

Resource users exploit the environment in and around the Bay in multiple ways. The principal resource activities surrounding the Bay are small-scale artisanal fisheries, commercial fisheries, fish processing, and nature-based tourism – primarily recreational whale watching. More intensive resource use (e.g. nature-based tourism/ecotourism, commercial fishing, and maritime traffic) characterize the central and northern areas of the Bay (Hastings and Fischer, 2001; Sawatsky, 2008; Secretaría de Promoción y Desarrollo Económico, 2015). However, small-scale fishing is the primary livelihood activity for 48% of households in PSC and 37% of households in PALM. Sixty-nine percent (192) of households in PSC and 65% (137) of households in PALM generate income from fishing or fish related activities, which includes artisanal fishing, industrial fishing, fish processing and other related activities (Sawatsky, 2008).[5]

In contrast, tourism and related activities (hotel, restaurant, whale watching, sport fishing) are the primary income generating activities for only 2% of households in PSC and 6% of households in PALM. Tourism is more important as a secondary activity; 4% of households in PSC and 15% of households in PALM use tourism and related activities as additional forms of income. However, 18% of households are involved in 'activities that may benefit from tourism' (household involved in tourism), which include businesses that provide services for tourists: 26% of households in PALM, 13% of households in PSC and 12% of households in PM (Sawatsky, 2008). Thus, whale watching, while extending benefits to a number of households, does not represent a significantly large element in the local economy at present.

The unemployment rate in Baja California Sur has been higher than the national rate since 1970s. For instance in the year 2014 the unemployment rate in Baja California Sur was 5.2%, and it was higher than the national rate by 0.4% (INEGI, 2014). The former situation makes whale watching an employment opportunity in PSC and PALM.

4. Whale Watching Operations in Bahia Magdalena

In 1996, the International Whaling Commission's (IWC) Scientific Committee developed general international principles for the development of whale watching to minimize the risk of adverse impacts on cetaceans, including disturbance from noise and to allow cetaceans to control the nature and duration of interactions. These general principles influenced the creation of rules and regulations in over fifty countries worldwide. The IWC's Whale Watching Working Group has established a five-year whale watching strategy and is developing a Handbook for Whale Watching outlining industry best practices (IWC, 2015). Since 2006, the Mexican government has adopted all these guidelines for use wherever whale watching occurs in Mexico. However, in the Bahia Magdalena region there are additional regulations because this is a reproduction and nursing area for gray whales; thus, it includes zones where boats may not enter.

After disputes between local and US whale watching operators, who dominated the market prior to 1994, Mexican authorities granted an exclusive right to the local people in 1994 and issued a limited number of whale watching permits. These permits were free of charge, location-specific, non-transferable, and non-tradable, but are shared within families and among groups of operators (e.g. cooperatives). The federal Department of Environment and Natural Resources, Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT), manages whale watching activity. Until mid-December, when the first whales arrive, local people fish for shrimp, one of the most profitable fisheries in the region (García-Martínez and Chávez-Ortiz, 2007). Then fishers in possession of a whale watching permit convert their open fishing skiff or *panga* to accommodate up to six clients for whale watching. After whale watching ends in March, most operators resume fishing for clams, finfish and lobster, as well as other species found outside the lagoon.

The institutional characteristics of whale watching operations are very different in the two communities, partly because of different environmental conditions and social structures in the communities (Table 1). For more than 30 years, PALM has had an excellent reputation for its whale watching opportunities. In PALM, there are two large cooperatives holding almost all of the 27 permits issued to that community. Permits pass efficiently from a returning to a departing boat, maximizing the use of each permit. In addition to the cooperatives, there are two sole proprietors owning four permits. On average, whale watching trips last for 2 hours and boats fill almost to capacity (SEMARNAT, 2005). Commonly, whale watchers can observe whales within minutes of departure. At peak times, the density of whales rises to more than six whales per km^2 in this portion of the bay. In 2005, PALM had more than 9300 whale watchers embarking on 1748 trips (SEMARNAT, 2005). The average price for whale watching at PALM was Pesos 620 per boat hour, weighted by the prices paid by and numbers of different types of customers.

Due to the vast area of the middle part of the lagoon complex, whale watching in PSC is more of a wilderness experience compared to the crowded activities occurring at PALM. In contrast to PALM, the level of cooperation among operators in PSC is much lower. For example, operators are less likely to share their permits, as there are an equal number of boats and permits (there are 35 permits in PSC). The one cooperative in PSC that owns 21 permits actually behaves more like a group of eleven sole proprietors than a cooperative organization, as is the case in PALM. Three larger individual operators in PSC together own 14 permits. In addition, three businesses tend to specialize in year-round tourism activities, rather than participate in local fisheries during the rest of the year. During peak times, there is only one whale for every 5 km^2 of bay area. The combination of the large area and low numbers of whales visiting this portion of the bay presents a challenge to operators at PSC. As a result, the fleet fills only a little over four seats per boat trip. At PSC, whale watching trips are on average three hours long and depend on whale density, weather, and ocean conditions. During the 2005 season, 3384 whale watchers purchased 813 trips and the weighted price charged to different customer groups was Pesos 582 per boat hour at PSC.

The observed ecological and organizational differences between the two whale watching communities affect fuel consumption. Use of more fuel-efficient four-stroke engines by some operators at PSC results in less fuel use than at PALM on longer trips, but greater distances covered to reach the whales at PSC mean more fuel is used when similar engine types are compared (Table 2). During times of highest whale

Table 1
Whale watching characteristics by community, Puerto San Carlos (PSC) and Puerto Adolfo Lopez Mateos (PALM).
Source: various.

	PSC	PALM
Whale abundance at peak	100	200
Lagoon size	560 km^2	32 km^2
Whales per km^2 at peak	0.2	6.25
Lagoon entry	Wide, deep	Narrow, shallow
Whale return	More certain	Less certain
Historic exploitation	High	Low
Independent operators (permits)	3 (14)	2 (4)
Cooperatives	1	2
Membership in cooperatives (permits)	11 (21)	55 (23)
Level of cooperation	Low	High
Number of boats	34	59
Proportion of more efficient four-stroke engines	40%	0%

[5] The primary sources of income by households are small-scale fishing (46%), fish processing (13%), other commerce and services (13%), government employment (10%), construction and transportation (5%), tourism (3%), and industrial fishing (3%) (Secretaria de Promocion y Desarrollo Economico, 2015).

Table 2
Mean fuel consumption by location and trip length for different engine types and high versus low whale abundance based on 18 interviews with *pangueros* (liters/trip).
Source: Survey of *pangueros*.

Engine	Location	Trip length				
		1 h	2 h	3 h	4 h	5 h
2-stroke	PSC	–	37.00	49.00	54.00	60.00
2-stroke	PALM	22.17	31.53	41.00	–	–
4-stroke	PSC	–	34.50	32.81	41.25	43.75
Whale abundance						
High	PSC	–	27.20	35.30	44.40	45.60
Low	PSC	–	45.20	48.20	54.10	50.00
High	PALM	18.00	28.60	39.20	–	–
Low	PALM	26.30	34.40	43.80	–	–

abundance, fuel consumption in both communities is much lower because more time is spent idling while watching whales. Similarly, fuel savings are greater for shorter than longer trips, since proportionally more time is spent idling in the former case.

5. A Model of Economic Rent from Whale Watching in Bahia Magdalena

We model local livelihood values arising from gray whales as the economic rent earned in the whale watching industry at Bahia Magdalena.[6] Ricardo (1817) defines resource rent in two ways: as scarcity rent, which exists in situations where the resource is naturally or artificially scarce, and differential rent, which is rent received as a result of resources of differing quality. Scarcity rent arises in situations when resources are limited in supply. On a per unit basis, scarcity rent is equal to the difference between the product price and the marginal production cost. Gunton (2004) defines differential rent in the mining sector as the difference in cost between the mine that just covers the cost of variable inputs and capital (marginal mine), estimated at their opportunity cost prices, and the mine generating a surplus over and above the cost of production (intra-marginal mine). Intra-marginal mines can occur where there is higher quality ore, cheaper transportation or easier extraction. Typically, economists calculate economic rent accruing to a natural resource as a net present value given the dynamic nature of resource exploitation (Gunton and Richards, 1987); typically, the following expression is used:

$$\mathrm{NPV} = \sum_{t=0}^{T} \frac{R_t - C_t}{[1+r]^t} \tag{1}$$

where NPV is the net present value of economic rent over the period T, R_t is the annual revenue earned from resource operations, C_t is the annual total cost of production (including capital) measured in opportunity costs terms, r is the discount rate and t is the year. Our analysis is a short run analysis since we assume whale watching capacity is fixed, due to a limit on the whale watching permits as well as boat size and capacity.

Revenue obtained by the community from whale watching is: $R_t = p(y_t) \cdot y_t$, where $p(y_t)$ is the downward sloping inverse demand curve for whale watching trips, expressed as a function of annual boat hours supplied by the community, y_t; we later specify this using a visitor generating or growth function. Annual boat hours, y_t, are calculated as the product of the annual number of trips, g_t, and the average length of a trip, l, measured in hours. We calculate annual trips, g_t, by dividing annual visitors, v_t, with the average number of boat seats occupied per trip, s. This yields the following expression for annual boat hours:

$$y_t = g_t \cdot l = \frac{v_t}{s} \cdot l \tag{2}$$

The annual number of trips, g_t, is constrained in two ways. First, the maximum number of trips per permit per day is h/l, where h is the maximum hours of operation per boat per day. Second, whale watching activity is limited by the fixed number of permits in the community, n, and the season's length in days, j. Together these considerations describe the following constraint:

$$g_t \leq \frac{h}{l} \cdot n \cdot j \tag{3}$$

Following (2), we express the demand for whale watching trips as a function of the number of visitors and use a visitor growth function moderated by year-to-year changes in price to generate annual visitors. We express this function as $v_t = v_{t-1}(1+\varepsilon\frac{\Delta p}{p})(1+\eta)$, where η is the growth in annual visitation in percent, ε is the own price elasticity of demand with $|\varepsilon| < 1$ if demand is inelastic and $|\varepsilon| > 1$ if demand is elastic, and $\frac{\Delta p}{p}$ is the proportional change in price from year-to-year.

The community incurs annual costs, C_t, equal to:

$$C_t = OC_t + k_t + F_t \tag{4}$$

where OC_t is the annual operating cost, k_t is the annual amortized capital charge, and F_t is the annual fixed cost. The latter two terms are associated with a given capital stock K, representing mainly investment in *pangas* (fishing skiffs used for whale watching as well), but may also include construction of kiosks for carrying on business, advertising (e.g. billboards) and working capital (Baker and English, 2011). OC_t comprises annual fuel cost CF_t, measured in (undistorted) opportunity costs terms, and the opportunity cost of labor, CL_t.

The cost of the fuel used depends upon the annual number of whale watching hours, y_t, and fuel use per trip hour, f, in the following way:

$$CF_t = \sum_{i}^{m} \sum_{u}^{q} \sum_{x}^{z} g_{it} \cdot a_{iu} \cdot f_{ux} \cdot \left[p_f + \varphi_x p_o\right] \tag{5}$$

where m is the number of individual operators, i; q is the number of trip types, u; and z is the number of individual engine types, x. The number of trips per operator in time t is represented by g_{it}, the proportion of trips by operator and trip type is a_{iu}, and the volume of fuel used per trip dependent on the engine type is f_{ux}. The expression in brackets is the per-liter price for the engine specific oil-gasoline mixture, where p_f is the undistorted per-liter-price of fuel, p_o is the per-liter price for oil additive, and φ_x is the mixture proportion coefficient that differs by engine type.

Traditionally, the opportunity cost of labor is the payment available from the wage earner's next best employment opportunity (Griffin et al., 1976). We calculate the opportunity cost of labor per hour as:

$$CL_t = \sum_{i=1}^{m} w_{\min}[y_{it} + \gamma g_{it}] \tag{6}$$

where $w_{\min}$ is the opportunity cost wage and γg_{it} is an allowance for time need for boat cleaning.

We calculate annual capital charges as the amortized NPV of the sum of initial capital investment, K_0, and capital investments that replace the assets once they reach the end of their life, K_t. The amortized annual capital charge is equal to:

$$k_t = \left(K_0 + \sum_{t=0}^{T} \frac{K_t}{(1+r)^t}\right) \cdot \frac{r}{1-(1+r)^{-T}} \tag{7}$$

[6] While this approach may seem somewhat narrow, as it excludes any non-consumptive use values at the local level, we believe that the contribution of whale watching to local livelihoods is the most important component in local values but plan to confirm this thesis in subsequent research. Here, we exclude these other potential local values.

Table 3
Mean fixed cost by community based on interview data (2006 Pesos per unit).
Source: Survey of whale watching operators.

	PSC (n = 8)	PALM (n = 4)	Max	Min	Unit	PSC total	PALM total
Motor and boat repair	4182 (n = 3)	4559 (n = 4)	7500	1625	Per boat	29,272	53,796
Office expenses	10,032 (n = 4)	3000 (n = 3)	25,000	3000	Per operator	140,455	12,000
Office workers	14,697 (n = 6)	5905 (n = 3)	72,000	2600	Per operator	205,757	23,621
Travel	10,371 (n = 5)	19,680 (n = 4)	50,000	2500	Per operator	145,199	78,720
Advertising	784 (n = 8)	45 (n = 4)	40,000	6000	Per operator	10,974	178
Insurance	1113 (n = 7)	603 (n = 4)	1400	409	Per boat	38,950	35,584
Switching cost	706 (n = 3)	44 (n = 1)	2500	44	Per boat	0	78,667
Boat transport	1802 (n = 6)	0 (n = 4)	2600	1485	Per boat	0	0
Water access fee	1000	1000			Per boat	35,000	59,000
Mean fixed cost, F_t						605,608	341,566

where the expression in brackets is the present value cost of assets employed over period T, taking into account the proportion of time used in whale watching versus fishing.[7] Operators report no salvage value for assets, so we ignored this possibility. The model also does not account for the cost of borrowing as suggested by several authors (Curry and Weiss, 2000; Baker and English, 2011). Interviews and other sources indicate that operators have difficulties financing through banks (Young, 1999), although no information was available on informal borrowing activities and the effective borrowing rate.

The community's fixed cost includes the lease of office buildings, office expenses, wages paid to office workers, travel, advertising, insurance, the cost of preparing the fishing boat for whale watching (switching cost), boat and motor repair, boat transportation costs, and the water access fee. We express fixed cost for the industry, F_t, as the sum of each individual operator's annual fixed cost, F_{it}, or $F_t = \sum_{i=1}^{m} F_{it}$.

Recalling (1), the analysis focuses on the calculation of NPV over a time horizon, T, of 30 years.[8] The concept of NPV represents the value of the resource over the entire time horizon, constituting a stock. However, it is more pragmatic and more meaningful to the community to present local values of the resource as an annual flow of value rather than in form of a value over a hypothetical time horizon. In this regard, we apply an amortization formula to convert NPV into an annual equalized (constant) flow of value in the sense of levelized costs used in the power generation industry (Stoft, 2002). Annual levelized cost can be expressed as:

$$C_{levelized} = \left(\sum_{t=0}^{T} \frac{C_t}{(1+r)^t} \right) \cdot \frac{r}{1-(1+r)^{-T}} \qquad (8)$$

6. Parameter Values and Capital Stock in the Whale Watching Industry

From February 22 to March 8, 2006, we conducted twelve semi-structured interviews with whale watching operators, focusing on the cost structure of their businesses. In PSC, we interviewed four members of the single cooperative, three locally-based sole proprietors, and another sole proprietor operating out of PSC but residing outside the community. We selected members of the cooperative in PSC to interview using a snowball sampling approach (Goodman, 1961). In PALM, we interviewed one representative from each of the two large cooperatives, and both of the independent operators. Representatives of the two cooperatives in PALM were selected based on our requests to speak to a person familiar with the management of the cooperative. In addition, we carried out a fuel consumption survey with 18 *pangueros* that we selected using the same snowball sampling approach and carried out at the point of departure for whale watching trips (either a dock or landing area). More than half of the *pangueros* interviewed (57%) were working for operators located in PSC with the remainder working in PALM. We did not have information on the total number of *pangueros* employed. We also obtained annual visitor data filed with the government regulatory agency, SEMARNAT (2005).

Determining the opportunity cost prices for fuel and wages required a more detailed analysis. At the time of data collection (2006), the Mexican government effectively subsidized retail petroleum prices in Mexico. Domestic prices, set by government, were allowed to fall below international prices when the latter rose significantly, but the reverse could hold during periods when the international price dropped significantly. In 2006, both situations occurred so that a canceling effect was experienced thereby more-or-less nullifying the distortion (Segal, 2012). For this reason, we chose to use the market price in 2006 to reflect the opportunity cost of fuel.

As the opportunity cost of labor, we might have preferred to use the wage earned in fishing, since this is the primary alternative income source for *pangeros*. However, calculating an average fishing wage is difficult due to the many types of fisheries with different skill and labor requirements, and the seasonality of the work. In addition, the use of a crew share system in some fisheries, where wages are dependent upon fish abundance and catch, makes determination of an opportunity cost wage even more difficult. As a result, we used the minimum wage in our baseline calculations and tested wage variations in the sensitivity analysis. Using the minimum wage as a measure of the opportunity cost of labor is an established practice (Belli, 2001).[9]

The interviews with whale watching operators revealed information on fixed cost and capital charges in the whale watching industry at Bahia Magdalena. We used small sample statistics, specifically the geometric mean, to calculate the mean fixed cost and capital charges per community. Fixed costs, F_t, amounted to Pesos 605,608 in PSC and Pesos 341,566 in PALM (Table 3).[10] In PALM, operators work closely in cooperatives sharing fixed cost.

We separately determined the initial capital cost, K_0, based on information about asset prices and asset life (Table 4). We then used information on the proportional use of the asset and aggregated information on

[7] Note that permit value is not part of capital cost because it is not a factor of production. Instead, the permit value (if marketable) would constitute the sum of expected future returns from using the resource. Accounting for this value in our calculations would "double-count" the value of the resource.

[8] A 30 year time horizon seems appropriate relative to the useful life of assets used for whale watching. Also, due to the relatively large discount rate of 12% longer time horizons won't have any significant effect on the results because the more distant costs and benefits occur in the future, the lower their present value. However, one could argue that lengthening the time horizon to more than 30 years would be more appropriate for measuring existence value given the lifespan of gray whales. Although our analysis does not measure existence value, we consider this alternative approach as part of the sensitivity analysis.

[9] However, this approach may undervalue labor by ignoring the economic value of the specific skill set of *pangueros*', including but not limited to boat handling, safety, communication, and whale biology.

[10] These estimates account for the 20% proportional use associated with whale watching related to assets that are both used for fishing as well as for whale watching. Community totals were calculated based on per boat or per operator estimates shown in Tables 4 and 5 and then multiplied by the number of boats or operators specific to each community.

Table 4
Initial capital charges by community based on interview data (2006 Pesos per unit).
Source: Survey of whale watching operators.

Asset	Asset life (years)	PSC (n = 8)	PALM (n = 4)	Max	Min	Unit	PSC Total	PALM Total
Vehicle	5	23,319 (n = 7)	55,000 (n = 1)	55,000	1000	Per operator	65,295	55,000
Trailer	3	7611 (n = 7)	0 (n = 4)	10,000	5000	Per boat	53,274	0
Boat hull	30	40,000 (n = 6)	44,721 (n = 4)	50,000	40,000	Per boat	280,000	527,712
Motor	5	40,532 (n = 7)	41,425 (n = 4)	72,000	10,000	Per boat	283,723	488,811
Life jackets	3	297 (n = 7)	560 (n = 4)	700	250	Per permit	10,385	58,860
Safety and other	4	6000 (n = 7)	6379 (n = 4)	26,900	1500	Per permit	210,000	172,237
Initial capital charges, K_0							902,676	1,302,620

the number of boats, permits, and operators in order to calculate K_0 for each community (Table 4). The larger scale of operations in PALM, with 59 boats versus 35 boats in PSC, results in a higher initial capital cost of Pesos 1,302,620 for PALM (versus Pesos 902,676 for PSC).

In order to determine an appropriate rate for the elasticity of demand for whale watching, we consulted a variety of sources. Larson and Shaikh (2003) estimate the elasticity of demand for three whale watching destinations on the Pacific coast, ranging from −0.1009 at Half Moon Bay to −0.5571 at Monterey Bay. Further studies investigating the demand elasticity for whale watching along the Pacific Coast are not known and other whale watching or cetacean-related demand studies are rare. Most recently, Robertsen (2013) estimated an elasticity of demand for whale watching in Norway of −0.37, consistent with the estimated range from Larson and Shaikh (2003). While the two studies above suggest that demand for whale watching recreation may be inelastic, we use the more elastic measure for Monterey Bay due to its similarity to the study site and as a more conservative assumption for our base case. In addition, the availability of substitute but differentiated recreational whale watching sites along the West coast of the Baja peninsula (e.g. Bahia de La Paz for blue whale, Laguna San Ignacio for gray whale, Los Cabos for humpback whale) supports this choice. However, we vary the assumption widely as part of the sensitivity analysis later on.

In addition, we were required to make assumptions about the discount rate. Although many valuation studies focus on social welfare, the investments we consider and the scale at which we apply our analysis are more consistent with the use of a private discount rate that reflects the source of capital and risk (Curry and Weiss, 2000). Much uncertainty surrounds the cost of capital in developing countries, where the availability of credit can be limited and risk premiums are high (Block and Vaaler, 2004). For our analysis, the marginal opportunity cost of capital needs to be higher than the risk free rate to reflect these conditions realistically. Bulte and van Kooten (2002) use 18% as the baseline assumption for estimating the value of elephant conservation in Africa, but this high rate may reflect special circumstances in Africa. Since the long-term risk free interest rate for Mexico is between 7 and 8% (OECD, 2006), and likely lower than in Africa, we used a baseline rate of 12% and tested 6% and 18% in the sensitivity analysis.[11]

For our initial modeling, we used parameters derived from the sources cited above plus others from our interviews and published sources (Table 5). Later we vary the key parameter assumptions as part of a comprehensive sensitivity analysis to address the various sources of uncertainty in our parameters.

7. Estimated Economic Rent from Whale Watching in Bahia Magdalena

In this section, we discuss our estimates of economic rent in the whale watching industry at Bahia Magdalena. We present our results for each community in three forms: the NPV, followed by an annual equivalent value and, finally, we express the latter value on a per permit basis (Table 6). This third measure allows for a more meaningful comparison of value between the two communities. Except for the NPV results, all values presented are levelized values, meaning they represent an amortized annual equivalent of NPV, as portrayed in (8). Since the cost calculations are more complex, we discuss these further below.

Annual operating costs are substantially higher in PALM, although operating costs expressed as a share of revenue are about the same in the two communities (Table 6).[12] The main difference in operating costs between communities is better engine technology in PSC, leading to lower fuel consumption. In both communities, actual *panguero* wages are substantially higher than the minimum wage, which we have used to calculate the opportunity cost of labor.

The difference between the two wages represents the share of rent captured by labor, so we excluded it from operating cost. As noted above, the *pangueros* have specialized skills that also may explain some of this difference. Capital charges represent the smallest portion of total cost in each community. Overall, the total annual costs in the two communities are similar, but this masks lower fixed costs and higher fuel costs in PALM.

The annual levelized economic rent captured by the community is a measure of the annual value of the whale resource to the community. Utilizing (1) and an amortization formula adapted from (4), the annual levelized value of gray whales in PSC is Pesos 1.35 million and in PALM it is Pesos 2.04 million (Table 6). Over a thirty-year time horizon and using a 12% discount rate, this levelized annual value amounts to a net present value of Pesos 10.9 million (46% of revenue) for PSC and Pesos 16.4 million (57% of revenue) for PALM. More rent accrues in PALM, which in part is due to the higher abundance of whales, a complementary effect that arises when the environmental good (in this case whales) enhances the quality and enjoyment consumers derive from purchasing a marketed good such as a whale watching trip (Freeman, 2003). More accurately, one could speak of weak complementarity, since environmental quality as captured by the presence and number of whales is just one of several influences on the visitation rate and willingness-to-pay for whale watching trips. Some of these additional influences include visitor income, the marginal value of time when recreating, quality of tour guides, marketing strategy, the quality of local facilities, and other factors influencing recreation demand (Larson and Shaikh, 2003).

The difference in the rent generated in each community on a per permit basis is greater than the difference observed for the total values by community (Table 6). In PSC, the higher number of permits and the lower amount of total rent generated, result in an annual economic rent per permit of Pesos 38,691, whereas in PALM the rent per permit is almost double this figure. This finding suggests that a portion of the accrued rent is associated with capping the total number of permits in each community, thereby limiting entry into whale watching. As a result, the quantity constraint imposed by a fixed number of permits creates scarcity rent in association with the gray whales.

[11] For comparison, some recent examples of valuation and cost benefit studies from rural Mexico use discount rates of 3 and 7%, respectively (Balderas Torres et al., 2013; García-Frapolli et al., 2010).

[12] Where shown, Mexican Pesos were converted to US Dollars at a rate of 0.077 US Dollars per 1.00 Mexican Peso.

Table 5
Parameter assumptions for base case economic rent calculations.

Parameter		PSC	PALM	Source
r	Discount rate	12%	12%	OECD (2006)
p	Price per boat hour	Pesos 582	Pesos 620	Personal interviews
$w_{\min}$	Minimum hourly wage	Pesos 47	Pesos 47	Personal interviews
s_{max}	Seats per boat available	6	6	Personal interviews
s	Average seats per boat occupied	4.16	5.33	SEMARNAT (2005)
η	Visitor growth per year	10%	10%	personal interviews
ε	Elasticity of demand	−0.5571	−0.5571	Larson and Shaikh (2003)
p_o	Price of oil-mixture per liter	Pesos 30	Pesos 30	Personal interviews
p_f	Price of fuel per liter	Pesos 6.25	Pesos 6.25	Personal interviews
γ	Time factor for boat cleaning	0.3	0.3	Personal interviews
φ	Gas-oil-mixture	1/50	1/50	Personal interviews
h	Daily hours of operation	6	6	Personal interviews
j	Season length in 2005	44 days	44 days	Personal interviews
v_0	Visitors in 2005	3384	9317	SEMARNAT (2005)
g_0	Trips in 2005	813	1748	SEMARNAT (2005)
l	Average length per trip	3.0 h	2.1 h	SEMARNAT (2005)
f	Fuel efficiency	93.6 l/h	105.6 l/h	Personal interviews
m	Number of individual operators	15	59	Personal interviews
T	Time horizon	30 years	30 years	Author assumption
q	Amount of trip types offered	4	3	Personal interviews
z	Engine types	2,4-stroke	2-stroke	Personal interviews
n	Permits	35	27	Personal interviews

In terms of the distribution of economic rent, we estimate that the federal government collects 28% of the rent as income tax (Table 6). The share captured by labor varies from 14% in PSC to only 5% in PALM, reflecting the higher *panguero* wages paid in PSC. Overall, the largest proportion of economic rent goes to business owners reaching almost two-thirds in PALM.

8. Sensitivity Analysis

We test the validity of our results by varying key parameter assumptions; we use variations of ±25% and ±50% from base case assumptions (see Table 5). Even though this approach does not account for all uncertainties inherent in our analysis, it outlines possible effects and enables us to identify where uncertainty in individual parameters is liable to influence our results most significantly. The sensitivity analysis considered the opportunity cost of fuel and labor, the discount rate, price per boat hour, elasticity of demand, and annual growth in demand (Table 7). We also examine whether different prices for whale watching trips affect the distribution of resource rent among stakeholders.

Table 6
Levelized (annual) revenue, cost and economic rent and distribution of rent under base case assumptions (2006 Pesos, 12% discount rate, 30 year life).

	PSC (Pesos/year)	% of revenue	PALM (Pesos/year)	% of revenue
Total revenue	2,917,554		3,604,509	
Total cost	1,563,379	54%	1,567,763	43%
Operating costs	728,623	25%	925,947	26%
Fuel	469,455		614,011	
Labor	259,167		311,936	
Fixed costs	605,608	21%	383,969	11%
Capital charges	229,148	8%	300,250	8%
Rent distribution	1,354,176	46%	2,036,746	57%
Labor	195,987	14% of rent	103,981	5% of rent
Operators	779,020	58% of rent	1,362,477	67% of rent
Government	379,169	28% of rent	570,289	28% of rent
Rent per permit	38,691		75,435	
Rent per operator	55,644		23,093	

Table 7
Sensitivity analysis of levelized (annual) economic rent estimates (2006 Pesos).

Parameter	% deviation from base case	Economic rent PSC (Pesos/year)	% change from base case	Economic rent PALM (Pesos/year)	% change from base case
Base case		1,354,176		2,036,746	
Opportunity cost of fuel	+50%	1,133,148	−16%	1,756,632	−14%
	+25%	1,243,662	−8%	1,896,689	−7%
	−25%	1,464,689	+8%	2,176,804	+7%
	−50%	1,575,203	+16%	2,316,861	+14%
Opportunity cost of labor	+50%	1,224,592	−9.6%	1,813,176	−7.7%
	+25%	1,289,384	−4.8%	1,958,762	−3.8%
	−25%	1,418,967	+4.8%	2,114,731	+3.8%
	−50%	1,483,759	+9.6%	2,192,715	+7.7%
Discount rate	+50%	1,006,459	−25.7%	1,813,176	−11.0%
	+25%	1,165,453	−13.9%	1,921,288	−5.7%
	−25%	1,575,058	+16.3%	2,157,838	+5.9%
	−50%	1,826,011	+34.8%	2,280,775	+12.0%
Price per boat hour	+50% [a]	2,039,435	+50.6%	3,100,665	+52.2%
	+25%	1,787,586	+32.0%	2,667,860	+31.0%
	−25%	759,065	−43.9%	1,245,659	−38.8%
	−50%	24,445	−98.2%	333,475	−83.6%
Demand elasticity[b]	+50%	1,595,088	−21.8%	2,625,083	−15.3%
	+25%	1,822,715	−10.6%	2,872,916	−7.3%
	−25%	2,245,924	+10.1%	3,309,544	+6.7%
	−50%	2,443,000	+19.8%	3,501,016	+12.9%
Annual demand growth	+50%	1,703,511	+25.8%	1,969,654	+6.2%
	+25%	1,549,434	+14.4%	1,922,315	+3.6%
	−25% (8%)	1,100,954	−18.7%	1,756,773	−5.3%
	−50% (5%)	779,738	−42.4%	1,599,091	−13.8%

[a] Indicates the price change scenario used to assess variations in demand elasticity in the same table (just below).
[b] An increase in elasticity (demand becomes more elastic) means that the elasticity index decreases towards −1, whereas a decrease in elasticity means demand becomes less elastic and the elasticity index approaches 0.

Our rent estimates are slightly more sensitive to assumptions surrounding the discount rate than they are for most other parameters. Varying the discount rate demonstrates the effect that changes in the opportunity cost of capital have on rent. As expected, if we increase the pre-tax marginal opportunity cost of capital the NPV of the resource will decrease, assuming prices remain constant. Applying a discount rate of 18% (+50% from the base case) as our maximum discount rate value results in a substantial reduction in resource rent in PSC but somewhat less so in PALM. mostly due to differences in the size of the annual rent in earlier years (higher in PALM) and the year in which full whale watching capacity is reached (much sooner in PALM).[13] In other words, the NPV calculation for PSC relies on substantial growth in annual rent in later years and these values are affected more so by the discount rate.

Next, we investigate the sensitivity of resource rent to the price in 2006 for whale watching trips (Fig. 2). A price increase decreases the number of whale watching trips demanded but the effect on rent depends upon several factors. Even with an elasticity of demand between 0 and −1.0, a price increase does not necessarily cause an increase in net returns (rent), although revenue does increase. Other factors liable to influence the direction of the effect of a price change on rent include the structure of costs, particularly fixed costs, and growth in demand. At our assumed elasticity of demand (−0.5571), price increases cause economic rent to rise to a maximum (rent-maximizing price) initially, but this is followed by a decline as further price increases reduce demand

[13] The capacity constraint was expressed earlier as (3) and we found that it became binding for most (but not all) of the various base case and sensitivity analyses we carried out. Using base case parameter assumptions, full capacity was achieved by year 8 in PALM but not until year 15 in PSC. Obviously, this will diminish NPV in comparison to the situation with no capacity constraint.

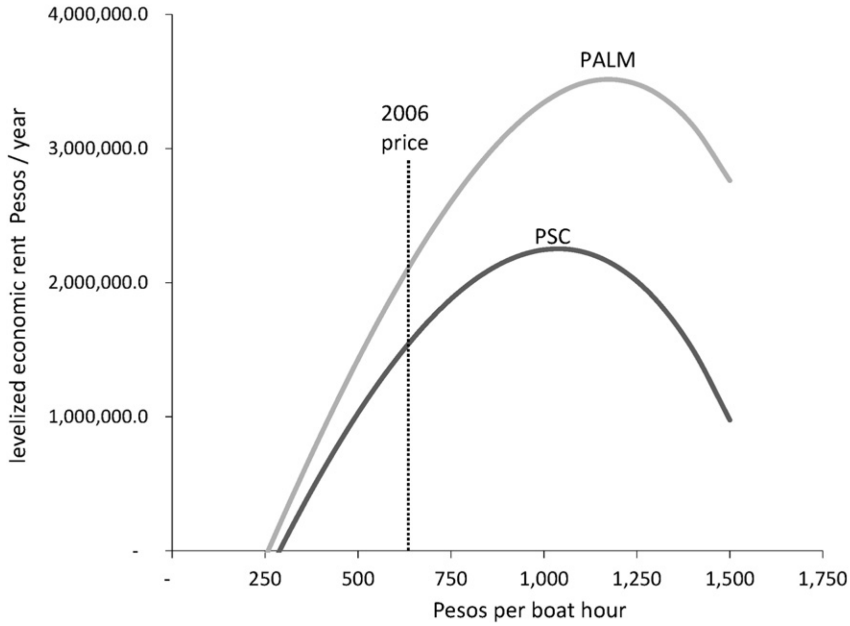

Fig. 2. Annual levelized rent as a function of the price in 2006, by community.

sufficiently that increasing average fixed costs now dominate any gain in revenues. As a result, rent follows a parabolic trajectory across the price-axis (Fig. 2).

Fig. 2 suggests that both communities may not have been pricing at the rent-maximizing price level in 2006, given our assumptions for elasticity of demand. We discuss the implications of subsequent changes in fuel and whale watching prices since 2006 in the next section.

Since there is significant uncertainty surrounding the elasticity of demand assumption, we further investigate how the estimated resource rent varies in response to the elasticity of demand (and price). First, we show the effects of different elasticity assumptions within the inelastic range for a fixed 50% increase in price from the base case (Table 7). Clearly, while somewhat responsive the estimated rent shows less sensitivity to the elasticity of demand than to most other parameters (e.g. discount rate).

Given its critical role in our model and the critical interaction between price changes and elasticity of demand, we examine an additional set of elasticity assumptions, ranging from highly inelastic demand (−0.1) to elastic demand (−1.0), across a range of different prices for a whale watching trip (Fig. 3). The resulting trajectories for our set of elasticity assumptions show predictable patterns, becoming more monotonic as demand becomes more inelastic and dipping sharply as demand becomes elastic. Results for intermediate elasticity values demonstrate the critical role of relatively high fixed costs in our model, as noted above. Given that operators set prices under imperfect information about demand elasticity, one could argue that pricing at Pesos 600 per boat hour in 2006 might have served as a conservative pricing strategy that secured net social returns for the communities without taking on substantive demand-related risk.

Next, we consider the annual growth rate in visitation and find that increasing this rate leads to increases in net returns to the community, not surprisingly (Table 7). Holding all other factors constant, there is moderate but varying sensitivity in estimated resource rents to visitor demand growth. For example, a 50% increase in base case growth

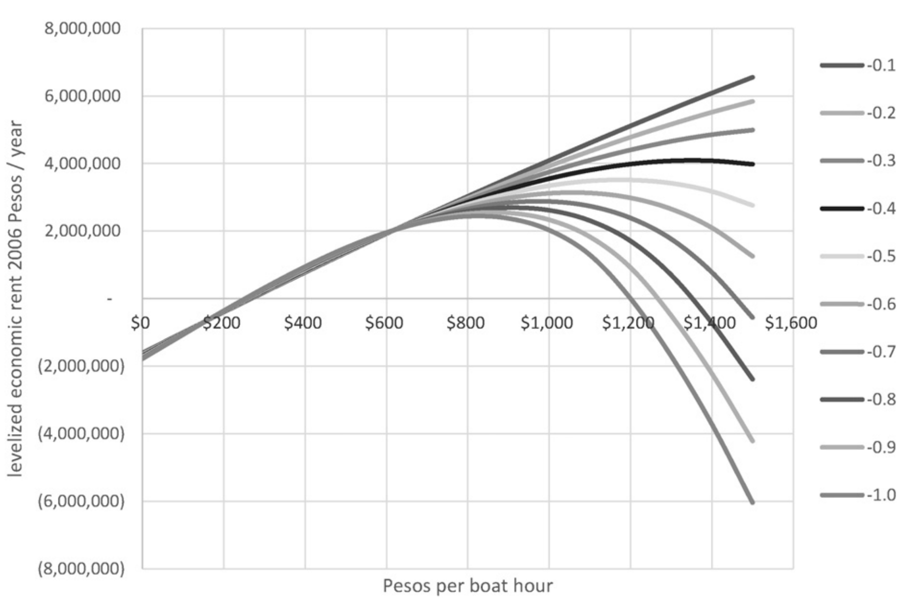

Fig. 3. Sensitivity of resource rent to varying assumptions for the elasticity of demand in Puerto Adolfo Lopez Mateos (PALM).

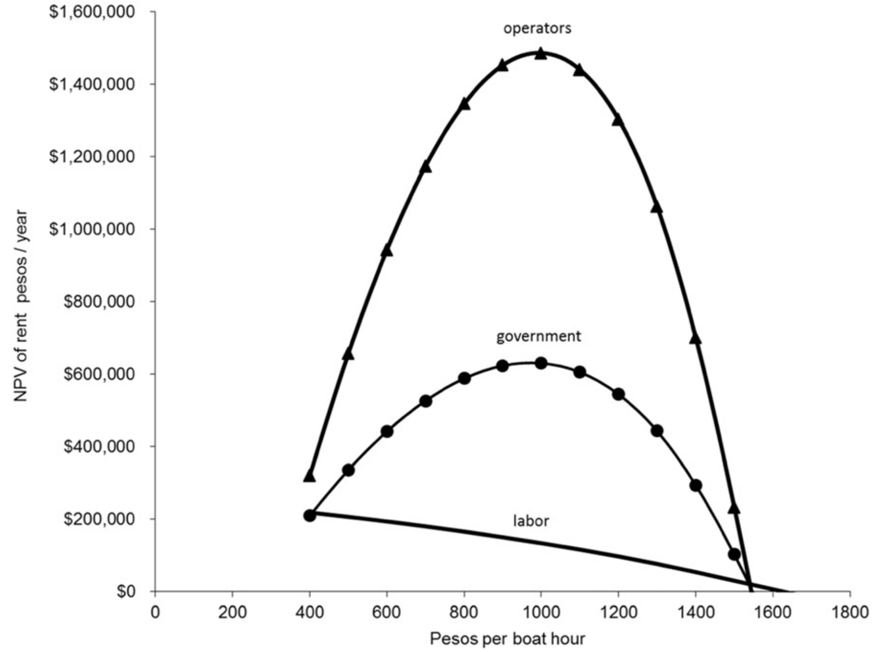

Fig. 4. Sensitivity of resource rent shares accruing to different stakeholders in Puerto San Carlos (PSC) under varying levels of price for whale watching trips.

leads to a 25% increase in resource rent in PSC, whereas a 50% decrease in base case growth results in a 42% decrease in estimated economic rent. For PALM, the estimated percentage effects of the growth assumption are much lower, suggesting that estimates for resource rents are more robust for PALM. However, capacity constraints would limit potential increases in rent in PALM, as discussed earlier.

In addition, we investigate the effect of price changes on the distribution of resource rent among stakeholders (Fig. 4). Changes in the price per boat hour affect stakeholders differently. For price increases up to the optimal price per boat hour, business owners and government collect all of the rent increase, whereas labor's share of the rent decreases. In other words, an inelastic demand curve allows business owners to increase their income through a price increase despite facing a reduction in trips demanded, but the latter consequence results in fewer labor hours and a reduction in rent going to labor. For prices beyond the optimal price per boat hour, total rent decreases with operators losing the most, followed by government and workers.

Lastly, we test the sensitivity of our time horizon assumption, considering this from the perspective of the life of the asset of arguably greatest value (adult gray whales). Mexican researchers have tracked some individual gray whales for as much as 50 years; generally, the lifespan for a gray whale is suggested to range from 25 to 80 years, but there is considerable uncertainty (McGinley, 2011). Using an alternative time horizon of 50 years for our valuation exercise, and holding all other assumptions at base case levels, resource rent in PSC would increase by 6.7% to Pesos 1.4 million annually, and in PALM it would increase by 3.7% to Pesos 2.1 million annually. Thus, variations in time horizon do not appear to alter dramatically our estimate of rent, in part because of the high discount rate used in our base case.

Overall, sensitivity results indicate that the rent estimates for PALM are more robust than the estimates for PSC. Regarding individual parameters, our results demonstrate less sensitivity to the opportunity cost of fuel or labor and more sensitivity to the discount rate, elasticity of demand, and growth in annual demand, and the highest sensitivity to the whale watching price (Table 7). Given that the resource rent estimates are not very sensitive to the opportunity cost of fuel or labor, further effort to refine our estimates for these parameters would have relatively little effect on our resource rent estimates.

9. Discussion

Determining the total economic value of the stock of North Pacific gray whales is complex due to the existence of tangible and more intangible values that cut across international borders. This study provides a first look at values from the local producer perspective of people whose livelihoods depend on gray whales returning to Bahia Magdalena. Further completion of the value picture would take into account other local values related to gray whales and the values accruing to stakeholders outside the local communities. On the demand side, the consumer surplus from whale watching by local people is likely to be small in relation to the consumer surplus captured by the international and national whale watching clientele (Loomis and Larson, 1994). Examples of other non-local stakeholders include tour companies brokering whale watching tours for gray whales along their migratory route and other national and international whale watching business owners outside Bahia Magdalena.

Additional theoretical concerns arise with respect to whether the estimated values are a true measure of value. For example, rent generated by whale watching cannot be attributed entirely to the whales, since location-specific quality attributes of the local environment play a role, as described earlier. In addition, the rent generated from whale watching does not provide a marginal value and, at best, it could be used to generate an average value (ignoring the variation in numbers of whales visiting each year). To consider explicitly marginal values we would suggest an exercise investigating how a change in the numbers of whales returning affects the profitability of the industry.[14] Complementarity and substitution effects relate to the central question of whether or not whale watchers travel to the breeding grounds to watch whales or to also watch other wildlife and enjoy the environment as a whole. Stated preference techniques can aid in determining the contribution of an additional whale to consumers' willingness to pay.

[14] We are carrying out such an exercise using a bioeconomic modeling approach but the problem is surprisingly complex since variations in whale numbers can affect both in-season demand as well as the length of the season.

Finally, our study does not purport to measure a true "biodiversity value" since it is concerned with only one species and we have attempted to avoid the somewhat murky waters related to such valuations (Nunes and van den Bergh, 2001).[15]

Our results reflect conditions in 2006 and suggest that slightly increasing the price per boat hour would have constituted an environmentally sound strategy to increase local benefits from whale watching. Indeed, whale watching fares in the Bahia Magdalena region have increased on average from Pesos 690 per boat hour in 2006, to Pesos 1200 in 2011, and to Pesos 1900 in 2014 (Secretaría de Turismo de Baja California Sur, 2015). Comparing 2014 to 2006, the increase in fares amounts to 175%. However, the price per liter of gasoline has increased 104% since 2006, from Pesos 6.74 to Pesos 13.31 in 2014 (see Appendix A). This change would have had a direct and partially offsetting influence on operating costs, despite a more than 70% larger rise in whale watching fares than in fuel prices. Interestingly, general price inflation in Mexico has been relatively modest, with prices about 40% higher in 2014 than in 2006, as recorded by the national consumer price index (see Appendix A). As a result, whale watching fares and fuel prices have been increasing substantially faster than inflation since we collected our data in 2006. This may not have improved profitability for operators but may have dampened demand for whale watching somewhat. Further increases in whale watching fares should be incremental and experimental, given the uncertainties inherent in such adjustments. Options to deal with capacity issues could include implementing a peak-pricing strategy in order to re-allocate peak demand to other times of the week when the fleet has unused capacity.

A final observation concerns the efficacy of increasing the number of whale watching permits, as desired by some members of the local communities. We would argue that an increase in the number of permits could lead to rent dissipation as these extra permits generate an increase in capital costs, and they could lead potentially to greater stress on the resource, even to the point where the whales might abandon the lagoons, as happened farther north at Laguna Guerrero Negro (Ortega-Rubio et al., 1998).

10. Conclusion

This valuation exercise demonstrates that the estimation of producer values at the local community level further aids in completing a pluralistic value picture that is essential to formulating effective international conservation strategies. In the case of migratory species, convincing local communities to participate in conservation is essential because the global value of a species must include the local value in critical habitat areas. Production theory provides an economically sound approach to estimating this local stakeholder value. Promoting such values can help convince local people to participate in conservation of the wildlife they depend on for nature-based tourism activity.

This case study of local value of the "Baja born" gray whale to two communities shows that local value is substantial. In Bahia Magdalena the gray whales generate a net benefit of Pesos 3.4 million (US$ 260,000) annually for local communities over the relatively short three month whale watching season. This valuation effort is of particular importance to local, national, and international decision makers as it complements other valuation studies that estimate the consumer surplus of the whales to the international community. The estimation also will aid the communities of Bahia Magdalena in expressing their value of the resource with national and international decision makers and with stakeholders interested in alternative community development that could threaten the benefits locals derive from gray whales.

[15] Hoehn and Loomis (1993) caution that the aggregate value of a group of species (whales and dolphins for example), might be different from the sum of values associated with individual species, thus adding to the complexity of estimating the value in terms of biodiversity.

Acknowledgments

Special thanks go to the whale watching business owners of Puerto San Carlos and Puerto Adolfo Lopez Mateo for sharing proprietary information and valuable business insights. Without their collaboration, this project would have not been possible. We also owe particular gratitude to Dr. Héctor Pérez-Cortés whose world-wide recognized knowledge of gray whales brought us physically and educationally in close contact to this charismatic species. We extend our thank you to Dr. Sean Cox for his modeling advice, to Dr. Tom Gunton for valuable comments concerning the analysis and to James W Shewmake II for his assistance with the map. We are indebted to Dr. Gunnar Knapp and three peer reviewers for providing comments that improved the analysis and presentation of our research. This research would not have been possible without generous funding from the Social Sciences and Humanities Research Council of Canada, grant number 410-2005-1720.

Appendix A. Average nominal price per liter of gasoline and inflation rate (CPI), Mexico (2006 to 2015)

Source: PEMEX (2015), OECD (2010).

Year	Price of gasoline (Pesos/liter)	Consumer price index (CPI), average inflation rate (2010 = 100)
2006	6.74	83.4246
2007	7.01	86.7339
2008	7.23	91.1790
2009	7.70	96.0091
2010	8.76	100.0000
2011	9.73	103.4073
2012	10.27	107.6589
2013	11.46	111.7569
2014	13.31	116.2479

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