The Economic Value of Gray Whales to Local Communities: A Case Study of the Whale Watching Industry in Two Communities in Baja, Mexico

by

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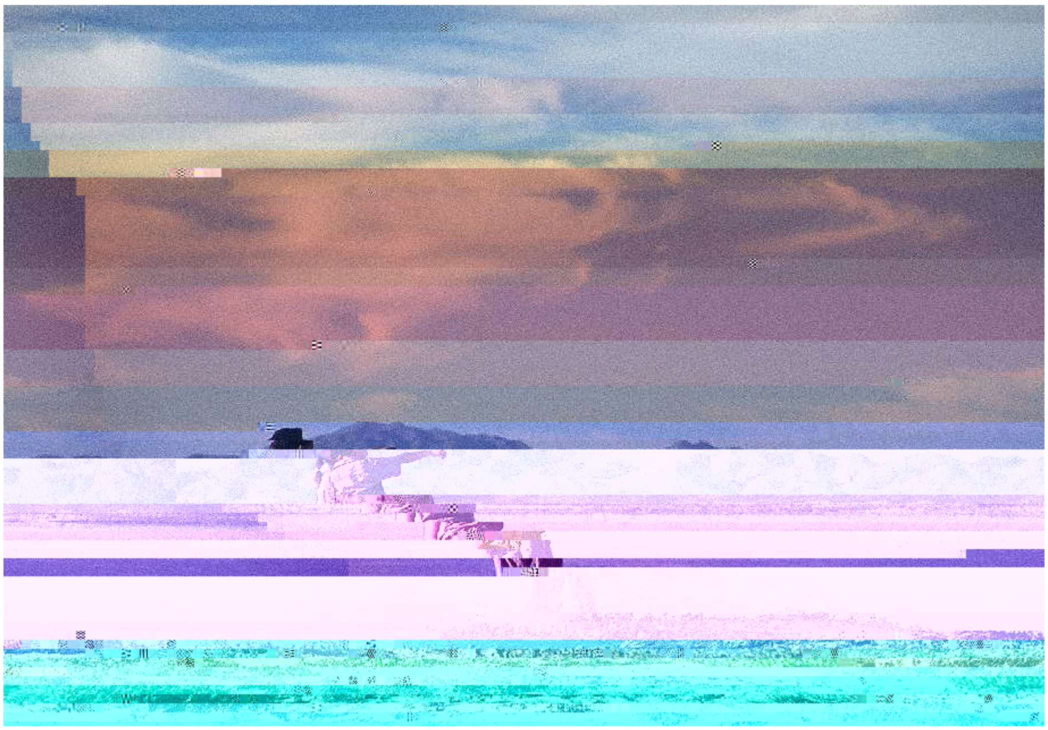
ABSTRACT

Worldwide, whale watching is a growing business for coastal communities but over-exploitation of the environment, particularly in developing countries, is still a common problem for which tourism does not provide a simple solution. The situation demands economic conservation measures that provide incentives for local people to act as stewards of the environment. This study investigates the economic value of gray whales (*Eschrichtius robustus*) in two communities in Baja, Mexico. I develop a cost benefit framework for estimating the amount of economic rent that gray whales generate for local communities and offer cost effective strategies to maximize this rent, accounting for distributional effects of income to stakeholders. Results show that the rent currently captured by local communities is significant

DEDICATION

To the children of Bahia Magdalena – may this research in some way help them to establish a life around the natural wonders for which they will be stewards.



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CHAPTER 1 INTRODUCTION

1.1 Overview

The loss of biodiversity is one of the most striking problems of our time. Many scientists agree that biodiversity is not only essential for the earth's ecosystems but also crucial for our own existence (Gowdy 1997). Biodiversity conservation is a world-wide issue especially prevalent in resource based communities of developing countries where family survival depends on the availability of common pool resources. Unfortunately, the abundance of wildlife is often viewed as a "barrel without a bottom" making over-exploitation a common issue. One way of dealing with the problem is to investigate what strategies and incentive structures would convince people to sustainably use their natural resources (Wunder 2000).

Nature-based tourism is often advocated as a conservation strategy for developing countries as it gives local people motivation to protect the wildlife and ecosystems that attract visitors , while benefiting the community (Gössling 1999). This economic incentive is crucial for achieving economic development and nature conservation, especially in areas where no environmental regulation and enforcement occurs (Wunder 2000). But as long as protected areas do not allow local people access, eco-tourism will not provide a long-term strategy to promote sustainable community development and ensure a long-term flow of benefits from conservation (Bookbinder et al. 1998).

In this context, Mexico provides an interesting case study since it is one of the world's richest countries in terms of its biodiversity and also rapidly developing in many of its hinterland regions. Therefore, finding long-term community development strategies

1.2 Specific problem statement

The Bahia Magdalena lagoon complex does not contain any protected areas, even though it harbours the third largest congregation of gray whales (Urban et al. 2003). Despite growing income from tourism, the richness and diversity of local fisheries remains the backbone of the economy of Bahia Magdalena and draws a large influx of migrant workers. The exploitative pressure on marine resources caused by outside *permisionarios* remains largely unregulated due to the centralized government system ill-suited to deal with problems in hinterland regions.[3] As a result, many shellfish species have not recovered within the last 20 years and other fisheries are declining (Young 1999). While local fisheries are dwindling, new alternatives in tourism are on the horizon but rarely offer solutions. During the two-month-long whale watching season, a number of local fishermen convert their fishing boats into tour vessels to take visitors whale watching. While few visitors spend time in the local communities beyond what's required for whale watching, a growing number of shops, hotels, and restaurants are trying to keep visitors in town longer (García Martínez 2006).

Communities in Bahia Magdalena are facing several challenges including declines in local resources, increased tourism causing cultural change, and the seasonal influx of migrant workers. Conflict over resource allocation and the lack of trust between people arriving from different parts of the country often inhibit local collaboration that could be an important part economic valuation of wildlife can be an important bridge between people divided by conflict but with common long-term goals.

1.3 important bridge between p

Few socio-economic studies exist on measuring welfare effects of whales, and focus mainly on estimates of consumer welfare, ignoring the value to producers entirely. Day (1987) quantifies the non-consumptive use value of whales to whale-watchers in Massachusetts, USA, and crosschecks estimates from a contingent valuation survey with calculations using the travel cost technique. The first contingent valuation survey eliciting values for eastern Pacific gray whales was conducted by Hageman (1985). In a survey of California households, the author estimates the mean annual willingness to pay (WTP) for gray whale conservation to be US$ 26.98 per year (Hageman 1985).

Chien (1994) and Loomis and Larson (1994) conduct two additional valuation surveys on gray whales and find similar results. In addition, results from these studies indicate diminishing marginal WTP in relation to increasing whale abundance. *Users* are willing to pay US$ 10.89 for a 50% increase in the population of eastern Pacific gray whales, whereas for a 100% increase they are willing to pay less than double that, US$ 14.52.[6] Further findings also suggest that increases in the population of whales will make *non-users* more likely to become whale watchers. As would be expected, there is higher WTP for *users* compared to *non-users*.

Utilizing data by Loomis and Larson (1994), Larson and Shaikh (2003) estimated the demand for gray whales and calculated consumer surplus for three whale-watching sites on the California Coast. WTP estimates range from US$ 79 to US$ 360 per person depending on trip length and location (Larson and Shaikh 2003). Besides the deficiencies and strengths of studies discussed above, the work by Foucat and Alvarado (1998) represents the only attempt to value benefits of gray whales to local communities in Baja.

[6] Users are defined as people who whale watch.

However, the authors estimate the benefits communities derive from gray whales based on aggregate revenue information which is inconsistent with economic theory because it ignores the costs associated with viewing whales.

Summarizing, preceding studies indicate that there is significant non-use value associated with the eastern North Pacific stock of gray whales. Due to the one sided consumer approach to valuation, however, the above mentioned studies provide an incomplete value picture because they ignore the value to producers at the local level. Studies that attempt to estimate local benefits are not in compliance with economic theory which calls for a more thorough micro-economic analysis as suggested by this study.

2.3 Valuing the environment to producers

Economic rent theory provides a framework for estimating net social returns from natural resources. The concept of economic rent was first introduced by one of the most influential classical economists, David Ricardo (1817). The classical school of economics employs three factors of production, land, labour, and capital, each earning a distinct type of income: rent, wages, and interest. In economic terms, rent accrues to the owner of the land in excess of the cost of keeping the land in its current use. Note, the latter definition emphasizes the owner's trade-offs involving utilizing the land in its current use, by accounting for the income that the land could have earned in its second best use (opportunity cost of land). In the context of natural resources, economic rent is defined as the surplus remaining "after revenues from natural resources have been disbursed to pay all costs of production – including a return on investment, or 'normal profit', equivalent to what could be earned in the next best use of the capital" (Gunton and Richards 1987, p.xxxi). More generally, Anderson (1985) defines rent as the difference between the social value of an economic activity and the social cost attributable to that activity.[7] Gunton and Richards (1987) call economic rent the most appropriate measure for estimating the contribution of natural resources to human welfare.

Ricardo (1817) defines two concepts surrounding resource rent: *scarcity rent*, which exists in situations where the resource is scarce, and *differential rent* which is rent received through resources of differing quality.[8] Other conceptually different categories of rent include *monopoly rent*, *user cost rent*, and *windfall rent* (Gunton and Richards 1987). *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. *Differential rent*, often calculated in the mining sector, for example, is defined as the difference in cost between one mine just covering the cost of labour and capital (marginal mine) and another mine generating a surplus above the costs of production (intra-marginal mine) (Gunton 2004). Intra-marginal mines can occur in situations when higher quality ore, cheaper transportation, or easier extraction exists. *Monopoly rent* arises when producers exercise market power to curtail supply in order to raise the price and generate rent. *User cost rent* is generated when current resource prices increase due to people's anticipation of resource exhaustion. *Windfall rent* originates in cases of inelastic supply where an unanticipated increase in demand raises price in the short run and causes above-normal returns to producers. An additional complication related to windfall rent is the concept of *quasi-rent*, which is defined as the income

[7] Social cost accounts for the opportunity costs associated with utilizing all factors of production.
[8] Differential rent is sometimes also called Ricardian rent.

earned by a fixed input and therefore equal to the opportunity cost of capital investment. In other words, quasi-rent occurs through the distinction of short run costs, as the sum of variable and operating costs, and long run costs, which include capital costs since capital is variable in the long run (Gunton and Richards 1987, p.33-34).

Economic rent analysis is widely applied

Summarizing, the above mentioned studies illustrate the wide applicability of rent analysis to investigate effective taxation, changes in management policies, and industry efficiency with the latter constituting the main goal of traditional rent analysis. Besides the overarching aim to maximize rents, however, a more novel approach to the analysis incorporates considerations of equity as being the distribution of income to all claimants of economic rent.

2.4 Addressing issues of equity and distribution

Increasingly, conservation and development strategies centre around local communities due to their direct linkage and dependence on natural resources (Pagiola, von Ritter, and Bishop 2004). However, besides calculating the magnitude of local welfare, the question of who gains and who loses from utilizing the environment is a growing consideration of effective policy development, particularly in developing countries (Charles 1988; Martinez-Alier 2001). Issues of equality are intensified in the context of common pool resources such as fisheries, where a wide range of stakeholder interests can create conflict and add complexity to finding effective management schemes. Fisheries are commonly known for having a variety of management objectives including social considerations such as maintaining the resource, economic performance, and equity (Charles 1988).

The question remains whether fisheries management should focus on maximizing resource rents, be concerned with equity, or whether both goals are obtainable. Bromley and Bishop (1977) argue that social welfare considerations need to be “based on both efficiency and equity” (p. 299). This multi-objective view constitutes a paradigm shift away from the traditional single-objective of rent maximization. But Hannesson (1981) warns that there is no "best world" and that multi-objective management is associated with trade-offs between objectives.

Research on wealth distribution often employs the Lorenz curve which graphically illustrates the distribution of income in society (Lorenz 1905). Extending this framework, the Gini index quantifies inequality by determining a ratio based on graphical areas measured under the Lorenz diagram. An index of zero is attributable to perfect equality while an index of 100 is associated with perfect inequality (Gini 1921).[9]

Studies on the distribution of rent in fisheries are quite numerous (Griffin, Lacewell, and Nichols 1976; Huq and Huq 1985; Toufique 2000). Griffin, Lacewell, and Nichols (1976) analyse the distribution of net social returns in the Gulf of Mexico shrimp fishery and find that crew members' share of rent is less affected by changes in product price than the share going to vessel owners. However, if crew and vessel owners split some of the costs, which is common in fisheries, rent accruing to crew-members becomes more sensitive to changes in product price. Huq and Huq (1985) apply the Lorenz curve and calculate Gini indexes to compare income distribution across different regions in Bangladesh. Toufique (2000) investigates the distribution of rent in the inland fisheries of Bangladesh, and concludes that fishers receive large amounts of rent but ownership and access rights are important factors determining the amount of rent received by individual fishers. Also the distribution of rent is more egalitarian, the better the fishing grounds are, suggesting that heterogeneity between fishing grounds plays a role in the distribution of rent (Toufique 2000).

[9] Mexico's Gini-index is equal to 49.5 compared to Sweden's 25 and Bolivia's 60 (United Nations 2006).

Other methodologies to describe the distribution of income can be found in the project valuation and cost benefit literature. For example, Curry and Weiss (2000, p. 265) discuss income distribution effects of a telecommunications project to different stakeholders such as project owners, workers, lenders, government, and telephone users. Their approach is based on estimating income flows from financial statements and analysing income transfers between stakeholders. The advantage of Curry and Weiss's (2000) approach lies in the ease of discounted present values tracing the distributional effects of the project. In particular, the annual income flows of the project are capitalized into a net present value that is used to analyse the distribution of income over the life of the project, instead of comparing income effects year by year (Curry and Weiss 2000). Critical to note, however, is that the approach becomes inaccurate when financial and economic prices change over time, in which case the conversion factor is not constant (Curry and Weiss 2000, p. 266).[10]

[10] For cases where a project's outputs and inputs are tradable, financial prices need to be converted into

CHAPTER 3 ECONOMIC AND ECOLOGICAL LINKAGES

3.1 Total abundance

The eastern North Pacific stock of gray whales (*Eschrichtius robustus*), also called the California stock, is the largest of the two populations of gray whales still in existence today.[11] Besides the smaller western population inhabiting the coast of Korea and hunted to almost extinction, the eastern world's biomass of amphipods. Research shows a decline in the amphipod population in this area, possibly due to increased predation pressure caused by the doubling of the eastern North Pacific gray whale stock since the 1970s (Le Boeuf 1999). The decline of amphipods is also seen as an indicator that gray whales are reaching carrying capacity (Le Boeuf 1999). Other propagates of this starvation hypothesis think that the major threat to the eastern North Pacific stock of gray whales is the decline of its prey rather covered by sea ice (Rugh, Shelden, and Schulman-Janiger 2001).[12] Perryman et al. (2002) finds evidence that the longer the primary feeding area remains ice-free the higher the calf production in the following year.

The whales take approximately two months southbound, and three months for their northbound journey, which constitutes the longest migration of any mammal (Rugh, Shelden, and Schulman-Janiger 2001). Feeding during migration is uncommon since the whales' food source is mainly located in the Arctic Ocean (Mate, Lagerquist, and Urban R. 2003). The resulting six months long energy deficit causes the whales to be more slender in shape on their northbound migration compared to the southbound journey (Perryman and Lynn 2002). During southern migration, northern lagoons are

in the abundance of whales (Pérez-Cortés, Maravilla, and Loreto 2000; Urban et al. 2003). Annual fluctuations in abundance can be caused by climatic events or environmental disturbances such as changes in tides. For example, the El Niño event in 1998 caused a large reduction in the relative abundance of gray whales in Bahia Magdalena (Gardner and Chavez-Rosales 2000). Instead, the missing proportion was observed in San Ignacio and Ojo de Liebre, two breeding areas to the North of Bahia Magdalena that were not as affected by the increase in water temperature (Pérez-Cortés, Maravilla, and Loreto 2000).

Besides climate impacts, other environmental influences can change relative abundance in the breeding lagoons. For example, tidal activity and ocean current can transport large amounts of sand to and from important breeding and nursing area (Pérez-Cortés, Maravilla, and Loreto 2000; Urban et al. 2003).

3.3 Habitat utilization

Less than one third of the eastern population of gray whales visits the breeding lagoons in Baja; the remainder spreads along the coast from Alaska to California (Dedina 2000; Pérez-Cortés, Maravilla, and Loreto 2000). At present, not all lagoons are equally important for calf production and population numbers have varied over the last 150 years due to exploitation in bays where commercial whalers had easy access to the breeding locations. Since pregnant female gray whales return to their natal lagoons for calving, hunting in a particular lagoon can have detrimental long-term effects on a lagoon's future one breeding site and colonize another. This type of behaviour is commonly known to occur among metapopulations (Hanski and Gilbin 1991). In ecology, the theory of metapopulations suggests that populations live in a patchy environment characterized by extinction and recolonization of vacant habitat patches (Hanski and Gilbin 1991).

3.4 Human impact on gray whales

Research on human activities threatening gray whales focuses mainly on short-term reactions to human impacts, rather than investigating long-term consequences (Moore and Clarke 2002). Impacts range from coastal and offshore development to whale watching and commercial fishing. The level of disturbance caused by coastal development seems to increase the likelihood of gray whales abandoning their breeding lagoons (Findley and Vidal 2002; Gard 1974; Reeves 1977). A prime example for the loss of valuable breeding habitat is San Diego Bay. Before the 1950s the bay was heavily populated by the gray whale but the enormous coastal development caused the whales to abandon the area (Reeves 1977). Another example of human activity displacing whales from their nursing areas is Guerrero Negro as I mentioned in the previous section (Gard 1974). In addition to the currently used breeding lagoons on the west coast of the Baja peninsula, there were two more calving sites on the Northwest coast of mainland Mexico (western coast of Gulf of California) where a small number of gray whales congregated until the mid 1980s. Findley and Vidal (2002) believe that the whales left these breeding areas because of increased disturbances through coastal development.

Breeding cow-calf pairs are especially affected by development occurring in the inner areas of the lagoons because during gestation the pairs utilize shallow areas closer to shore more frequently than solitary adults, breeding pairs, and juveniles who swim outside the lagoon (Ollervides and Pérez-Cortés 2000). Coastal development could cause mothers and calves to abandon the protected waters of the inner lagoon areas and force them to move offshore where the survival of calves would be more uncertain due to higher predation of killer whales (*Orcinus orca*) and more turbulent ocean conditions (Pérez-Cortés 2005).

Offshore oil and gas development, large commercial vessel traffic, or aircraft can negatively affect gray whales particularly in the way they communicate (Moore and Clarke 2002). Gray whales use underwater vocalization, which may be disturbed by underwater noise from seismic activity or engine noise from boats or airplanes. Moore and Clark (2002) mention, that eastern North Pacific gray whales may be stressed by increased noise levels near shipping lanes or ports, particularly apparent in the Southern California Bight. Also, common fisheries related whale deaths occur when whales get entangled in fishing gear or collide with fishing vessels. In British Columbia for example, 27 percent of all gray whale fatalities are related to fishing activity (Baird et al. 2002).

Whale watching can also negatively affect gray whales in their nursing areas as well as on their migration path (Duffus 1996; Ollervides and Pérez-Cortés 2000; Heckel et al. 2001). Depending on the angle and speed of an approaching vessel, gray whales change their swim velocity and swim behaviour, which is believed to increase their energy consumption (Heckel et al. 2001). In particular small boats such as the ones used for fishing and whale watching in the breeding lagoons can severely harass whales (Norris et al. 1983). Since annual reproduction occurs in the specific nursing area, any detrimental effects from whale watching in these locations can production of calves and jeopardize the status of the stock (IWC 2000). Gray whales are most vulnerable in their breeding grounds where they congregate more densely than in any other parts of their migration (Heckel et al. 2001). However, most researchers do not consider whale watching activities to be solely responsible for variations in the whale abundance and habitat utilization (Ollervides and Pérez-Cortés 2000; Pérez-Cortés, Maravilla, and Loreto 2000). More likely, the variation in the number of whales visiting the lagoon annually is related to changes in the environment such as climatic or physiologic effects, as discussed in the previous section.

3.5 Local resource conditions

The Bahia Magdalena lagoon complex consists of an extensive array of narrow mangrove channels and wide open waterways that are subdivided into three regions: the northern, middle and southern region (Figure 3-1) (Rice et al. 1981).[14] Even though the three regions are connected by water ways navigable by humans, the whales cannot pass through the narrow channel, called Curva del Diablo (Devil's Bend). Curva del Diablo nor7hern, d in thTw(ize bay. Thi0 Twturc-bor-0.ns)5.1(2 th)5.9(e)]TJ-1922 -2.295 TD0.00creTD0.0wo c

Whales are spotted most frequently in the two dark areas indicated on Figure 3-1 (Dedina 2000; Norris et al. 1983; Pérez-Cortés 2005; Rice et al. 1981). In the northern region, whale watching activities are based in

Approximately ten percent of the breeding population of gray whales frequent the Bahia Magdalena lagoon complex. Two thirds visit the northern part of the lagoon complex, whereas the remainder congregates in the middle and southern sections (Le Boeuf 1999; Rice et al. 1981; Pérez-Cortés, Urban, and Loreto 2004). The first whales arrive in early January and leave by the end of March (Pérez-Cortés 2005; Rice et al. 1981). In 1980, maximum counts for each part of the lagoon complex were observed between Feb 7th – Feb 10th (Rice et al. 1981).

The whales utilize the region differently, where the Santo Domingo Channel constitutes one of the most productive breeding sites with 12 percent of all calves born to the eastern North Pacific stock, Bahia Magdalena attracts more solitary whales for mating and congregating (Rice et al. 1981; Pérez-Cortés, Urban, and Loreto 2004). While, the lagoon in PALM harbours predominantly nursing mothers and their calves (83 percent), 89 percent of all whales observed out of PSC are single whales (Le Boeuf 1999).

The observed pattern of habitat utilization with only a few cow-calf-pairs visiting Bahia Magdalena did not always occur. Le Boeuf (1999) states that Bahia Magdalena once was a more important breeding site during pre-exploitation times. Considering the fact that mothers are more likely to return to their natal lagoons than to other breeding sites, the reason for the lack of mother-calf-pairs in PSC relates to extensive past commercial whaling for which Bahia Magdalena was very suitable (Le Boeuf 1999).[15]

Summarizing, Bahia Magdalena provides an interesting case study because the Bay seems to be a marginal breeding area at the southern end of the migratory path that

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[15] Large vessels are able to easily navigate through the entrance to Bahia Magdalena which created particular incentives for commercial whaling.

has unused capacity. From an economic perspective, the increase in population of gray whales expanding the use of this area could more than in other lagoons affect economic benefits to whale watching operators.

3.6 Local whale watching

Prior to 1994 the market for whale watching in Baja was dominated by U.S. based companies who offered boat tours to many breeding lagoons including the Bahia Magdalena lagoon complex. It was not until the early 1990s that local fishermen began seeking alternative income from tourism as a result of declining fisheries (Dedina 2000). After disputes between foreign operators and an ever increasing fleet of local fishermen offering whale watching tours, the Mexican government granted an exclusive right to local operators in 1994. Federal authorities demanded the formation of cooperatives for whale watching and issued a fixed number of permits (Dedina 2000).

The permits were available at no cost but required operators to pass an examination on whale watching guidelines that dictate "self enforcement among operators" (Government of Mexico 1998; Pérez-Cortés 2005; Spalding 2002). Operating permits are location-specific to whale watching areas, non-transferable, and non-tradable. However, permits are often shared within families, and cooperatives tend to reassign or share permits with new members who buy in. In the past, the industry was managed by the federal agency for agriculture, rural development, and fisheries SAGARPA (Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentacion), who recently transferred responsibilities to the federal department of environment and natural resources SEMARNAT (Secretaría de Medio Ambiente y Recursos Naturales).

The whale watching season is governed by the arrival of whales in January and usually lasts from mid January to the end of March, totalling 44 days in 2005 (Gonzalez Agundez 2006). Until the first whales arrive, the coastal communities of the region are mainly occupied with fishing for shrimp, one of the most profitable fisheries in the region. As soon as the whales arrive, shrimp fishing is restricted to areas not occupied by whales to avoid conflicts and entanglement of the whales with fishing gear (Pérez-Cortés 2005). Then, fishermen in possession of a whale watching permit convert their typical Mexican fishing boat, called panga, to suit whale watching activities.[16] The fishermen install cushions and flooring and paint the inside and outside of the boat to provide an appealing look.

Pangas are open skiffs, five to seven meters in length and built from fibreglass. These small fishing boats seat six passengers and the pangero comfortably. Most boats run on a sixty-five horsepower two-stroke outboard engine, which is frequently used by fishermen in the region. Even though there are no regulations in place that govern the size of boats and engines the industry shows almost homogeneous types of engines and boats.

The interviews with pangeros focused on fuel consumption and how it might vary throughout the year depending on whale abundance, engine type, and length of trip. Fuel consumption in both towns is considerably lower during times when maximum numbers of whales are observed in the bay compared to the beginning of whale season when operators must drive all the way to the mouth of the lagoon to see whales (Figure 3-2). Clearly, boats in PSC are more efficiently run which is partly explained by the differing engine technologies used in each community. In PSC, 40-percent of the engines used for

[16] Fishermen only switch once from fishing to whale watching and therefore won't engage in both activities at the same time should they decide to offer whale watching tours.

whale watching are fuel efficient four-stroke engines, whereas operators in PALM exclusively use less efficient two-stroke engines.

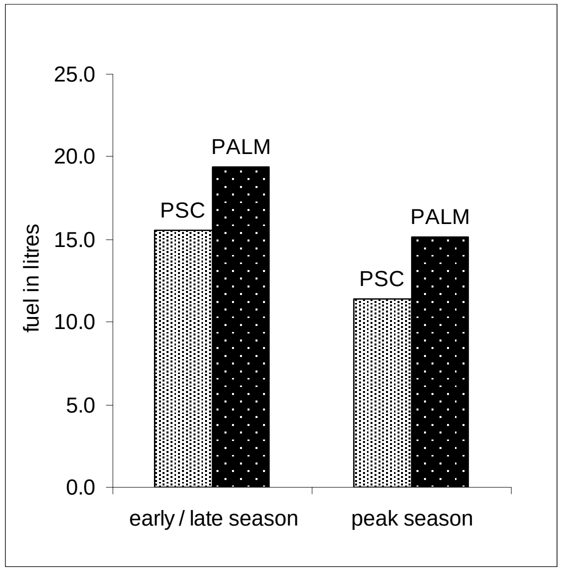

Figure 3-2 Average per hour fuel consumption dependent on whale abundance

It is interesting to note that all whale watching operators based in Puerto San Carlos that don't fish during the rest of the year use more fuel efficient four-stroke engines. Table 3–1 shows that fuel consumption in litres per trip varies by trip length and engine type in each community. Longer trips use relatively less fuel per boxh during

Whale watching is limited to approximately six hours per day, constrained by weather and ocean conditions. High winds can prohibit whale watching activities occurring in the afternoon, especially in the early season (Gonzalez Agundez 2006). After the whale watching season is over, most operators begin fishing clams and lobster as well as other species found outside the lagoon (Pérez-Cortés 2005).

In the following sections I will first describe whale watching activities in the Santo Domingo Channel and then explain operations in Bahia Magdalena, since resource conditions and industry struct

Occasionally, these habitat changes hinder whales from entering the lagoon and cause year by year fluctuations in the number of whales returning to the estuary (Norris et al. 1983; Pérez-Cortés, Maravilla, and Loreto 2000; Urban et al. 2003).[18]

The first-time-visitor to Puerto Adolfo López Mateos will have an easy time finding the local whale watching businesses due to the well marked directions throughout town. After travelling about one kilometre from the town's plaza visitors reach the facilities on the eastern shore of the Santo Domingo Channel. Visitors arriving by plane to go whale watching use the town's airstrip near the embarkment point. Small restaurants and souvenir shops established themselves near the tourism dock and the tourist police keeps an eye on organized parking, businesses, and visitors alike. Plans are under way to build more restaurants and tourism facilities, which would offer year-round activities such as turtle and bird watching, surfing and sports fishing to keep visitors in town for longer.

Often, whale watchers can readily observe whales in close vicinity of the tourist pier. The dock holds approximately sixty boats that are ready to transport visitors to their *once-in-a-life-time* encounters with gray whales. The walk-in whale observer can choose among four businesses, located next to each other. The operations are run very efficiently with pangeros (Spanish for boat driver) already waiting at the dock to take visitors on tours. Several dock hands provide a helping hand when visitors embark the skiffs from the docking facility.

[18] For example, in 1998 the maximum whale count was only 31 whales which indicates high variation in whale abundance considering maximum counts of 200 (Pérez-Cortés, Maravilla, and Loreto 2000).

Boat trips last between one and three hours with first whales being sighted within minutes of departure. The boat tour focuses on the calm waters inside the lagoon and avoids the outer parts on the Pacific Ocean due to the dangerous mouth of the lagoon at the Boca de Soledad. During the tour, visitors observe whales in very close proximity displaying different behaviours such as courting, mating, nursing, or spy hopping. Due to the narrow area of the lagoon in which the whales are constrained, individual whales are easily observed for extended periods of time. However, the geographical setting also leads to some crowding of tour boats in areas of intense whale activity.

Operations in PALM show a high degree of cooperation and partnership among participants in the industry. The whale watching industry consists of two large cooperatives and two small sole proprietors that together hold a total of twenty seven whale-watch-permits (Table 3–2). The two cooperatives are run similarly and each have twenty five to thirty members and hold between ten and thirteen permits. Most members of the cooperative are long time residents that predominately fish during the rest of the year.[19] Besides sharing whale watching permits, members contribute half of their revenue to the cooperative to cover costs for lobbying, marketing, office expenses, and whale watching equipment.[20] Pangeros are hired at a local wage of Pesos 70 per boat hour.

[19]Income from fishing amounts to approximately 80 percent of total annual income where the remainder is attributable to whale watching.
[20] In the next chapter I will provide a more detailed account of these costs and how the benefits from whale watching are distributed among the community.

Table 3–2 Distribution of whale watching permits by location and organization

	PSC		PALM	
	operators	permits	operators	permits
local				
not organized	3	14	4	4
organized in union/coop	11	21	55	23
sub-total	14	35	59	27
non-local				
not organized	2	4	--	--
total	16	39	59	27

PALM has a well-established client base mainly through pre-arranged package tours by travel agencies that amounts to 54 percent of total business (Table 3–3). The second strongest clientele comes through walk-in whale watchers (35 percent), followed by cruise ship business (8 percent) and independently organized bus groups (3 percent). Prices per boat hour differ somewhat among operators and depending on client groups range from Pesos 600 to Pesos 650 per boat hour (Table 3–3). For PALM walk-in

Table 3–3 Price discrimination depending on client group

(in 2006 Mexican Pesos)	***PSC***	***PALM***
walk-in		
proportion	57%	35%
price	600	650
group/bus		
proportion	10%	3%
price	n/a	n/a
cruise-ship		
proportion	0%	8%
price	n/a	n/a
agency		
proportion	33%	54%
price	550	600
price per boat hour [a]	**582**	**620**
price per person [b]	**140**	**116**

Notes:
a) weighted price
b) assumes 4.16 (5.33) seats per boat occupied in PSC (PALM), see: SEMARNAT (2005)

Locals also receive business through an American based company that runs weekly cruise ship excursions entering the Santo Domingo Channel from the south through Bahia Magdalena.[21] The company, who is also known as a world leader in geography, cartography, and exploration and known for its large and internationally known publication, hires local guide services to gain access to whale watching rights. Commonly, cruise ship passengers do not visit the town of PALM. During interviews with local operators, respondents report that especially on weekends, the whale watching fleet is reaching capacity and cooperatives are seeking to buy larger boats to accommodate this peak demand.

[21] In personal interviews, local fishermen criticised the cruise ship for damages to the benthic environment in the narrow mangrove channel at Curva del Diablo.

3.6.2 Puerto San Carlos

Bahia Magdalena forms the middle and largest part of the Bahia Magdalena lagoon complex, extending thirty one kilometres North-South and twenty two kilometres East-West (Rice et al. 1981). Two mountainous islands, Isla Magdalena and Isla Margarita, protect the bay from the Pacific Ocean and form a five kilometre wide access channel used by whales and large vessels alike to enter the lagoon (Dedina 2000).[22]

Visitors on their first trip to PSC will find it difficult and somewhat cumbersome to whale watch. The businesses are located throughout town and each operator has his own signage. There is also no common location where whale tour businesses sell whale watching trips, as in PALM. Local tour guides commonly receive business by flagging down costumers that are driving through town.

After initial contact with customers, operators load their boats on trailers, from their home or office location across town, to a common launching beach that serves as a natural launching site for all operators. Besides the logistics of the operations being quite cumbersome for clients and operators alike, this natural embarkment point is affected by tidal changes that make launching a difficult and laborious task.

Most whales are seen closer to the mouth of the bay which is approximately twenty kilometres distant from the town of PSC (Figure 3-1). The vast and extensive area of the bay turns boat trips into two to five hour long wilderness experiences, that are occasionally constrained by weather and water conditions (Gonzalez Agundez 2006).

Compared to their northern competitors, whale watching in PSC is less organized and participants cooperate less, showing more tension and competition. The industry is comprised of three sole proprietors that together hold a total of thirteen permits (Table 3–2). Additional twenty one permits are held by a union which can be characterized as a joint venture between its members. It is interesting to note that there is less cooperation in between members of the union in PSC than observed in cooperatives in PALM. For example, the eleven members of the union in PSC each hold two permits that they generally do not share among members, revenues and costs are also not shared.

Cooperation exists in the form of occasionally allotting excess clientele to other members.

Similar to cooperatives in PALM, union members in PSC are fishers during the remainder of the year. However, the three sole proprietors specialize in year-round nature based tourism and offer natural history tours, wildlife viewing, kayaking, surfing and sports fishing. Interviews with operators reveal that union members and the three sole proprietors are in fierce competition and rarely cooperate to share clients or to lobby the government for their cause. Central docking and business facilities, comparable to the ones found in PALM, are being built and should considerably improve the dangerous and inconvenient embarkment situation.[23] Pangeros earn Pesos 100 per hour which reflects the higher risks involved in taking out visitors in the vast and sometimes rough waters of Bahia Magdalena, compared to PALM (Pesos 70 per hour).

PSC's client base is less established and mainly involves walk-in customers (57 percent). Only 33 percent of the operators' business comes from travel agencies and 10 percent through individually organized groups (bus tours) (Table 3–3). Local operators do not receive any business through cruise ships but occasionally are hired to transport clients for two, non-local, whale watching companies based in the state's capital, La Paz. Both of these companies own two whale watching permits each, and offer multi-day whale watching, where clients stay in remote whale watching and nature camps in the Bahia Magdalena area (Table 3–2).

Similar to PALM, I observe some price discrimination in PSC, where the price per boat hour varies somewhat among operators and ranges between Pesos 550 and Pesos

[23] The construction of docking facilities in PSC is being stalled due to regulatory issues.

600 depending on the client group (Table 3–3). Since business focuses on walk-in customers and package tours (travel agency), the weighted average price per boat hour is equal to Pesos 582 in PSC (Table 3–3).

CHAPTER 4 ECONOMIC RENT ANALYSIS OF WHALE-TOURISM

4.1 Overview

In this section I develop a framework for evaluating the financial contribution of gray whales to economic welfare in PALM and PSC. Economic rent is the most appropriate measure of this contribution because it calculates the surplus remaining after revenues have been used to pay all costs of production including a return on investment, or "normal profit" (Gunton and Richards 1987).[24] Normal profit is equal to what could have been earned in the next best use of the capital (opportunity cost of capital). A key distinction between this type of economic analysis and a financial analysis is that it reflects the social opportunity costs associated with utilizing the project's factors of production (Curry and Weiss 2000, p. 38). In the case of whale watching in Bahia Magdalena, any surplus above and beyond this opportunity cost is equal to rent that is attributable to the gray whales visiting the bay, the resource conditions and site specific characteristics of each location, and the organization of the industry, just to name a few fixed factors of production.[25]

The method of estimating rent is conceptually straightforward but entails some practical hurdles, one of which is the proper calculation of the opportunity cost of capital (Lyon 1990; Schwindt, Vining, and Globerman 2000; Gunton and Richards 1987; Gunton 2004). Cost-benefit theory requires that costs accruing as investments be

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[24] Normal profits are part of total costs and therefore not part of surplus rent.
[25]

converted into the stream of costs and benefits that would have resulted if the investments had not taken place (Schwindt, Vining, and Globerman 2000).

Costs and benefits that arise in different years cannot be valued equally across the years of a project because we associate higher value to benefits that occur sooner rather than later.[26] Discounting helps to account for this time value of money, which is different depending on society's perspective or the view of an individual decision maker. While society's goal is to allocate resources efficiently, an individual perspective focuses on the decisions surrounding income. In the former case, the discount rate accounts for the social opportunity cost of using up society's capital resources for the project, which then accounts for the cost of not using the capital in its next best use. In the latter case, the theoretic basis for the discount rate is that it accounts for people's time value of money, as reflecting the opportunity cost of deferring consumption.

Since this study is a social analysis I focus on social discount rates and ignore private discount rates. Economists apply two distinct approaches to the social discount rates. The consumption discount rate (formerly called the time preference rate) reflects the social time preference and allocation of resources to society. It is often assumed to be proxied by the yield on government bonds. In contrast, the production discount rate reflects returns on the next best investment opportunity and is proxied by the marginal rate of return on capital (MOC). The latter is always higher than the consumption discount rate and emulates the risk involved in market investments (Curry and Weiss 2000, p.38). For the purpose of this analysis, I use the MOC because the project uses private capital even though the analysis focuses on social outcomes. The implications of a

[26] No discounting would assume that beneficiaries are indifferent between costs and benefits in year one and costs and benefits in year 30.

This approach is justifiable since the general assumption is that high returns above the long run opportunity cost of capital will compensate for low returns during weak markets. However, Gunton (1987) notes that high returns could also be misinterpreted as rents instead of compensation and therefore skew the value picture. While economists normally base their projections on an average historic profit (Gunton and Richards 1987; Schwindt, Vining, and Globerman 2000), a better method is to simulate fluctuating returns for the forecast to account for market uncertainty (Morgan and Henrion 1990).

Market imperfections are a third potential issue because the estimation assumes

estimate the aggregate rent generated through whale watching, and second I calculate the distribution of rent as it accrues to operators, labour, and government.

I collected cost data for the industry through semi-structured interviews with twenty-five operators conducted between February 22nd and March 8th 2006, and analyzed the revenue and cost structure of the industry based on the approach taken by Curry and Weiss (2000, p. 25). I also used annual business reports submitted in 2005 to SEMARNAT (SEMARNAT 2005). One serious limitation arises from the lack of historical data, which prevented the analysis from accounting for temporal variation in the data (Morgan and Henrion 1990). Often the availability of data is limited in developing countries and requires extensive data collection by the researcher who is constrained by the study's budget and time frame. Further data on historical business activity and macro economic parameters, combined with a Monte Carlo simulation, could improve the value estimates of this study.

4.3 Industry revenue and costs

Assuming an inelastic demand curve, each community captures total benefits from whale watching equal to industry revenue, formally stated as:

$$R(t) = p[y(t)] \cdot y(t),$$
$$\text{where:} \quad y(t) = g(t) \cdot l \, ,$$
$$g(t) = \frac{v(t)}{s} \qquad \text{for} \qquad g(t) \leq \frac{h}{l} \cdot n \cdot j \, , \qquad (4.3)$$

where $p[y(t)]$ is a downward sloping inverse demand function, where p is the price per boat hour, and $y(t)$ is the number of boat hours supplied by the industry. The latter is equal to the product of total annual trips supplied, $g(t)$, and the average trip length in hours, *l*.[34,35] I calculate the number of trips by dividing annual visitor numbers, *v*(*t*), by the number of seats occupied per trip, *s*.[36] Note, *h* is the maximum hours of operations per day, and *g*(*t*), cannot exceed the maximum possible number of annual trips which is equal to the product of the number of trips per permit per day, *h/l*, the number of permits, *n*, and the season's length in days, *j*.

Larson and Shaikh (2003) estimate the elasticity of whale watching demand in Monterey Bay to be minus 0.5571.[37,38] Since, Monterey Bay is frequented by the North East Pacific stock of gray whales and observation activity tends to be similar there, I use their estimate to represent changes in visitation responding to changes in the price per boat hour.[39] World wide whale watching demand has grown on average between 10 and 13.6 percent annually between 1991 and 1998 (Hoyt 2001). For the base line case in this analysis I assume the demand for whale watching will grow 10 percent annually, an assumption consistent with reports of historic business activity collected through the semi-structured interviews.

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[34] Consumer surplus occurs but accrues to outsiders, in this case whale watching clients residing in other parts of Mexico or foreign countries. Since clients are non-local, I ignore consumer surplus for this analysis.

[35] Average trip length, *l*, is 3.0 hours in PSC and 2.12 hours in PALM (SEMARNAT 2005).

[36] The number of seats occupied, is based on visitation data provided by SEMARNAT (2005).

[37] Since the actual whale watching demand in Bahia

For each of the two towns, I express the annual aggregate industry cost *C(t)*, as the sum of annual operating costs, $OC(t)$, annual capital charges, $K(t)$, and annual fixed cost, F :

$$C(t) = OC(t) + K(t)_{\text{levelized}} + F\ . \tag{4.4}$$

In addition, I assume $OC(t) = C_F(t) + C_{oL}(t)$ with C_F representing total annual fuel cost, and C_{oL} being the opportunity cost of labour.[40]

4.3.1 Operating costs

Industry fuel cost is based on the different trip-lengths and engine types (two-stroke vs. four-stroke) as observed in personal interviews with pangeros in PALM and PSC, and equal to:

$$C_F(t) = \sum_{i}^{m} \sum_{k}^{n} \sum_{j}^{z} g_i \cdot a_{ik} \cdot f_{kj} \cdot [\, p^{fuel} + \varphi_j \; p^{oil} \,]\ , \tag{4.5}$$

where m is the number of individual operators, i; n is the number of trip types, k ; and z is the number of individual engine types, j. The number of trips per operator is represented by g_i, a_{ik} is the proportion of trips by operator and trip type, and f_{kj} is the volume of fuel used per trip dependent on the engine type (Table 3–1). The expression in square brackets is equal to the unit price for fuel, which is the sum of the per-litre-price of fuel p^{fuel}, and the value of oil-additive, where φ_j is the proportion of oil-gas-mixture per engine type,

[40] Capital charges include investment costs and costs for working capital as outlined in Curry and Weiss (2000, p. 21). Note, capital charges are equal to the amortized value of the sum of all capital used over the time horizon of the project.

and p^{oil} the per-litre-price of oil-additive. Note, the engine is running constantly during a trip, therefore a one hour trip results in the engine running for one hour.

Labour costs are valued at their opportunity cost which in reality is unknown and subject to further assumptions (Griffin,

4.3.2 Capital charges

I 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 their life, *K*(*t*) (Curry and Weiss 2000, p. 28). The levelized annual capital charge is equal to:

$$K(t)_{\text{levelized}} = K_{PV} \cdot \frac{r}{1-(1+r)^{-T}}$$

$$\text{where: } K_{PV} = K(0) + \sum_{t=0}^{T} \frac{K(t)}{[1+r]^{t}}, \qquad (4.7)$$

where *K*(*t*) is the ongoing capital replacement which varies according to a schedule. Capital charges are adjusted for the share in use of each asset for whale watching, for example the boat is used for fishing and whale watching.[42]

transportation costs, and the water access fee. I express fixed cost for the industry, *F*, as the sum of each individual operator's fixed costs, F_i:

$$F = \sum_{i=1}^{m} F_i \,. \tag{4.8}$$

With estimates of all the components of total cost that are accounted for in this study, I can calculate total cost as the sum of opportunity costs associated with the utilization of all factors of production accounted in this analysis. I calculate the present value of total cost as follows:

$$C_{PV} = \sum_{t=0}^{T} \frac{C(t)}{(1+r)^t} \,, \tag{4.9}$$

with the levelized cost being equal to:

$$C_{\text{levelized}} = C_{PV} \cdot \frac{r}{1-(1+r)^{-T}} \tag{4.10}$$

4.4 Rent

Following the model of rent outlined in (4.1), I express the distribution of rent as the sum of rent to labour, Π_{labour}, rent to operators, $\Pi_{\text{operators}}$, and rent to the government, Π_{gov}, or:

than in distribution analysis.[44] While taxes are ignored in the former they are explicitly taken into account in the distribution analysis since government is considered a stakeholder. It is important to note that even though taxes are included in the distribution analysis, they do not affect the overall efficiency result, meaning they do not affect the total amount of rent generated (Curry and Weiss 2000, p. 266). Gunton and Richards (1987) mention that it is possible that rents support non-wage benefits such as job security or unemployment insurance, which is not the case in Bahia Magdalena. The main transfer payments are taxes that amount to 28 percent of net income and apply to labour and operators equally.[45]

I will calculate the post-tax-rent accruing to labour and business owners, before estimating the total amount of taxes from rent. The NPV of rent appropriated by labour is equal to:

$$\Pi_{\text{labour}} = \sum_{t=0}^{T} \frac{[C_L(t) - C_{oL}(t)]\cdot[1-\tau]}{(1+r)^t}$$

$$\text{where: } C_L(t) = \sum_{i=1}^{m} w_d\, y_i + w_c\, \gamma\, g_i\ , \qquad (4.12)$$

where C_L is the actual labour cost, w_d is the driver's wage and w_c rs000 Tw[(e1)Tjqual te1

For the calculation of rent accruing to operators, I first consider that taxes are not part of the analysis. Thus, the calculation of rent (pre tax) to operators is equal to the total rent minus the rent (pre tax) that goes to labour. Operators will pay taxes on this remaining "pre tax amount" and keep a share equal to $[1-\tau]$

CHAPTER 5 RESULTS AND DISCUSSION

5.1 Parameter assumptions

The calculations of rent are based on the parameter assumptions summarized for the base case scenario as follows (Table 5–1).

Table 5–1 Parameter assumptions for base case scenario

		PSC	***PALM***	***source***
varying parameters				
r	*discount rate*	12%	12%	OECD (2006)
p	*price per boat hour of whale watching in Pesos*	582	620	personal interviews
w_{min}	*hourly minimum wage in Pesos*	47	47	García Martínez (2006)
s_{max}	*seats per boat available*	6	6	personal interviews
s	*average seats per boat occupied in 2005*	4.16	5.33	SEMARNAT (2005)
η	*visitor growth per year*	10%	10%	Hoyt (2001)
ε	*elasticity of demand*	-0.5571	-0.5571	Larson and Shaikh (2003)
fixed parameters				
p_o	*price of oil mixture in Pesos per litre*	30	30	personal interviews
p_f	*price of fuel in Pesos per litre*	6.25	6.25	personal interviews
w_d	*hourly panguero wage in Pesos*	100	70	personal interviews
w_c	*hourly wage for boat cleaning in Pesos*	60	60	personal interviews
γ	*factor for boat cleaning (0.3/trip)*	0.3	0.3	personal interviews
τ	*income tax*	28%	28%	García Martínez (2006)
φ	*gas-oil-mixture*	1/50	1/50	personal interviews
h	*daily hours of operations*	6	6	Gonzalez Agundez (2005)
j	*season length in 2005 in days*	44	44	Gonzalez Agundez (2005)
$v(0)$	*visitors in 2005 (excl. outsiders' business)*	3384	9317	SEMARNAT (2005)
$g(0)$	*trips in 2005 (excl. outsiders' business)*	813	1748	SEMARNAT (2005)
Φ	*proportional use of asset for whale watching*	20%	20%	personal interviews
l	*average length per trip in hours*	3.0	2.1	SEMARNAT (2005)
f	*average fuel consumption per boat hour in litres*	93.6	105.6	personal interviews

According to equation (4.5) and respective parameters stated in Table 5–1, annual fuel costs in 2006 amount to Pesos 228,443 in PSC and Pesos 300,633 in PALM (Table 5–2). Fixed costs, *F*, are Pesos 449,765 in

It is interesting to note that PSC spends seven times more in advertising: Pesos 82,500 compared to Pesos 11,323 in PALM. PSC's advertising expense is higher because of the lack of cooperation in between operators, but also due to the fact that PALM is well known for its superb whale watching whereas PSC is just starting to become a whale watching destination. While whale watching operations in PALM started more than 30 years ago, most tour companies in PSC have only been in business for 15 years. Also, the lack of docking facilities in PSC force operators to transport their boats between their business location and the embarkment point for each trip. This creates transportation costs for PSC that are non-existent in PALM. Finally, the vast and extensive area of Bahia Magdalena translates into higher insurance costs and higher expenses for safety equipment in PSC (Table 5–2). Note, the longer distance to see whales and the rougher ocean conditions in PSC could possible result in higher fuel consumption, would PSC exclusively use two-stroke engi training is needed. More than half of them communities is almost identical, amounting to approximately 50 percent of revenue with for whale-watching at a given price. Thus, higher rent in PALM is associated with the higher whale density and therefore higher quality of the whale watching experience in PALM.

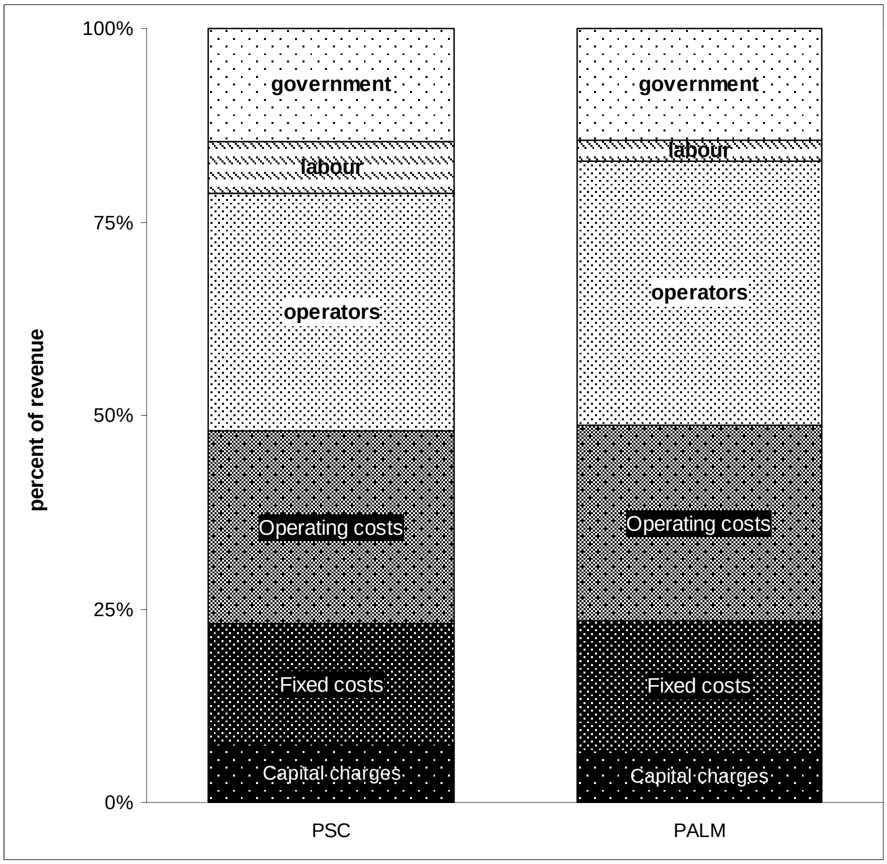
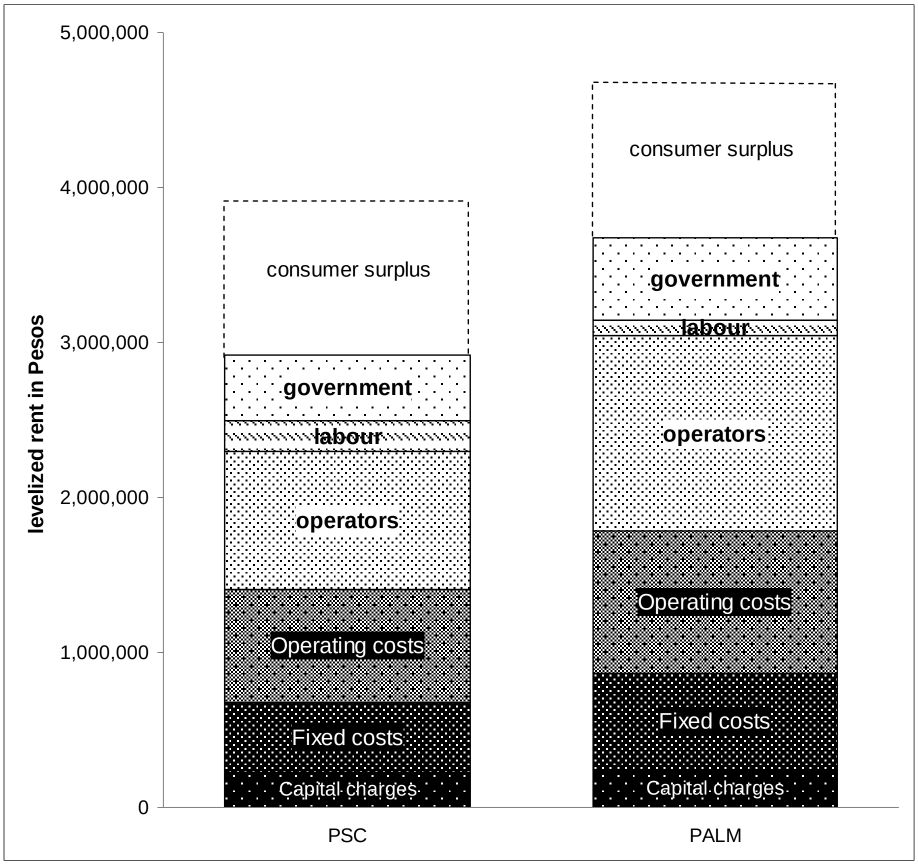


Figure 5-1 Cost structure and rent distribution as a percentage of revenue

The distribution of resource rent among stakeholders follows equation (4.11). Rent accruing to labour (equation (4.12)) is equal to Pesos 195,987 in PSC, and amounts to 13 percent of total rent generated. In contrast, the share of rent that goes to labour in PALM is much smaller in relative and absolute terms, equalling 6 percent of rent and Pesos 103,981, which is due to the lower pangero wage in PALM. The smaller labour share in PALM leaves operators with a much larger portion of rent (66 percent of rent), equalling Pesos 1,253,036, compared to PSC (59 percent of rent) and Pesos 895,230.

Using equation (4.14), rent accruing to government measures to Pesos 424,362 in PSC and Pesos 527,729 in PALM, where the proportion of total rent is equal to the tax rate of 28 percent (Table 5–3).[49,50]



PALM the rent per permit is equal to Pesos 69,805, which could indicate that a portion of rent is related to the restriction of permits and creates scarcity rent that is traceable to the whales visiting Bahia Magdalena.[51]

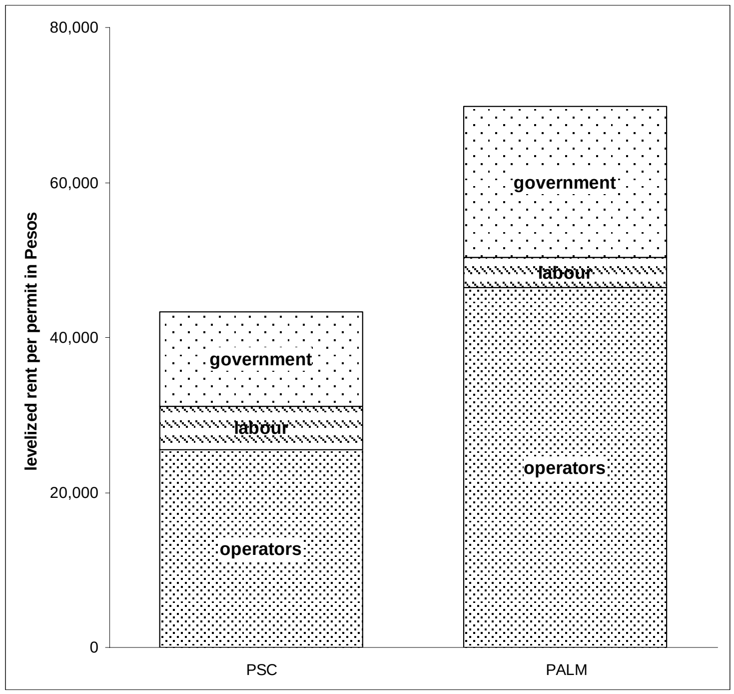


Figure 5-3 Annual rent per permit and location

Note, the resource values calculated above are equal to benefits from whale watching as they accrue in the two communities. This approach consequently ignores additional value gained by other interest groups not included in this study, and likely underestimates the total economic value of the resource. From the producer side, the approach excludes rents generated by whale watching businesses based in La Paz. On the consumer side, the framework fails to account for substantial consumer surplus arising from direct use value to subsistence hunters in the Siberian Arctic (IWC 2004), for

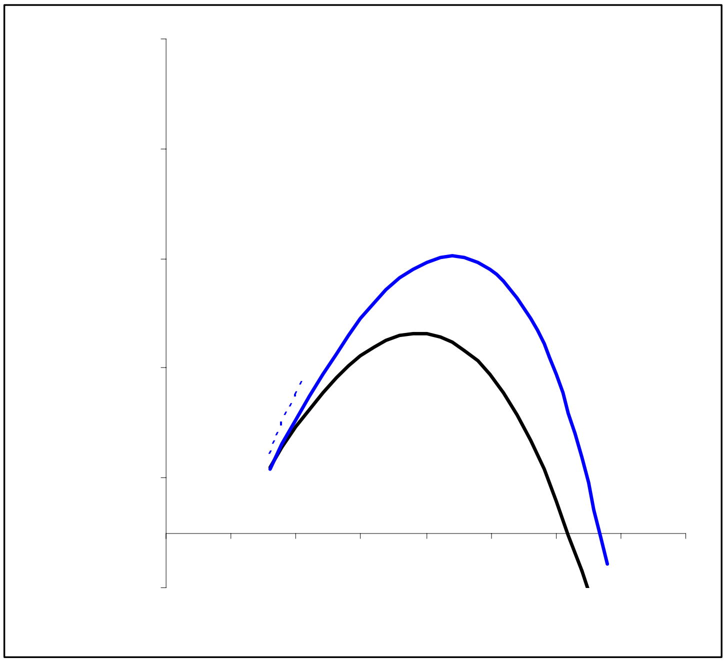
[51] An additional interesting consideration arises when we investigate the rent accrued per operator. In this context, the per operator rent in PALM is smaller compared to PSC, Pesos 63,945 per operator in PSC versus Pesos 21,238 per operator in PALM (Table 5–3, Figure 5-3).

example. Also, there exist significant non-use value and existence value associated with the preservation of the whales for communities and whale observers world wide, as preceding research indicates. Thus, the dotted boxes in Figure 5-2 conceptually indicate additional value in form of consumer surplus occurring elsewhere. However, since the study's "accounting stance" is the communities of the Bahia Magdalena lagoon complex, I ignore values accruing elsewhere even though they are significant and would be required for the completion of the value picture (Whittington and Mac Rae 1986).[52]

Another theoretic complexity surrounds the question whether the values estimated in this study can be associated with the whales directly and be considered a biodiversity value. Estimates of rent generated in the whale watching industry cannot fully be attributed to the whales. Instead, the rent generated is also due to locational advantages of PALM versus PSC, and due to the experience as a whole. In economic terms, the value of whales is different from the rent generated because the calculated rent does not account for species substitution or complementary effect. In order to explicitly take these effects into account and estimate the value of a whale, a marginal valuation exercise investigating how profitability of the industry changes when the number of whales changes, is required. Complementarity and substitution effects relate to the central question 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. Thus, it is essential to associated with individual species, thus adding to the complexity of estimating the value of biodiversity. The notion of biodiversity effects of changes in the base line assumptions. Due to their large size, sensitivity tables are placed in an Appendix.

The sensitivity of resource rents to minimum wage assumptions varies slightly in the two communities (Table 5–4). Increasing the opportunity cost of labour from Pesos 47 to Pesos 60, decreases annual resource rents in PSC by Pesos 71,684 and 4.7 percent and in PALM by Pesos 86,281 and 4.5 percent. The share of total resource rent that goes to labour is slightly more affected by minimum wage assumptions in PALM, where a accrued in PSC at 12 percent discount is shown by the lower bold curve in Figure 5-4. The higher the discount rate the lower the NPV trajectory.

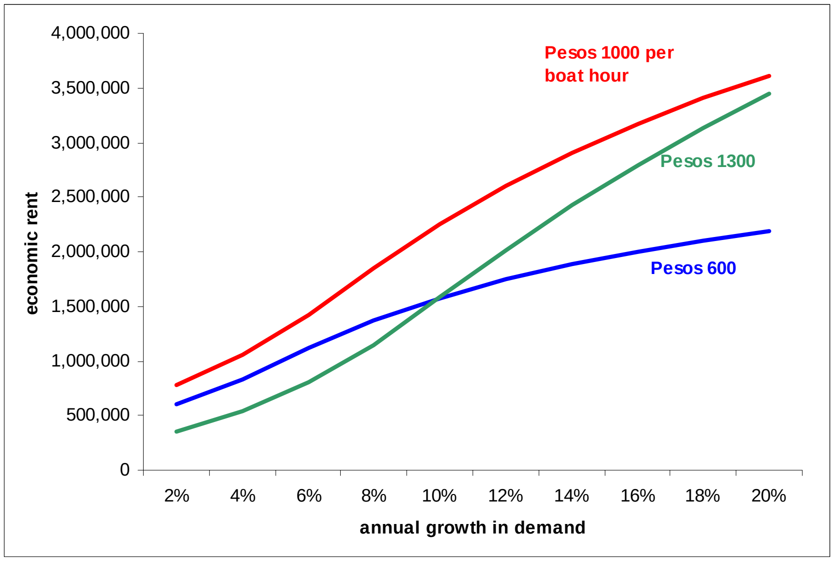
Besides the effect the opportunity cost of capital has on rent, Figure 5-4 also shows the effect of a downward sloping demand curve. A price increase decreases the amount of whale watching trips demanded, however, depending on the elasticity of demand, a price increase does not necessarily cause an initial decline in net social returns. Increases in the price per whale watching hour will cause rent to first rise to a maximum and then decline as the additional price increase restricts demand beyond the optimal price that is maximizing rent. Beyond the optimal price, marginal net gains from marginal increases in price will be smaller than the marginal losses from a restriction in demand caused by the rise in price. Thus Figure 5-4 shows rent following a parabolic trajectory across the price-axis.



Also, the opportunity cost of capital assumptions affect the optimal price at which rent is maximized in each community. Assuming a discount rate of 18 percent, rent in PSC is maximized at approximately Pesos 900 per boat hour, whereas at 2 percent, rent is maximized at Pesos 1100 per boat hour. Even at a marginal borrowing rate of 45%, rent is maximized at Pesos 900 per boat hour in PSC and Pesos 1000 in PALM (Appendix 1). For PALM the respective discount scenarios relate to optimal prices of Pesos 1000 and Pesos 1300. While this result shows that the optimal price is higher in PALM than in PSC, it also suggests that resource rent is more sensitive to discount assumptions in PALM (Appendix 3 A). Again, these results assume that the demand elasticity is equal to that found in Monterey Bay.

The sensitivity of resource rents to assumptions surrounding the elasticity of demand show that the more elastic demand the lower the optimal price per bout hour that maximizes rent. Larson and Shaikh's (2003) analysis of elasticities in three whale watching destinations off the Pacific coast in California reveal, that Monterey Bay has the most elastic demand (-0,5571), while the two other study sites (Point Reyes and Half Moon Bay) show considerable more inelastic demand (-0.1193 and -0.1009 respectively). I use the elasticity of demand for Monterey Bay as the base line assumption. Calculations outlined in Appendix 4 and Appendix 5 show that elasticities between minus 1 and minus 0.6 are associated with optimal prices ranging between Pesos 700 and Pesos 900 for PSC and Pesos 800 to Pesos 1100 for PALM. Thus, the recommended optimal price per boat hour of Pesos 900 in PSC and Pesos 1000 in PALM is justified. Figure 5-5 supports this result for PSC. It is interesting to note that the current price of Pesos 600 is not sensitive

superior to a price of Pesos 1300. For growth beyond 10 percent, the higher price of Pesos 1300 will increase rent more than a price per boat hour of Pesos 600.



by Pesos 671,958 or 43 percent of current resource rents and in PALM by Pesos 1,342,743 or 75 percent.

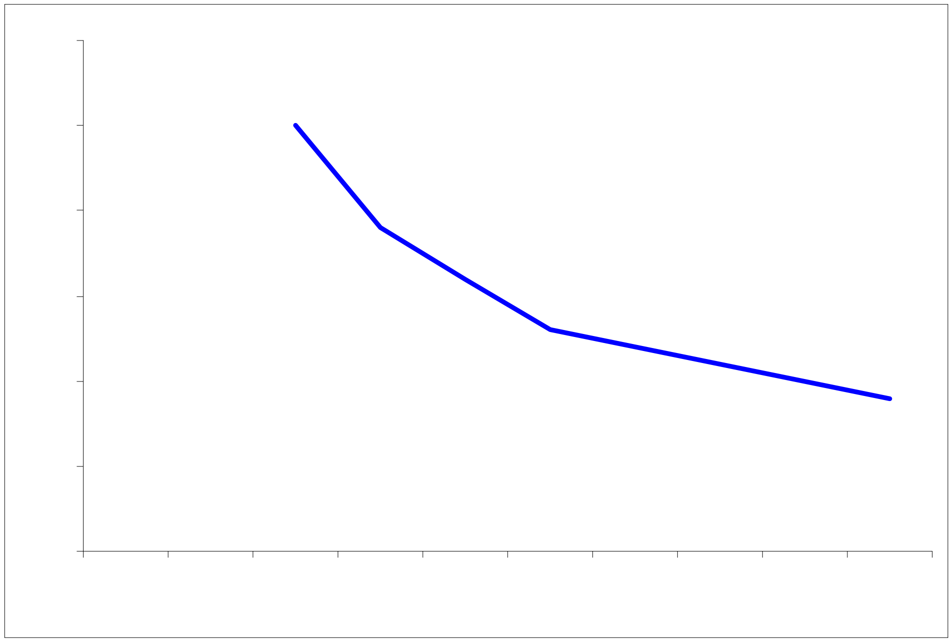
However, changes in the discount rate a

Rent accruing to operators and labour as a share of total rent varies depending on discount and growth assumptions. In the case of PSC, rent accrued by operators decreases with an increasing marginal cost of capital and increases with rising growth in demand (Appendix 6). For PALM the above described effect seems to be weaker (Appendix 7).

5.4 Capacity considerations

During interviews with operators in PSC and PALM, many respondents identified that they would like more permits for the industry. While section 3.4 of this study supports the claim that an increase in permits could have a negative effect on gray whales, this section will investigate whether or not the request for more permits would be beneficial. Other options for maximizing rent may be more economically and environmentally sound than an increase in permits. Often, producers forget that more permits also mean more capital and ultimately higher costs, which could jeopardize profitability (Gunton and Richards 1987). The call for more permits was especially strong in PSC, where the industry already owns more permits (35) than in PALM (27). In the following section I calculate the remaining years for which the whale watching industry in each community has excess capacity. The model used for the calculation assumes a fixed number of permits, constant demand throughout each season but increasing demand over the projected 30 year time horizon. The assumption of constant seasonal demand is somewhat arbitrary since there is peak demand namely on weekends. Consequently, this approach inflates the results causing the calculations to overstate the number of years remaining until capacity is reached. However, the analysis still provides insight, should operators decide to implement peak-pricing, in which case peak-demand could be re-allocated to weekdays when the fleet has unused excess capacity.

Figure 5-8 summarizes the calculations outlined in Appendix 8 and Appendix 9 for three price scenarios in PSC and the current price scenario in PALM. The graph shows the estimated time in years from now, when operators are expected to hit full capacity depending on varying annual growth rates in demand. Capacity is reached earlier the higher the growth in demand and the lower the price per boat hour. Raising the price will result in capacity being reached later due to dampened demand. Under base-line assumptions (current price of Pesos 600 and 10 percent growth), operators in PSC will be operating at full capacity in 16 years. This result means that whale watching is not operating at full capacity right now and suggests that a call for more permits is not justified. On the other hand, operations in PALM are much closer to full capacity, as the black dotted line in Figure 5-8 shows. Industry in PALM will reach the capacity limit in an estimated time of eight years from now. However, since this result ignores peak demand it could be that PALM already operates at full capacity, particularly on weekends. Respondents in PALM raised concerns about not having enough capacity on weekends already. However, in case PALM decides to raise the price per boat hour to Pesos 1,100, this would lengthen the time under which the industry could operate at the current capacity to 14 years from now.



CHAPTER 6 CONCLUSIONS AND RECOMMENDATIONS

Unlike any of the preceding economic studies the approach taken in this project estimates the net benefits from whale watching to local communities. Thus, the analysis fills an important gap for completing the "value picture" of the eastern North Pacific stock of gray whales and provides information to the whale watching industry for efficient decision making at the local level. The main objective of this study was to assess the cost and revenue structure of the whale watching industry in the Bahia Magdalena lagoon complex in order to estimate the amount of economic rent generated by the whales in the lagoon. In addition, it offers alternative strategies fo

Annual net benefits differ in both comm

My project has indicated that whale watching in the Bahia Magdalena lagoon complex has significant value to local communities. Such information can help government to formulate and implement more effective policies focusing on a multi-objective approach to the management of marine resources. For the communities of PSC and PALM, the results presented herein could enable them to make better and more informed decisions to increase the profitability of their enterprises and to improve the wellbeing of their communities. Moreover, the results can contribute to a more sustainable future in which upcoming generations can continue to enjoy the natural wonders surrounding Bahia Magdalena.

APPENDICES

Appendix 1 Sensitivity analysis showing NPV of resource rents in PSC

A

discount	price per boat hour													
	$400.00	$500.00	**$600.00**	$700.00	$800.00	$900.00	$1,000.00	$1,100.00	$1,200.00	$1,300.00	$1,400.00	$1,500.00	$1,600.00	$1,700.00
2%	$27,337,609	$41,751,313	$54,897,586	$66,536,731	$76,376,189	$84,063,287	$89,010,302	$90,525,306	$87,366,540	$77,710,010	$57,799,952	$29,375,884	($4,088,105)	($42,592,015)
4%	$19,382,210	$29,743,883	$39,047,306	$47,116,350	$53,741,869	$58,678,804	$61,529,905	$61,847,338	$58,855,363	$51,478,989	$37,624,772	$18,397,416	($4,239,175)	($30,285,002)
6%	$14,059,089	$21,722,200	$28,492,964	$34,241,247	$38,816,673	$42,047,957	$43,664,888	$43,375,926	$40,693,320	$34,980,037	$25,061,701	$11,641,213	($4,158,885)	($22,338,593)
8%	$10,413,380	$16,236,338	$21,299,632	$25,506,602	$28,748,532	$30,905,033	$31,791,193	$31,216,206	$28,871,565	$24,378,040	$17,073,284	$7,405,888	($3,975,651)	($17,071,332)
10%	$7,859,621	$12,398,456	$16,284,614	$19,445,933	$21,803,402	$23,271,953	$23,724,324	$23,035,021	$21,007,856	$17,416,261	$11,885,095	$4,701,736	($3,755,318)	($13,486,065)
12%	$6,031,680	$9,654,101	$12,710,810	$15,147,667	$16,906,962	$17,928,280	$18,123,556	$40973409.7(9,638)-1583.4($)-,14-9.7(,3,709)-1583.4($211-9.7(,203)-,94-153)T7($)-9.6(8,).2(,4)]0						

Appendix 2 Sensitivity analysis showing levelized resource rents accruing to different stakeholders in PSC

A **Operators**

discount	price per boat hour $400.00	$500.00	**$600.00**	$700.00	$800.00	$900.00	$1,000.00	$1,100.00	$1,200.00	$1,300.00	$1,400.00	$1,500.00	$1,600.00	$1,700.00
2%	$596,346	$1,068,428	$1,500,798	$1,885,947	$2,214,686	$2,475,918	$2,651,357	$2,719,304	$2,641,085	$2,359,759	$1,758,428	$888,642	($143,167)	($1,337,000)
4%	$538,538	$979,624	$1,377,664	$1,725,493	$2,014,581	$2,234,916	$2,370,464	$2,402,988	$2,301,150	$2,021,402	$1,479,239	$717,197	($186,798)	($1,232,746)
6%	$480,664	$891,954	$1,257,543	$1,570,764	$1,823,893	$2,008,114	$2,109,701	$2,113,702	$1,995,320	$1,722,067	$1,234,299	$566,104	($226,561)	($1,143,697)
8%	$424,379	$807,899	$1,143,751	$1,425,861	$1,647,384	$1,800,723	$1,874,371	$1,856,329	$1,727,383	$1,463,828	$1,024,460	$435,939	($262,212)	($1,069,991)
10%	$370,858	$729,138	$1,038,411	$1,293,251	$1,487,697	$1,615,322	$1,666,647	$1,632,219	$1,497,416	$1,245,276	$847,874	$325,642	($293,871)	($1,010,665)
12%	$320,795	$656,570	$942,544	$1,173,938	$1,345,644	$1,452,303	$1,486,221	$1,440,068	$1,302,879	$1,062,730	$701,011	$233,132	($321,904)	($964,095)
14%	$274,478	$590,466	$856,299	$1,067,820	$1,220,705	$1,310,539	$1,331,152	$1,276,932	$1,139,763	$911,389	$579,600	$155,868	($346,795)	($928,391)
16%	$231,898	$530,656	$779,243	$974,080	$1,111,540	$1,188,024	$1,198,631	$1,139,110	$1,003,517	$786,216	$479,314	$91,270	($369,059)	($901,672)
18%	$192,859	$476,702	$710,606	$891,514	$1,016,408	$1,082,377	$1,085,557	$1,022,758	$889,664	$682,483	$396,185	$36,960	($389,180)	($882,236)
20%	$157,061	$428,032	$649,469	$818,778	$933,463	$991,183	$988,911	$924,271	$794,154	$596,044	$326,786	($9,113)	($407,584)	($868,625)

B **Labour**

Appendix 4 Sensitivity analysis showing levelized resource rents in PSC depending on elasticity of demand

elasticity	price per boat hour $400.00	$500.00	**$600.00**	$700.00	$800.00	$900.00	$1,000.00	$1,100.00	$1,200.00	$1,300.00	$1,400.00	$1,500.00	$1,600.00	$1,700.00
-0.1	$630,102	$1,121,384	$1,601,017	$2,067,083	$2,520,826	$2,962,245	$3,391,340	$3,808,112	$4,209,746	$4,597,510	$4,972,240	$5,333,939	$5,682,604	$6,013,066
-0.2	$656,987	$1,138,254	$1,595,974	$2,026,754	$2,432,888	$2,811,878	$3,162,326	$3,486,258	$3,777,182	$4,040,648	$4,269,043	$4,467,719	$4,628,729	$4,757,651
-0.3	$683,871	$1,155,124	$1,590,931	$1,986,426	$2,342,367	$2,655,498	$2,922,641	$3,143,682	$3,315,502	$3,432,489	$3,494,312	$3,497,304	$3,437,635	$3,311,359
-0.4	$709,235	$1,171,993	$1,585,888	$1,946,097	$2,249,369	$2,492,561	$2,671,169	$2,780,351	$2,815,014	$2,768,740	$2,633,249	$2,401,749	$2,063,078	$1,603,453
-0.5	$734,416	$1,188,863	$1,580,846	$1,904,839	$2,154,832	$2,324,434	$2,406,972	$2,394,125	$2,274,868	$2,037,082	$1,664,212	$1,136,886	$480,326	($284,877)
-0.6	$759,598	$1,205,733	$1,575,803	$1,862,190	$2,056,864	$2,150,148	$2,129,273	$1,980,693	$1,684,915	$1,219,487	$569,790	($214,170)	($1,128,502)	($2,173,206)
-0.7	$784,112	$1,222,491	$1,570,760	$1,819,541	$1,957,387	$1,968,883	$1,835,125	$1,535,174	$1,035,454	$322,682	($545,221)	($1,565,226)	($2,737,330)	($4,061,535)
-0.8	$807,559	$1,238,292	$1,565,718	$1,776,892	$1,854,538	$1,779,941	$1,524,742	$1,053,459	$330,376	($578,014)	($1,660,233)	($2,916,281)	($4,346,158)	($5,949,865)
-0.9	$831,005	$1,254,092	$1,560,675	$1,733,480	$1,749,339	$1,582,741	$1,194,156	$527,685	($377,734)	($1,478,710)	($2,775,245)	($4,267,337)	($5,954,987)	($7,838,194)
-1.0	$854,452	$1,269,893	$1,555,632	$1,688,552	$1,641,696	$1,376,799	$840,859							

Appendix 6 Share of rent to operators (A) and labour (B) under varying discount and growth assumptions in PSC

A - operators

discount	growth rate						
	2%	4%	6%	8%	**10%**	12%	14%
2%	0.56	0.59	0.60	0.60	0.61	0.61	0.61
4%	0.55	0.58	0.60	0.60	0.60	0.61	0.61
6%	0.55	0.58	0.59	0.60	0.60	0.60	0.61
8%	0.54	0.57	0.59	0.59	0.60	0.60	0.60
10%	0.53	0.56	0.58	0.59	0.59	0.60	0.60
12%	0.52	0.56	0.57	0.58	0.59	0.59	0.60
14%	0.52	0.55	0.57	0.58	0.59	0.59	0.59
16%	0.51	0.54	0.56	0.57	0.58	0.59	0.59
18%	0.50	0.53	0.55	0.57	0.58	0.58	0.59
20%	0.49	0.52	0.54	0.56	0.57	0.58	0.58

B - labour

discount	growth rate						
	2%	4%	6%	8%	**10%**	12%	14%
2%	0.16	0.13	0.12	0.12	0.11	0.11	0.11
4%	0.17	0.14	0.12	0.12	0.12	0.11	0.11
6%	0.17	0.14	0.13	0.12	0.12	0.12	0.11
8%	0.18	0.15	0.13	0.13	0.12	0.12	0.12
10%	0.19	0.16	0.14	0.13	0.13	0.12	0.12
12%	0.20	0.16	0.15	0.14	0.13	0.13	0.12
14%	0.20	0.17	0.15	0.14	0.13	0.13	0.13
16%	0.21	0.18	0.16	0.15	0.14	0.13	0.13
18%	0.22	0.19	0.17	0.15	0.14	0.14	0.13
20%	0.23	0.20	0.18	0.16	0.15	0.14	0.14

Note: Decimals illustrate the share of total rent accrued by stakeholder group, where total rent is equal to 1.

Appendix 8 Estimated years in which capacity is reached in PSC

growth	price per boat hour													
	$400.00	$500.00	**$600.00**	$700.00	$800.00	$900.00	$1,000.00	$1,100.00	$1,200.00	$1,300.00	$1,400.00	$1,500.00	$1,600.00	$1,700.00
2%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6%	22	23	25	26	28	-	-	-	-	-	-	-	-	-
8%	17	18	19	20	22	24	25	28	30	-	-	-	-	-
10%	14	15	16	17	18	19	21	23	25	28	-	-	-	-
12%	12	13	13	14	15	16	18	19	21	24	27	-	-	-
14%	10	11	12	13	13	14	16	17	18	21	23	28	-	-
16%	9	10	11	11	12	13	14	15	17	18	21	25	-	-
18%	9	9	10	10	11	12	13	14	15	17	19	22	-	-
20%	8	8	9	9	10	11	12	13	14	15	17	20	29	-

Note: Cells marked with " - " indicate years greater than 30.

Appendix 10 Questionnaire for intervie

Activity	**2003**	**2004**	**2005**
trips			
clients			
boat-hours			

c) If you offer package tours for tourism agencies or cruise ships coming to the Bay from outside of Bahia Magdalena, can you explain how this works? What is the price for these package tours?

B.2 Can you tell us about the employees in your whale watching business?

	SALARIES			Place of origin (no. of employees)		**Comments**
	wage ($/unit)	**length of employment (units/yr)**	**total salary ($/yr)**	**Local**	**Non-local**	
manager						
pangeros						
office worker						
maintenance workers						
Other						

B.3 In addition to fuel, what are the main costs for your whale watching business?

Item	Quantity Required/Used	Cost (CHOOSE ONE TYPE)			Where purchased normally?
		purchase ($)	item life (years)	annual cost ($/yr)	
rent for land/buildings					
advertising					
insurance					
vehicles & trailers					
boats					
motors					
life jackets					
radios, first aid kits, etc.					
boat/motor maintenance					
taxes, licenses, other fees					
other					

B.4 (If co-operative or union) After you deduct your own costs, how are the remaining revenues shared or allocated? What share of revenues is provided to the co-op or union to cover its costs?

B.5 We would like to get an understanding of the relationship between the number of whales in the Bay and some of your costs associated with taking people out to watch whales. Taking the whale-watching trips you offer, what percentage does each type of trip represent of the total number of trips and how much fuel is used on each type of trip. Please answer for the early/late seasons when there are fewer whales and the peak season, when there are more whales [USE TABLE]

Early/Late Season	**Mid/Peak Season**

d) What is your opinion on how the government manages whale watching overall? What else could they do to assist you?

e) What do you believe are the future prospects for whale watching and *ecoturismo* in Bahia Magdalena?

f)

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