INSTITUTO POLITÉCNICO NACIONAL

CENTRO INTERDISCIPLINARIO DE CIENCIAS MARINAS

CICIMAR-IPN

ASSESSING THE ECONOMIC VALUE OF TOURISM WITH THE MUNK'S PYGMY DEVIL RAY (*Mobula munkiana*) IN BAJA CALIFORNIA SUR, MÉXICO

TESIS

QUE PARA OBTENER EL GRADO DE
MAESTRÍA EN CIENCIAS
EN
MANEJO DE RECURSOS MARINOS

PRESENTA

MARINE LUCY BRUGÈS

DIRECTORES DE TESIS
DR. ROGELIO GONZÁLEZ ARMAS
DR. FERNANDO ARANCETA GARZA

LA PAZ, B.C.S., DICIEMBRE DEL 2024

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La Paz, B.C.S., a 29 de NOV del 2024

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1.- Se designa al aspirante el tema de tesis titulado:

ASSESING THE ECONOMIC VALUE OF TOURISM WITH THE MUNK'S PYGMY DEVIL RAY (*Mobula munkiana*) IN BAJA CALIFORNIA SUR, MÉXICO

Objetivo general del trabajo de tesis:

Estimate the Total Economic Value (TEV) of the Munk's devil pygmy ray (*Mobula munkiana*) wildlife tourism along the east coast of Baja California Sur (BCS), Mexico.

2.- Se designa como Directores de Tesis a los profesores:

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Aspirante

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ASSESSING THE ECONOMIC VALUE OF TOURISM WITH THE MUNK'S PYGMY DEVIL RAY (*Mobula munkiana*) IN BAJA CALIFORNIA SUR, MÉXICO

del (la) alumno (a):

Apellido Paterno:	BRUGÈS	Apellido Materno:		Nombre (s):	MARINE LUCY

Número de registro: B 2 2 0 6 7 9

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MARINE LUCY BRUGÈS

Nombre completo y firma autógrafa del (de la) estudiante

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DEDICATION

In an attempt to be useful for the ocean, these efforts are dedicated to the unseen guardians of the ocean, those who tirelessly protect and care for marine life without recognition or applause. To those with their hands in the mud, whose quiet efforts sustain the beauty and vitality of our seas. To those who hold onto hope and persevere, even when everything seems lost, you are the lights that guide lost souls through the darkness of our human essence.

"La mer est l’infini visible." Victor Hugo

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Sahlo Folina

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RESUMEN

La raya diablo pigmea de Munk (*Mobula munkiana*) es una especie pelágica endémica del Océano Pacífico Oriental, caracterizada por su comportamiento de agrupación que puede involucrar a miles de individuos. La UICN clasifica a la especie como "vulnerable" a la extinción debido a su alta susceptibilidad al cambio climático, enmallamientos y usos extractivos (captura dirigida como incidental). Sin embargo, en algunas partes del mundo han surgido alternativas no extractivas, como las actividades turísticas recreativas. Desde la pandemia de COVID-19, Baja California Sur (BCS) ha registrado un importante incremento en el flujo de turistas interesados en la observación de *M. munkiana*, sin embargo, hasta el momento no se cuenta con estimaciones de los valores económicos asociados a este tipo de turismo en la región. Este estudio tiene como objetivo calcular el valor económico del turismo asociado a *M. munkiana* en BCS, determinando tanto el valor de uso (ej.: actividades recreativas) como el valor de no uso (ej.: donaciones para la conservación). Se realizaron encuestas directas en tres localidades de BCS: La Paz, La Ventana y Los Cabos, a un total de 310 turistas, evaluando sus gastos diarios y disposición a pagar (WTP, por sus siglas en inglés) para la conservación. Además, se encuestaron a 32 operadores turísticos para determinar costos operativos y beneficios económicos para las comunidades locales. Los resultados revelaron un Valor Económico Total (TEV, por sus siglas en inglés) del turismo de *Mobula munkiana* de aproximadamente USD 8.5 millones en 2023 en BCS. La Ventana contribuyó con la mayor proporción, debido al alto flujo de turistas durante la agregación estacional de la especie, con USD 4,233,913, seguida de Los Cabos con USD 2,170,449 y La Paz con USD 2,042,143. El Valor de Uso Directo se estimó en USD 97,678, mientras que el Valor de Uso Indirecto, que incluye gastos en alojamiento, alimentos y transporte, representó USD 8.2 millones. El Valor de No Uso, derivado de la disposición a pagar de los turistas para la conservación, se estimó en USD 186,278 para los 3,313 turistas estimados que participaron en los tours. Entre ellos, el 74% eran turistas extranjeros procedentes de seis continentes diferentes. Estos resultados resaltan el potencial económico del uso no extractivo de la vida silvestre, con valores comparables a otros tipos de turismo de vida silvestre en la región, como el turismo de manta rayas en Revillagigedo y el turismo de tiburón ballena en La Paz. Sin embargo, las disparidades en los marcos regulatorios entre las localidades subrayan la necesidad de medidas de conservación mejoradas, particularmente en áreas no reguladas como La Ventana, para que las comunidades locales puedan beneficiarse de actividades turísticas sostenibles.

Palabras clave: *Mobulidae*, conservación, encuestas, beneficios económicos, disposición a pagar.

ABSTRACT

The Munk's pygmy devil ray (*Mobula munkiana*) is a pelagic species endemic to the Eastern Pacific Ocean characterized by schooling behavior involving thousands of individuals. While the IUCN classifies the species as "vulnerable" to extinction because of its high susceptibility to climate change, entanglement or extractive uses (targeted and bycatch); non-extractive alternatives such as recreational tourism activities have emerged in some parts of the world. Since the COVID-19 pandemic, Baja California Sur (BCS) has experienced a significant increase in the number of tourists interested in observing *M. munkiana*, however, there are currently no estimates of the economic values associated with this type of tourism in the region. This study aims to calculate the economic value of tourism for *M. munkiana* in BCS by determining both the use-value (e.g., recreational activities) and the non-use value (e.g., donation for conservation). Direct surveys were applied in three BCS locations, La Paz, La Ventana, and Los Cabos, to 310 tourists, assessing their daily expenditures and willingness to pay (WTP) for conservation. Additionally, 32 tourist operators were surveyed to determine operational costs and economic benefits for local communities. Results revealed a Total Economic Value (TEV) for the *Mobula munkiana*'s tourism of approximately USD 8.5 million in 2023 in BCS, with La Ventana contributing the largest share due to high touristic influx during the seasonal aggregation for the species with USD 4,233,913, followed by Los Cabos with USD 2,170,449 and La Paz with USD 2,042,143. Direct Use Value was estimated at USD 97,678, while Indirect Use Value, including expenditures on accommodation, food, and transport, accounted for USD 8.2 million. Non-Use Value, derived from tourists' WTP for conservation, was estimated at USD 186,278 for the 3,313 tourists estimated to pay for the tours. Among them, 74% are foreign tourists dispersed over six different continents. These findings highlight the economic benefit potential of the non-extractive use of wildlife with values comparable to other wildlife tourism in the region, such as the manta ray tourism in Revillagigedo and the whale shark tourism in La Paz. However, disparities in regulatory frameworks among locations underscore the need for enhanced conservation measures, particularly in unregulated areas like La Ventana so that local communities can benefit from sustainable tourism activity.

Keywords: Mobulidae, conservation, surveys, economic benefits, willingness to pay.

GLOSSARY OF TERMS

Contingent Method: A survey-based approach to estimate economic value by asking people their willingness to pay for hypothetical scenarios.

Direct Use Value: The tangible benefits (e.g.: monetary benefits) derived from directly using a resource, such as fishing or tourism activities.

Economic Valuation: The process of estimating the monetary value of goods, services, or resources, including non-market aspects like ecosystems or tourism experiences.

Ecotourism: A form of sustainable tourism focused on visiting and experiencing natural areas to conserve the environment and support local communities.

Elasmobranch: A subclass of cartilaginous fish including sharks, rays, and skates.

Fixed Cost: Expenses that remain constant regardless of the level of activity, such as rent or salaries.

Independent Operator: expression used to define in this study the independent captains offering *Mobula munkiana* tourism activities.

Indirect Use Value: Benefits obtained from indirect using a resource, such as food, accommodation and transport derived from a touristic activity.

Mobulid: A family of large rays, including manta rays and devil rays, known for their filter-feeding behavior and wide geographic distribution.

Non-Use Value: The value of a resource independent of its current or future use, often tied to its existence or preservation.

Opportunity Cost: The value of the next best alternative foregone when choosing a particular course of action (e.g.: the value of the interest generated by the capital investment of a company).

Sustainable Tourism: Tourism that minimizes environmental and cultural impacts while maximizing economic and social benefits for local communities and future generations.

Tourism: The activities of people traveling to and staying in places outside their usual environment for leisure, business, or other purposes.

Tourism Company: Defined in this study as the larger companies offering *Mobula munkiana* tourism activities.

Total Economic Value: The sum of direct, indirect, and non-use values associated with a resource or ecosystem.

Travel Cost Method (TCM): A technique to estimate the economic value of a site by analyzing the travel expenses incurred by visitors.

Variable Cost: Costs that change with the level of activity, such as fuel or raw materials.

Willingness to Pay (WTP): The maximum amount an individual is willing to spend to acquire a good, service, or benefit, or to avoid something undesirable, often used in economic valuation and contingent methods.

1. INTRODUCTION

Since the 1940s, elasmobranchs populations have considerably declined due to anthropogenic activities (Colloca *et al.*, 2020). The high demand for their fins, meat and cartilage led to the overexploitation of their populations as target and by-catch species, in commercial or recreational fisheries, including loss and destruction of their habitats (Walker, 1998). Additionally, elasmobranchs' K-selected life-history traits—such as low fecundity, slow growth rates, and late maturity—make them highly vulnerable to overexploitation, resulting in slow recovery rates (Camhi *et al.*, 1998; Maynou *et al.*, 2011). Populations of elasmobranchs continue to decline, with 37% of all species classified as threatened with extinction by the IUCN in 2021, up from 24% in 2014.(Marshall, Barreto, Carlson, Fernando, Fordham, Francis, Herman, Jabado, Liu, Rigby, *et al.*, 2019; Dulvy *et al.*, 2021).

While fishing represents an extractive form of economic exploitation, non-extractive options such as tourism exists. It can extend to appreciate marine ecosystems to the sale of tour to observe specific species. This last type of tourism defined as wildlife tourism is defined as "viewing and experiencing animals in their natural habitat and non-consumptive" by the (*World Travel & Tourism Council*, 2019) and particularly developed around megafauna. Marine wildlife tourism offers experiences like snorkeling or scuba diving, where visitors can observe species or habitats of interest (Anderson *et al.*, 2011; Gallagher and Hammerschlag, 2011).Those recreational non consumptive activities have gained in popularity during the past decades and represent a great financial income to the local communities and is predicted to continue to increase in the future (Cisneros-Montemayor and Sumaila, 2010; Gallagher and Hammerschlag, 2011; O'Malley, Lee-Brooks and Medd, 2013; Moorhouse *et al.*, 2015). In 2018, wildlife tourism accounted for USD 241 billion globally—four times the value of illegal wildlife trade—supporting over nine million jobs. Marine wildlife tourism alone generates USD 47 billion annually and sustains one million jobs worldwide (Cisneros-Montemayor and Sumaila, 2010; Moorhouse *et al.*, 2015; World Travel & Tourism Council, 2019).

The realization that charismatic species such as elasmobranchs, cetaceans, seabirds, and manta rays are more valuable alive than dead has incentivized their conservation (Hooker and Gerber, 2004; Fondo *et al.*, 2015; Authier *et al.*, 2017; Mazzoldi *et al.*, 2019). This shift is particularly significant in developing countries where wildlife tourism supports local economies but often lacks robust regulations (Orams, 2002; Newsome, Dowling and Moore, 2005; Catlin *et al.*, 2013; Gallagher *et al.*, 2015; Venables *et al.*, 2016; Hani, 2021). For example, in Palau, shark diving industry is an encouraging example of a balance between the protection of endangered species and its use as a non-consumptive resource, generating profit to the industry estimated in USD 18 million annually and represents a direct income of USD 1.2 million to the local communities, while for commercial fishing purposes, a population of a

hundred sharks would only be worth ~USD 10,800 (Vianna *et al.*, 2012). This case highlights the possibility of successfully switching from fisheries to tourism activities and to improve financial income provided by non-consumptive activities. Furthermore, wildlife tourism could also support research and local communities and tourists education (Green and Higginbottom, 2000; Tisdell and Wilson, 2004). As demonstrated by Dobson et al. (2005), operators collecting predation data on Great White sharks have helped scientists publish a paper in 2004. Studies have also shown that tourists being educated during the tours are more likely to have a less disturbing behavior with the animals and are more likely to donate to conservation (Zeppel and Muloin, 2008).

Various marine megafauna species have a charismatic aspect to them and offer the potential for local fishermen to exploit their population through non-extracting practices. This is the case in Baja California for cetaceans but more importantly the regular presence of various elasmobranch species. The seasonal presence of whale sharks and other species of sharks such as silky sharks (*Carcharhinus falciformis*); blue sharks (*Prionace glauca*) and shortfin mako sharks (*Isurus oxyrinchus*) are important tourism drivers in the region. Manta rays (*Mobula alfredi*) represent also an attraction factors in places like Revillagigedo archipelago for scuba diving, moreover more recently a tourism centered around the smallest devil ray species, *Mobula munkiana* (Notarbartolo-di-Sciara, 1987), present in the BCS waters has caused significant interest.

Mobula munkiana is one of eight ray species belonging to the *Mobula* genus, which also includes famous species like *Mobula alfredi* and *Mobula birostris* (Table 1) (Notarbartolo-Di-Sciara, 1988). All the species of this family are large pelagic planktivorous elasmobranchs (Couturier *et al.*, 2012). *M. munkiana* is found in coastal waters, endemic of the Eastern Pacific Ocean, more specifically from the Gulf of California to Peru including Malpelo, Galapagos and Coco Islands (Lawson *et al.*, 2017; Marshall, Barreto, Carlson, Fernando, Fordham, Francis, Herman, Jabado, Liu, Rigby, *et al.*, 2019).

Table 1: Taxonomic classification of *Mobula munkiana*

Kingdom	Animalia	
Phylum	*Chordata* (Bateson, 1885)	
Class	*Chondricthyes* (Huxley, 1880)	Sharks and rays (218 especies)
Order	*Myliobatiformes* (Compagno, 1977)	Sting rays and relatives (44 especies)
Family	*Myliobatidae* (Bonaparte, 1835)	Eagle rays (17 especies)
Subfamily	*Mobulidae* (Gill, 1893)	Devil Rays and Manta Rays (8 especies)
Genus	*Mobula* (Rafinesque, 1810)	Devil Rays and Manta Rays (8 especies)
Species	*Mobula munkiana*	(Notarbartolo-di-Sciara, 1987)

Just like other elasmobranchs species, have a low fecundity, with one pup per litter for *M. munkiana*, slow growth rate, late sexual maturity and long gestation period (Couturier *et al.*, 2012; Marshall, Barreto, Carlson, Fernando, Fordham, Francis, Herman, Jabado, Liu, Rigby, *et al.*, 2019). This reproductive adaptation that made elasmobranchs evolutionary successful over the last 400 million years is now a drawback for their survival because of anthropogenic threats such as commercial fishing and as by-catch species, or because habitat destruction (Stevens *et al.*, 2000; Carrier, Pratt and Castro, 2004; Couturier *et al.*, 2012; Ward-paige, Davis and Worm, 2013). For instance, 13 000 mobulids are estimated to be taken annually in global tuna purse seine fisheries as by-catch (Hall and Roman, 2013; Croll *et al.*, 2016) and more specifically *M. munkiana* was the most caught batoid species between 1998 and 1999 in the Gulf of California, where 70% of the Mexican fisheries total production is harvested (Ulloa *et al.*, 2006; Bizzarro *et al.*, 2009). Therefore, all mobulids are either listed as "Vulnerable" including *M. munkiana* or "Endangered" by the IUCN with their populations declining (Ward-paige, Davis and Worm, 2013; Marshall, Barreto, Carlson, Fernando, Fordham, Francis, Herman, Jabado, Liu, Rigby, *et al.*, 2019). Thereby, several mobulids including *Mobula munkiana* have been also protected in Mexico under the NOM-029-PESC-2006 and NOM-059-SEMARNAT-2010 laws prohibiting their extraction and commercialization under any circumstances (Gonzalez-Muñoz, 2007).

Mobula munkiana is characterized by an aggregation behavior in large schools of thousands of individuals, probably for reproductive and migration purposes (Notarbartolo-Di-Sciara, 1988; Stewart *et al.*, 2018; Palacios *et al.*, 2021, 2024) depending on the food-availability and oceanographic conditions (Lezama-Ochoa *et al.*, 2019). But, while this schooling attracts tourists, it could also increase their vulnerability of being captured by fisheries (Ward-paige *et al.*, 2013; Croll, *et al.*, 2016; Guerra *et al.*, 2020). Globally, manta ray watching tourism is well developed and is estimated to be worth USD 140 million annually, with USD 73 million as direct revenue for dive operators (O'Malley *et al.* , 2013). In the same study the total expenditure was estimated to account for USD 5,084,600 with 40,680 manta ray dives annually in Mexico. In Baja California Sur (BCS), where the ecotourism industry is thriving, mobula ray tourism is still emerging. The region's ecotourism hotspots include La Paz, Los Cabos, and La Ventana. La Paz, a city that received 3,445,908 visitors and recorded over 500,000 hotel arrivals in 2019 (*Datatur3 - Baja California Sur*; Lopez, 2021) is a central location for *M. munkiana* tourism*,* typically taking place within the Espíritu Santo Archipelago National Park, where fishing and tourism activities are restricted according to the subzones delineated within the park's 48,655 hectares, as outlined in the current management plan.(CONANP, 2014, 2018). Los Cabos remains one of Mexico's most visited destinations. Indeed, in 2019, 1,060,000 tourists arrivals to hotels have been recorded and 553,800 in San José del Cabos

(Lopez, 2021). In contrast, La Ventana, known for kite-surfing, has become an important area for marine wildlife tourism, however has no restrictions, making it accessible yet vulnerable to overuse.

2. BACKGROUND AND JUSTIFICATION

Economic valuation of a resource such as an ecosystem or a species consists in translating the services it provides into a monetary value and is estimated by summing its direct, indirect, options and existence values (Pearce and Turner, 1989; Pearce and Moran, 1994; Torras, 2000; Pagiola, Von Ritter and Bishop, 2004; Catlin et al., 2010; Anderson et al., 2011; Cagua et al., 2014). The Total Economic Value (TEV) of a species is correlated with the size of the species populations and its charismatic aspect and many economic valuation of threatened and endangered species studies have been conducted (Richardson and Loomis, 2009). Among the Mobulids, manta rays species (*Mobula birostris* and *M. alfredi*) are the most studied and also benefit from more fishing regulations and protection status around the world than the other mobulids species, mainly because of their emblematic character (Lawson *et al.*, 2017).

Different methods to estimate the economic value of wildlife tourism exist. For example, the preference of tourists can be revealed using a choice experiment method where respondents are asked through survey between hypothetical scenarios to estimate the Willingness To Pay (WTP) for specific features of a conservation programs or tourism activities. The market price method estimates the value of a species based on the market price of goods or services derived from it such as fishery yields or tourism revenues which capture the direct use value but not the indirect and non-use value. The Travel Cost Method (TCM) allow to estimate the value of a species or its habitat based on the expenses incurred by tourists, including travel, accommodation or even entry fees. Various studies use the Contingent Valuation Method (CVM) where surveys are carried out to assess people's willingness to pay for the conservation of a certain species capturing the non-use value, this method is used in order to estimate the TEV provided by said species (Mitchell and Carson, 1989; Pearce and Turner, 1989).

The Direct Use Value (DUV) refers to the immediate benefits derived from utilizing a resource (Torras, 2000). In the context of wildlife tourism, the DUV represents the income generated from this activity. Clua et al. (2011) assessed the economic value of the Sicklefin lemon shark in French Polynesia and explained the importance of ecotourism in determining economic impacts. They labeled it the Direct non-consumptive Use Value, opposed to the Direct consumptive Use Value, which fisheries focused on. In this study, we focused solely on

the economic value derived from tourism related to *M. munkiana* tourism activities, thereby treating the total DUV as equivalent to the Direct Non-Consumptive Use Value.

Orams (2002) and O'Malley et al. (2013) assessed respectively the economic impact of Humpback whales in Tonga and the global economic impact of Manta ray tourism. They both defined the Indirect Use Value (IUV) as the expenditure on goods and services made by operators in order to operate.

The NUV, sometimes referred to as the existence value corresponds to the implication of the species in the ecosystem services which means associating its existence to a monetary value.

Given the growing importance of the tourism industry, numerous studies have been conducted to assess its economic value across various species and regions worldwide using various methods (Table 2).

Table 2: Economical value of tourism with various species (in USD). Source: literature review

Economic Value (USD)	Method	DUV	IUV	NUV	Species	Location	Author
25,571,174	Direct Spent	25,571,174		NA	Various shark species	Australia	(Huveneers *et al.*, 2017)
12 412 000	Direct Spent, Travel Cost	12 412 000	NA	NA	Various shark species	Mexico	(Cisneros-Montemayor *et al.*, 2013)
10,540,000	Travel Cost, Contingent Valuation		10,540,000		*Rhincodon typus*	Cenderawasih Bay National Park, Papua, Indonesia	(Anna and Saputra, 2017)
9,400,000	Direct Spent	9,400,000	NA	NA	*Rhincodon typus*	South Ari Atoll, Maldives	(Cagua *et al.*, 2014)
3,292,000	Market Price, Travel Cost	3,292,000	NA	NA	*Rhincodon typus*	La Paz Bay, BCS, Mexico	(Trejo, Gutiérrez and Lee, 2021)
7,595,097	Travel Cost	7,595,097	NA	NA	*Carcharhinus leucas*	Cabo Pulmo National Park, BCS, Mexico	(Pasos-Acuña *et al.*, 2020)
260,000	Market Price, Contingente Valuation	260,000	NA	NA	*Eschrichtius robustus*	Baja California Sur, Mexico	(Schwoerer, *et al.*, 2016)
140,716,597	Direct Spent, Travel Cost	140,716,597	NA	NA	*Mobula birostris and Mobula alfredi*	Worldwide	(O'Malley, Lee-Brooks and Medd, 2013)
34,004,859	Direct Spent, Travel Cost	10,938,912	23,065,947	NA	*Mobula birostris and Mobula alfredi*	Inhambane Province, Mozambique	(Venables *et al.*, 2016)
8,100,000	Direct Spent	8,100,000	NA	NA	*Mobula alfredi*	Maldives	(Anderson *et al.*, 2011)
14,111,414	Travel Cost, Contingent Valuation	3,597,156	10,170,358	343,900	*Mobula birostris*	Revillagigedo Archipelago, Mexico	(Ruiz-Sakamoto, 2015)

The commercialization of any part of *M. munkiana* being prohibited in Mexico under the NOM-029- PESC-2006 and NOM-059-SEMARNAT-2010 laws, the non-extractive exploitation though tourism activities is the only way to exploit the species. Nevertheless, reported illegal fishing (Heinrichs *et al.*, 2011) and by-catch of *Mobula spp.* in industrial fisheries especially in tuna fisheries are still participating in the decline of the species population (Hall and Roman, 2013; Croll *et al.*, 2016; Marshall *et al.*, 2019). Conservation measures such as the banning of fishing during the breeding season, the protection of critical habitats, including reproductive, pupping and nurseries areas, were already suggested by (Serrano-López *et al.*, 2021) and (Stewart *et al.*, 2018) for the different *Mobula* species. In Mexico, several measures already exist in order to protect elasmobranchs species. For example, a permit is needed in order to extract sharks and rays within Marine Protected Areas (MAPs), quotas are distributed according to the area and their availability in fishery resources and within areas categorized as refuge the use of gillnets during the month of June and throughout the year in certain area such as Espíritu Santo, BCS is prohibited.

In southern Baja California Sur waters, in the context of fishermen transitioning from extractive practices to tourism, driven by species protection and declining shark populations, seasonal aggregations of *Mobula munkiana* have helped creating an industry with the potential offer a new source of income for local communities, although this economic value remains unquantified. Assessing the Total Economic Value (TEV) of this tourism industry could highlight its economic importance while advocating for better regulation in areas like La Ventana to ensure sustainable practices.

3. HYPOTHESIS

The Direct Use Value, Indirect Use Value and Non-Use Value accounting for the Total Economic Value of the tourism with *M. munkiana* are different between the location studied in Baja California Sur.

4. OBJECTIVES

4.1 General objective

The main goal of this study is to estimate the Total Economic Value (TEV) of the Munk's devil pygmy ray (*Mobula munkiana*) wildlife tourism along the east coast of Baja California Sur (BCS), Mexico.

4.2 Particular Objectives

Develop a database of companies offering *M. munkiana* tourism services in the southern Baja California Sur, Mexico.

Determine the Total Economic Value of Tourism with *M. munkiana* for each main location known to exploit *M. munkiana* though tourism.

Determine the Total Economic Value of the tourism with *M. munkiana* in the southern Baja California Sur region, Mexico.

5. MATERIAL AND METHODS

5.1 Study Area

This study area is located along the southeast coast of Baja California Sur (BCS), from La Paz to Cabo San Lucas, between 24°28'17''N – 110°19'57'' W and 22°53'23''N – 109°54'56'' W where the *Mobula munkiana* tourism activity is developed in three locations; La Paz, La Ventana and Los Cabos (Figure 1). The *M. munkiana* tourism taking place around the Espíritu Santo Archipelago consists in night diving, requiring a permit issued by the National Commission on Protected Natural Areas (CONANP). In La Ventana, the tourism has exploded since the COVID-19 pandemic (pers. comm) and consists in snorkeling tour to see the target species around the Cerralvo Island, an unregulated area. Finally, in Los Cabos, a small MPA exists where *M. munkiana* can be observed part of the year. Marine protected areas in this region represent approximately 11% of its total area where only less than 1% are recorded as no-take areas (Brett Garling, 2015; Morzaria-Luna *et al.*, 2018). These locations do not have the same conservation status and therefore do not have the same regulations and restrictions regarding conservation.

The Gulf of California includes more than 900 isles conferring it a great variety of coastal habitat including mangroves, lagoons or coral reefs (Brusca *et al.*, 2005; Lluch-Cota *et al.*, 2007; Morzaria-Luna *et al.*, 2018). The topography of the region explains its important biological richness (Morzaria-Luna *et al.*, 2018). The southern Gulf of California is characterized by year-round Sea Surface Temperatures (SST) ranging from 20 to 30°C and a mix of sandy and rocky substrates and a narrow continental shelf leads to significant depths close to the coastline (> 3700m) (Nava Sánchez, 1992; Brusca *et al.*, 2005). During the cold season (from December to May), northwesterly winds cause evaporation and water surface heat loss, which allow upwelling events to occur with a weaker water stratification. This period is characterized by an average primary production of 10 $mg \cdot m^{-3}$. In contrast, during the warmer season (from June to November) weaker southeasterly winds (<5 $m \cdot s^{-1}$) and sea surface temperatures reaching up to 31°C led to strong water column stratification. This stratification reduces vertical water transport near the coast, resulting in a lower average primary production of 0.1 $mg \cdot m^{-3}$.(Santamaría-del-Angel *et al.*, 1999; Lavin, M.F., Marinone, 2003).

Figure 1: Map of Surveyed Cities in Southern Baja California Sur for *M. munkiana* Tourism

5.2 Data Collection

In this study, we employed a combination of the Travel Cost Method (TCM) and the Contingent Valuation Method (CVM) to estimate the Direct, Indirect, and Non-Use Values associated with *Mobula munkiana* tourism. Interviews were conducted with various tourism operators offering activities centered on this species. For the purposes of this study, *M. munkiana* tourism was defined as any activity where the primary motivation for tourists was observing this species in its natural habitat.

5.2.1Tourist Survey

5.2.1.1 Survey design

The primary objective of the tourist survey (Annex I) was to assess tourist expenditures on accommodation, travel, and food during their visit to Mobula munkiana sites, in order to estimate the indirect use value (IUV) regarding their economic impact in each locality. Additionally, the survey aimed to profile tourists based on their demographics, reasons for visiting, and their knowledge of and interest in M. munkiana. Furthermore, participants were asked about their willingness to pay (WTP) a donation to institutions involved in mobula research and conservation, serving as a proxy for calculating the non-use value (NUV).

5.2.1.2 Survey implementation for tourists

Surveys were applied and distributed to tourists using Survey Monkey in La Paz, La Ventana and Los Cabos, where *M. munkiana* tours are advertised between May 2022 and June 2023. Direct application of surveys took place at beaches or ports of the different locations where tourists returned from tours, allowing us to explain the project and encourage participation. Tourists were provided with a QR code linking to the online survey, facilitating responses at their convenience as tourists could access the survey quickly on their phones.

5.2.2 Operator Survey

5.2.2.1 Survey design

The primary objective of the operator survey (Annex II) was to assess their economic activities (profits and costs) related to M. munkiana tourism activities in order to estimate the direct use value (IUV).

The research of the *M. munkiana* tourism operators have been conducted from December of 2022 to March of 2023. A database was constructed with the possible tourism operators offering the observation activity of *M. munkiana* in BCS. For the latter, we used the search-engine of Google Maps using the following terms: “dive shop” followed by the different studied location name; “mobula tours, Baja California Sur”; “mobula tours, Los Cabos”, using either English and Spanish words. We focused on companies that explicitly advertised tours with the species on their website in order to include expenditures irrevocably attributed to the *M. munkiana* tourism and make a conservative approach. A pilot survey was then designed and shared with two trusted operators for feedback, providing valuable insights into the dynamics of the activity and informing adjustments for the final operator survey.

5.2.2.2 Survey implementation for operators

Between September and December 2023, operator surveys were conducted through in-person interviews in La Paz, La Ventana, and Los Cabos. This approach was chosen to minimize the risk of misinterpretation and ensure the accuracy of the collected data.

5.3 Data Treatment and Analysis

Responses were compiled from Survey Monkey and transferred to Microsoft Excel 2019. The data obtained was cleaned, organized, and prepared for analysis. Surveys were excluded if the information was considered insufficient or irrelevant and all values obtained in Mexican pesos (MXN) were converted into American Dollar (USD) using the mean exchange of 2023 rate of 0.05647195 MXN for one USD from the Banco de Mexico website (*Banco de Mexico - Mercado cambiario*, 2023).

5.3.1 Direct Use Value (DUV)

In order to calculate the DUV, first, we estimated the income per year per operator. This involved standardizing the data to a common unit for each operator, such as the number of *M. munkiana* tours per week, the number of weeks the activity was offered annually, and the mean number of tourists per tour, if the data were an estimation and not the precise value for 2022 and 2023. We then used equation 1 to estimate the income per tourism company per season and equation 2 to estimate the income per independent operator (captains). For our analysis, we only considered the income of independent operator when they were not employed by tourism companies, meaning they were either working independently or employed by freelance guides, to avoid any overestimation:

$$I_o = \sum_{type} (n_{t,o} \cdot W_o \cdot \left(1 - P_{loss,o}\right) \cdot S_{to}^{type} \cdot P_o^{type} \cdot T_o^{type}) \quad \textbf{eq. 1}$$

Where I_o represents the income per tourism company o, $n_{t,o}$ the number of tours per week for operator o, W_o the number of weeks operating per year, $P_{loss,o}$ the percentage of trip loss for bad weather (expressed as a decimal, e.g., 20% = 0.2), S_{to}^{type} the percentage sales of each tour type for operator o(e.g., snorkeling, diving; sum of all types = 1) P_o^{type} the mean price of tour type for operator o and T_o^{type} the mean number of tourists per tour type.

The income per independent operator (independent captain) was calculated as:

$$I_o = \sum_{type} (n_{t,o} \cdot W_o \cdot \left(1 - P_{loss,o}\right) \cdot S_{to}^{type} \cdot P_o^{type} \cdot T_o^{type} \cdot C_o^{type}) \quad \textbf{eq. 2}$$

Where C_o^{type} represents the percentage of sales as an independent operator. In cases where independent operator provided tour prices based on the boat rather than per person, we did not multiply these values by the number of tourists.

The general income per locality I_l per year for the locality l were estimated using the following equation:

$$I_l = \sum_{o \epsilon O_l} I_o \quad \textbf{eq. 3}$$

Where O_l represents the ensemble of the operators in the locality l.

The total income per year for the region I_{BCS} were estimated as:

$$I_{BCS} = \sum_{l \epsilon L} I_l \quad \textbf{eq. 4}$$

Where L represents the ensemble of the localities in the region R.

Secondly, we estimated the opportunity cost (OC), which represents the forgone benefit generated by an none chosen alternative (Panello, Gee and Dimech, 2017).

The OC per operator were calculated as:

$$OC_o = \sum_{i=1}^{n_o} K_{o,i} \cdot r \qquad \textbf{eq. 5}$$

Where OC_o represents the annual opportunity cost for the operator o, $K_{o,i}$ the capital value of asset i for operator o, r annual bank interest rate of 8% (29-31-22 / 12-01-23) related to CETES from the Bank of Mexico to estimate this value and n_o the number of assets for operator o.

The OC per locality OC_l per year for the locality l were estimated using the following equation:

$$OC_l = \sum_{o \epsilon O_l} OC_o \qquad \textbf{eq. 6}$$

Where O_l represents the ensemble of the operators in the locality l.

The total OC per year for the region OC_{BCS} were estimated as:

$$OC_{BCS} = \sum_{l \epsilon L} OC_l \qquad \textbf{eq. 7}$$

Where L represents the ensemble of the localities in the region R.

Thirdly, we estimated the variables and fixed costs of the operators providing the activity. Variable costs (VC), which are correlated to the activity level of the operators, include expenses such as fuel, boat maintenance and employee's remuneration. Contrarywise, fixed costs (FC) do not depend on the level of activity of the company such as boat insurance (Panello, Gee and Dimech, 2017).

The VC per operator were calculated as:

$$VC_o = \sum_{d=1}^{D} VC_{o,d} \times N_t \qquad \textbf{eq. 8}$$

Where VC_o represents the annual variable cost for the operator o, $VC_{o,d}$ the daily variable costs for the operator o and the day d, D the number of days where tours were carried out and N_t the total number of tours per year for the operator o.

The VC per locality VC_l per year for the locality l were estimated using the following equation:

$$VC_l = \sum_{o \epsilon O_l} VC_o \quad \textbf{eq. 9}$$

Where O_l represents the ensemble of the operators in the locality l.

The total VC per year for the region VC_{BCS} were estimated as:

$$VC_{BCS} = \sum_{l \epsilon L} VC_l \quad \textbf{eq. 10}$$

Where L represents the ensemble of the localities in the region R.

Each frequency was matched to the season for each operator. For instance, we determined the number of tours conducted during the year and multiplied this by daily costs, such as fuel or food and water provided to tourists. We adjusted frequencies for costs that had fixed time frames; for example, if spark plugs needed replacement every three months, we calculated the corresponding frequency based on the number of weeks in the mobula season. For the fuel values we used the mean price of the "gasolina regular" of May 2023 at 23.08 MXN/liter (IIEG, 2023). In cases where minimal data were missing, such as mean insurance costs, we used the mean costs from other operators. We estimated taxes for tourism companies at approximately 30% of the annual income, focusing only on estimated income generated during the *M. munkiana* tourism season.

The FC per operator were calculated as:

$$FC_o = \sum_{d=1}^{D} FC_{o,d} \times N_t \quad \textbf{eq. 11}$$

Where FC_o represents the annual variable cost for the operator o, $FC_{o,d}$ the daily fixed costs for the operator o and the day d, D the number of days where tours were carried out and N_t the total number of tours per year for the operator o.

The FC per locality FC_l per year for the locality l were estimated using the following equation:

$$FC_l = \sum_{o \epsilon O_l} FC_o \quad \textbf{eq. 12}$$

Where O_l represents the ensemble of the operators in the locality l.

The total FC per year for the region FC_{BCS} were estimated as:

$$FC_{BCS} = \sum_{l \epsilon L} FC_l \quad \textbf{eq. 13}$$

Where L represents the ensemble of the localities in the region R.

Finally, the DUV for each operator was calculated using the following formula:

$$DUV_o = I_o - (OC_o + VC_o + FC_o)$$

The DUV per locality was calculated using the following equation:

$$DUV_l = \sum_{o \epsilon O_l} DUV_o \quad \textbf{eq. 14}$$

And the total DUV for the region as:

$$DUV_{BCS} = \sum_{l \epsilon L} DUV_l \quad \textbf{eq. 15}$$

As the data were not normally distributed, we applied the Kruskal-Wallis test. If significant differences were detected, Dunn's test was employed to determine which locations had significantly different median values (Kruskal and Wallis, 1952; Dinno, 2017).

5.3.2 Indirect Use Value (IUV)

In this study, we used the tourist survey to estimate expenses related to food, accommodation, and transportation during their trip to BCS, as well as the duration of their stay. To identify and rectify any outliers, we employed RStudio. We detected errors in the reported prices for *M. munkiana* tours, where respondents sometimes indicated the total cost for an expedition rather than the price per person per day as asked. This correction aimed to mitigate any potential overestimation of the values. For all outliers identified in the price variables, except for the *M. munkiana* tour prices, we replaced the outlier values with the mean of the variable excluding the outliers, to avoid losing too much data. Flight prices were excluded from this analysis because, being national or international airlines, the benefits from these costs do not remain within B.C.S. However, flight prices were used to calculate the Airport Use Fee (Tarifa de Uso de Aeropuerto – TUA), as this fee contributes to the local economy. We calculated the mean TUA for the airports in San José del Cabo and La Paz, and adjusted for the proportions of foreign and Mexican tourists to determine the frequency of national versus international TUA rates (Aeromexico, no date; Volaris, no date). We estimated the number of tourists coming to observe *M. munkiana* using the data of the number of tours per year estimated per operator and the number of tourists per tour. Finally, we used the estimated number of tourists served by our sample of 32 operators each year to calculate the final IUV per location IUV_l using the following equation and compared the results using a Kuskall-Wallis test:

$$IUV_l = ((\bar{E}_{l,f} + \bar{E}_{l,a} + \bar{E}_{l,t}) \cdot \bar{D}_l + \bar{P}_{TUA}) \cdot T_L \quad \textbf{eq. 16}$$

where $\bar{E}_{l,f}$ represents the mean cost of food per day, $\bar{E}_{l,a}$ the mean cost of accommodation per day, $\bar{E}_{l,t}$ the cost of transport per day, $\bar{D}_l$ the mean number of days of the stay, $\bar{P}_{TUA}$ the mean cost of TUA per tourists, and T_L the estimated number total of tourists.

The IUV for the region IUV_{BCS} was calculated as:

$$IUV_{BCS} = \sum_{l \epsilon L} IUV_l \quad \textbf{eq. 17}$$

5.3.3 Non-use Value (NUV)

The NUV was estimated using WTP responses from tourists regarding their willingness to donate for the conservation of mobulids, translating their perceived value of *M. munkiana* into a monetary figure. The NUV per location was calculated as follows:

$$NUV_l = \overline{WTP_l} \cdot \bar{T}_l \quad \textbf{eq. 18}$$

where $\overline{WTP_l}$ represents the mean Willingness to Pay (WTP) for conservation in location l and $\bar{T}_l$ the number of tourists visiting location l to participate in a *M. munkiana* tour.

The NUV for the region was calculated as follows:

$$NUV_R = \sum_{l \epsilon L} NUV_l \quad \textbf{eq. 19}$$

5.3.4 Total Economic Value (TEV)

The TEV per location TEV_l was calculated as follows:

$$TEV_l = DUV_l + IUV_l + NUV_l \quad \textbf{eq. 20}$$

The TEV for the region TEV_{BCS} was calculated as:

$$TEV_{BCS} = \sum_{l \epsilon L} TEV_l \quad \textbf{eq. 21}$$

6. RESULTS

6.1 Tourists Demographics

We collected 314 completed surveys from tourists involving in *Mobula munkiana* tours. Among these respondents, 61% were women and 39% were men. The majority (41.7%) fell within the 25-34 age range, with a notable 8.2% employed in relevant fields (e.g.: dive master, marine biologist). The demographic profile reveals that 48% of tourists came from the USA, while 26% were national tourists, with over half of the latter originating from Baja California Sur, followed by 3.3% from Mexico City (CDMX), 1.7% from Quintana Roo, and 6.0% from other Mexican states. The remaining 26.5% of tourists originate from six different continents

and 35 distinct countries, highlighting the global nature of this tourism sector (Annex V A; Annex V B).

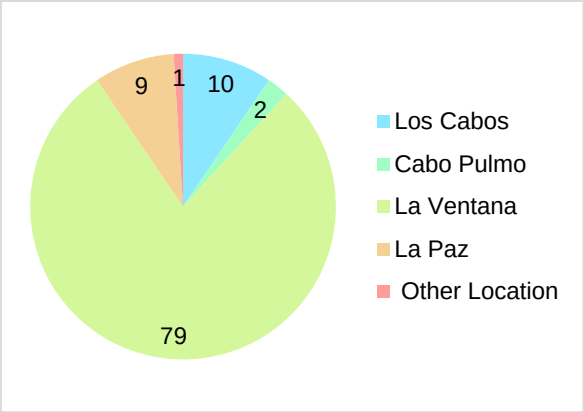

Figure 2: Tour Distribution by Location

Our estimates indicate that 79% of *M. munkiana* watching activity occurs in La Ventana, primarily between the months of May and June **(**Figure 2**)**. In fact, based on the responses from our 32 operators completed surveys, we estimated that each year, 700 tourists visit La Paz, 1,661 head to La Ventana and 952 to Los Cabos, all to observe this species during tourism activities.

Almost a third of tourists (32.4%) expected to encounter only one species of mobulids during their tour, while nearly another third (31.1%) were unaware that more than one species existed. Furthermore, a significant majority (93.2%) of participants did not know of any other destinations where they could snorkel with such large aggregations of mobulas as found in Baja California Sur. This tourism is predominantly promoted through word of mouth (48.2%) and social media (35.3%), with lesser influence from internet searches (11.7%), television or radio (3.2%), and magazines (1.6%).

Participants considered several factors as 'very important' when choosing to join a *Mobula munkiana* watching tour, with 67.6% citing large aggregations of mobulas, 52.8% highlighting the opportunity to contribute to mobula conservation, and 42.2% valuing underwater photography opportunities. Expanding knowledge on mobulas was also important for 55.3% of participants. Before the tour, only 21.1% of participants rated their knowledge as intermediate and 6.5% as advanced; however, post-tour, these figures rose significantly to 54.9% for intermediate knowledge and 37.3% for advanced knowledge. Nearly all participants (95.5%) appreciated receiving information about mobula biology and conservation during the tour.

The majority of participants identified various key features as very important during the mobula tour: good underwater visibility (46.6%), the number of mobulas observed (46.0%), proximity to the mobulas (43.0%), accurate information about the species during sightings (57.6%), the abundance and variety of marine life (57.9%), and the level of crowding on the tour (61.5%). Additionally, 74.8% of participants rated their overall tour experience as 5 stars, with 69.2% specifically rating their in-water experience with *M. munkiana* aggregations as 5 stars. Interestingly, 60.0% of tourists did not expect to see more mobulas than they actually did. Beyond the mobula tours, 76.5% of tourists engaged in other aquatic activities during their

trip in Baja California Sur. Almost all participants (99.0%) believed that mobula watching tourism could serve as a tool for *M. munkiana* conservation.

6.2 Operators Demographics

The database of *M. munkiana* tourism operators included 28 tourism companies that offer snorkeling sessions with the species in various locations within our study area. Among these operators, all provide one-day snorkeling trips with the mobulas; however, only four offer multi-day trips, commonly referred to as “Expeditions.” Additionally, only six operators provide night diving experiences, which are exclusively promoted in La Paz. Out of the 28 tourism companies, 16 responded to our survey, yielding a 57% response rate. Furthermore, we identified approximately 35 independent operators currently offering independent *M. munkiana* tours, with 16 participating in our survey, resulting in a 46% response rate

In Cabo Pulmo, we found that, despite the seasonal presence of *M. munkiana*, operators believed this did not significantly influence tourist influx, consequently we removed the location from our analysis. In San José del Cabo, only two operators were identified, with one providing partial responses to our survey. Consequently, we consolidated data from these operators with those from Cabo San Lucas, collectively referring to the area as Los Cabos.

Interestingly, while nearly all tourism companies (75%) involved in *M. munkiana* tourism are foreign-owned, all the independent operator leading these tours are Mexican nationals. Many of these independent operators (captains) are either employed by tourism companies to provide a boat for the tours or are independently organizing and promoting wildlife tourism around the area during the year, including the *M. munkiana* tourism activity (Figure 3).

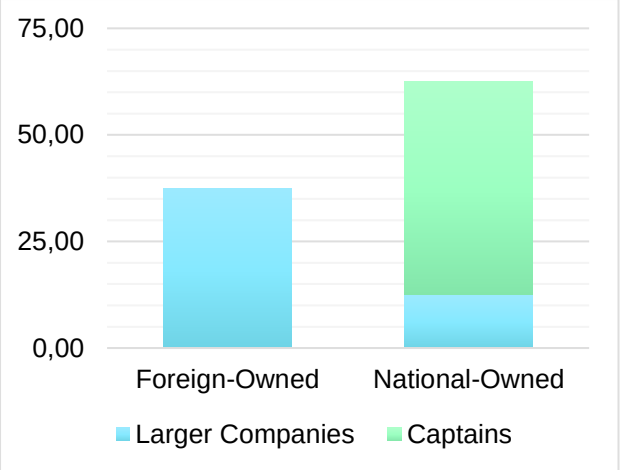

Figure 3: Ownership of operators in *Mobula munkiana* Tourism

Most operators surveyed acknowledged the importance of this tourism for their businesses. Specifically, 53% of registered companies and 63% of independent operators regarded the *M. munkiana* tourism season as highly important. Notably, 13% of independent operators indicated that *M. munkiana* tourism was the most critical aspect of their operations. Several operators also pointed out that the mobula season coincides with the low season for diving in La Paz and La Ventana, enabling them to supplement their income during this period.

From the tourist perspective, approximately 77% of respondents considered the opportunity to see *M. munkiana* a key factor in their decision to book a tour. We noticed that, 24% of tourists indicated they would not have booked a trip to BCS if mobulids aggregations were not present, and 30% mentioned they would have shortened their stay in the region.

6.3 Direct Use Value (DUV)

The yearly income was calculated from the three types of activities within M. munkiana watching tourism in BCS (Figure 4). The data from tourist surveys revealed that one-day snorkeling tours accounted for 88.3% of the total activity, contributing 13.2% to the mean income per operator in the region. In contrast, multi-day trips, which represented only 7.2% of the overall activity, generated a significant 79.0% of the mean income per operator, when offering this activity. Lastly, night diving constituted the remaining 4.6% of M. munkiana watching tourism and contributed 7.8% to the mean income per operator (Figure 4). Meanwhile the mean income for La Paz was USD 23,727 (±10,790), for La Ventana USD 18,854 (±22,992) and for Los Cabos USD 67,387 (±83,248), the Kruskal-Wallis test was not significative (p-value = 0.1093), meaning the mean yearly incomes per operator were not significantly different between locations (Annex VI).

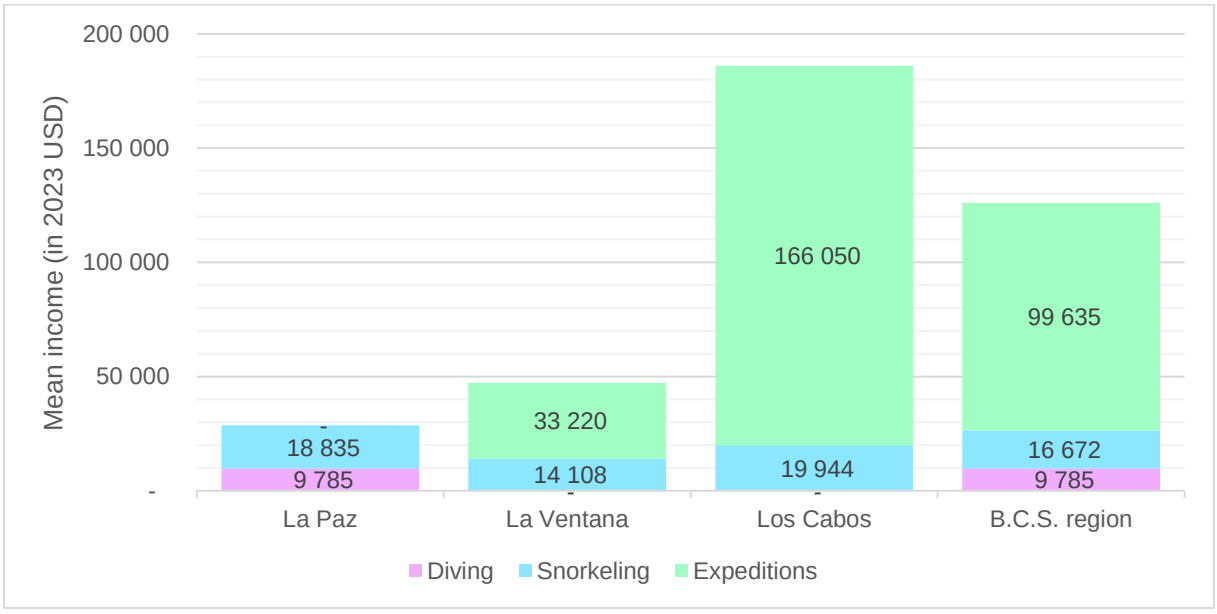

Figure 4: Mean operator income distribution across locations and *M. munkiana* watching activity types.

From the 32 operators and independent operators survey of *M. munkiana* tourism activity we were able to determine the capital investments of each location. (Table 3). The boat, the motor and the boat vehicle accounting for most of the capital investments in each location.

Table 3: Total capital charges by location based on interview data (2023 USD per unit).

Asset	La Paz (n=6)	La Ventana (n= 19)	Los Cabos (n=7)	Min	Max	Unit	Total La Paz	Total La Ventana	Total Los Cabos
Boat	25,694.74 (n=5)	10,174.36 (n=15)	39,470.94 (n=4)	3,953.04	100,000.00	Per boat	128,473.68	152,615.44	157,883.75
Motor	17,275.27 (n=5)	11,180.82 (n=15)	15,750.40 (n=3)	4,517.76	29,000.00	Per boat	83,061.77	167,712.27	47,251.19
Tourist Vehicle	NA	5 082,48 (n=1)	10,000.00 (n=1)	5,082.48	10,000.00	Per operator	NA	5,082.48	10,000.00
Boat Vehicle	10,911.80 (n=3)	2,241.23 (n=15)	16,941.58 (n=2)	564.72	28,235.97	Per boat	29,647.19	33,600.81	33,883.17
Trailer	4,128.72 (n=4)	1,707.01 (n=15)	2,823.60 (n=1)	564.72	7,000.00	Per boat	19,558.99	26,918.30	2,823.60
Shade	NA	1,085.32 (n=15)	NA	282.36	2,371828	Per boat	NA	16,332.75	NA
Equipment (Life jacket, snorkels, GPS, Drone, Cameras…)	9,168.03 (n=4)	890.64 (n=18)	2,248.37 (n=7)	217.82	25,047.08	Per operator	36,672.12	16,893.02	15,738.61
Mean Initial Capital charges	66,851.33	32,361.86	87,234.89	-	-	-	-	-	-
Total Capital Charges, K_0	297,413.76	406,091.05	267,580.32	-	-	-	-	-	-
Mean Oportunity Cost per operator	4,617 ±2,675	2,531 ±1,846	3,054 ±3,520	-	-	-	-	-	
Total Oportunity Cost per location	27,703.00	43,021.00	21,378.00	-	-	-	-	-	-

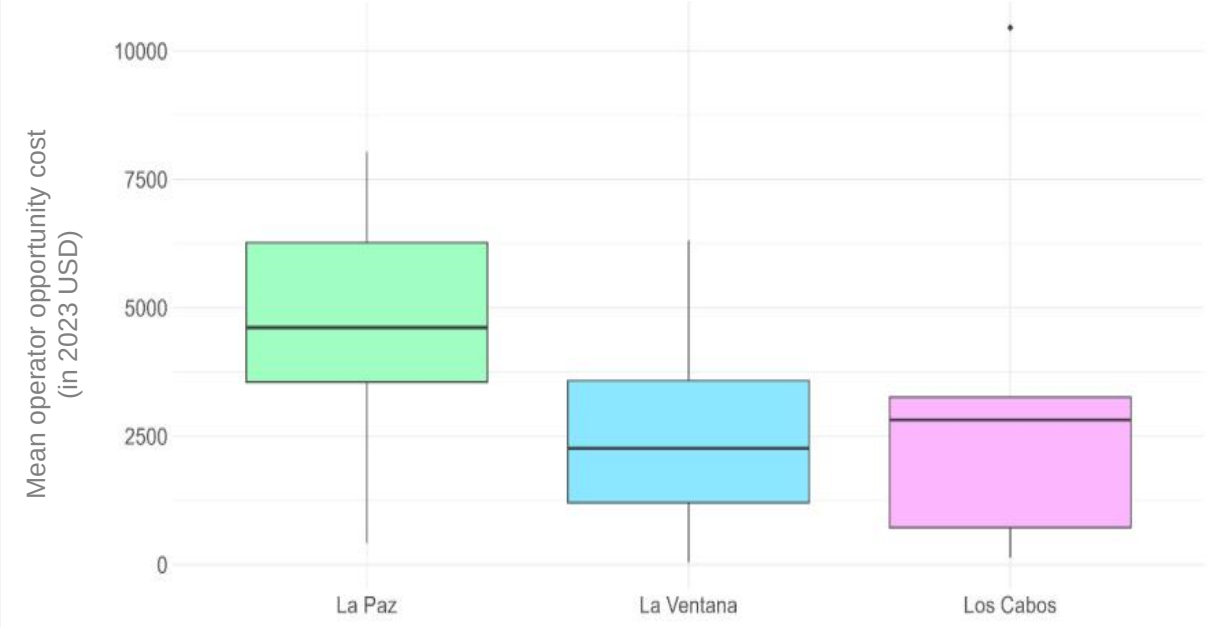

Figure 5: Mean opportunity cost by tourism companies and independent operators based on interview data (2023 USD per unit).

In our sample, the mean opportunity costs per operator were estimated as follows: in La Paz at USD 4,617 (± 2,675), in La Ventana at USD 2,531 (± 1,846), and in Los Cabos at USD 3,054 (± 3,520). However, operators in La Ventana had the highest total opportunity costs, amounting to USD 43,021, followed by La Paz with USD 27,703, and Los Cabos with USD 21,378. The higher total opportunity costs in La Ventana can be attributed to the tourism sample size in this location (Figure 5; Table 3; Annex VII). There were no significant differences between the mean operator's opportunity cost by location (Kuskall-Wallis: p=0.1926).

The mean variable cost in each region is shown in Table 4, Figure 6 and Annex VIII. La Paz and La Ventana operators presented the highest costs associated with boat rentals, averaging USD 452 and USD 427 per tour, respectively. In contrast, operators in Los Cabos presented the highest costs derived from taxes, estimated at 30% of revenue, with a mean cost of USD 485 per day of *M. munkiana* tourism activity (Table 4). The highest mean variable costs per year per operator was estimated in Los Cabos, (USD 44,6723 ± 37,181). In La Paz mean variable cost per year per operator was estimated at USD 8,413 ± 3,320. Finally, the operators from La Ventana, where 84% are independent operators who take tourists out independently—presented the mean variable cost of USD 10,408 ± 19,171 per year (Figure 6). We determined that the difference in mean variable costs were significant between Los Cabos and La Ventana (Kuskall Wallis = p =0.003429, Dunn's Test: p=0.0012).

Table 4: Mean variable cost by tourism companies and independent operators based on interview data (2023 USD per unit).

Parameters	La Paz (n=6)	La Ventana (n=19)	Los Cabos (n=7)	Min	Max	Unit
Boat renting	451.78 (n=1)	426.73 (n=3)	370.22 (n=4)	210.00	564.72	Per tour
Taxes	385.98 (n=6)	224.76 (n=3)	484.78 (n=7)	0%	30%	Per day
Hotel renting	NA	139.58 (n=2)	342.77 (n=2)	111.06	418.18	Per day
Expeditions chefs' salaries	NA	64.54 (n=2)	221.57 (n=1)	21.55	221.57	Per day
Fuel	197.24 (n=5)	80.09 (n=11)	107.67 (n=2)	39.53	325.84	Per tour
Freelancers' salaries	65.51 (n=1)	75.43 (n=6)	98.93 (n=5)	53.75	139.23	Per tour
Food and water supplies	65.98 (n=6)	26.95 (n=11)	50.97 (n=8)	0.28	158.12	Per tour
Employees' salaries	80.40 (n=4)	87.09 (n=3)	88.27 (n=3)	30.61	133.64	Per tour
Boat maintenance	19.37 (n=4)	7.05 (n=11)	20.33 (n=2)	1.55	33.60	Per tour
Other	15.31 (n=3)	0.97 (n=1)	47.43 (n=2)	0.96	68.51	Per tour
Mean Variable Cost	8,413 ± 3,320	10,408 ± 19,171	44,6723 ± 37,181	-	-	Per year
Total Variable Cost per region	50,476.00	145,708.00	312,708.00	-	-	Per year

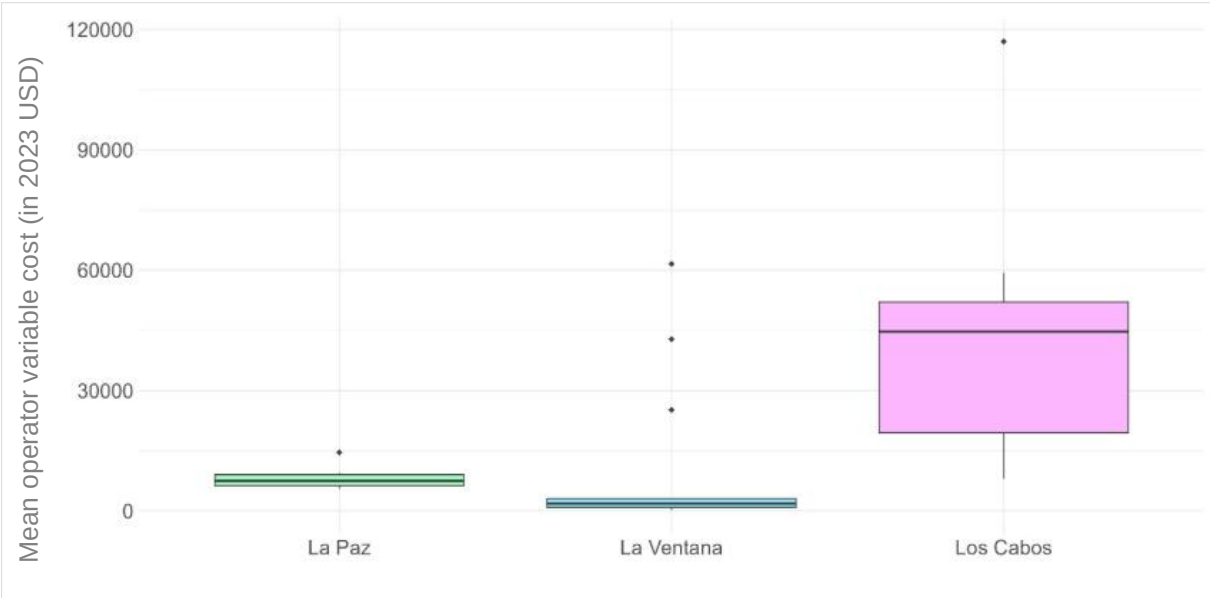

Figure 6: Mean operator variable costs by locations by season based on interview data (2023 USD per unit).

We estimated the mean value for each type of fixed cost in each region (Table 5; Figure 7; Annex IX). In La Paz and La Ventana, the fixed costs per tour were primarily associated with office rentals, averaging USD 34 and USD 19, respectively. In contrast, the highest fixed costs for operators in Los Cabos were dock expenses, averaging USD 51 per *M. munkiana* tour.

Table 5: Mean fixed cost by tourism companies and independent operators based on interview data (2023 USD per unit).

Parameters	La Paz (n=6)	La Ventana (n=19)	Los Cabos (n=7)	Min	Max	Unit
Office rental	34.79 (n=3)	18,55 (n=2)	36.93 (n=3)	14.84	40.82	Per tour
Dock expenses	11.80 (n=3)	NA	51.41 (n=2)	8.35	65.71	Per tour
Advertising	8.33 (n=4)	11,57 (n=3)	16.56 (n=3)	0.77	29.57	Per tour
Accounting	12.34 (n=4)	2,49 (n=8)	13.98 (n=3)	0.37	33.40	Per tour
Insurance	1.16 (n=4)	1,13 (n=11)	1.94 (n=4)	0.62	4.08	Per tour
Security	NA	NA	2.13 (n=2)	0.56	3.71	Per tour
Permits	0.37 (n=3)	1,26 (n=11)	0.42 (n=1)	0.17	3.09	Per tour
Other (Maintenance, GPS subscription…)	23.19 (n=1)	1,86 (n=1)	10.29 (n=3)	0.86	23.19	Per tour
Mean Fixed Cost	1,271 ± 762	467 ± 1,070	3,421 ± 2,733	-	-	Per year
Total Fixed Cost per region	7,629.00	6,534.00	23,947.00	-	-	Per year

We observed that the mean fixed costs per operators accounted per year for USD 3,421 ± 2,733 in Los Cabos, USD 1,271 ± 762 in La Paz and USD 467 ± 1,070 in La Ventana. The difference between Los Cabos and La Ventana was significant (Kruskall-Wallis, p=0.00132; Dunn's Test, p=0.0006; Figure 7).

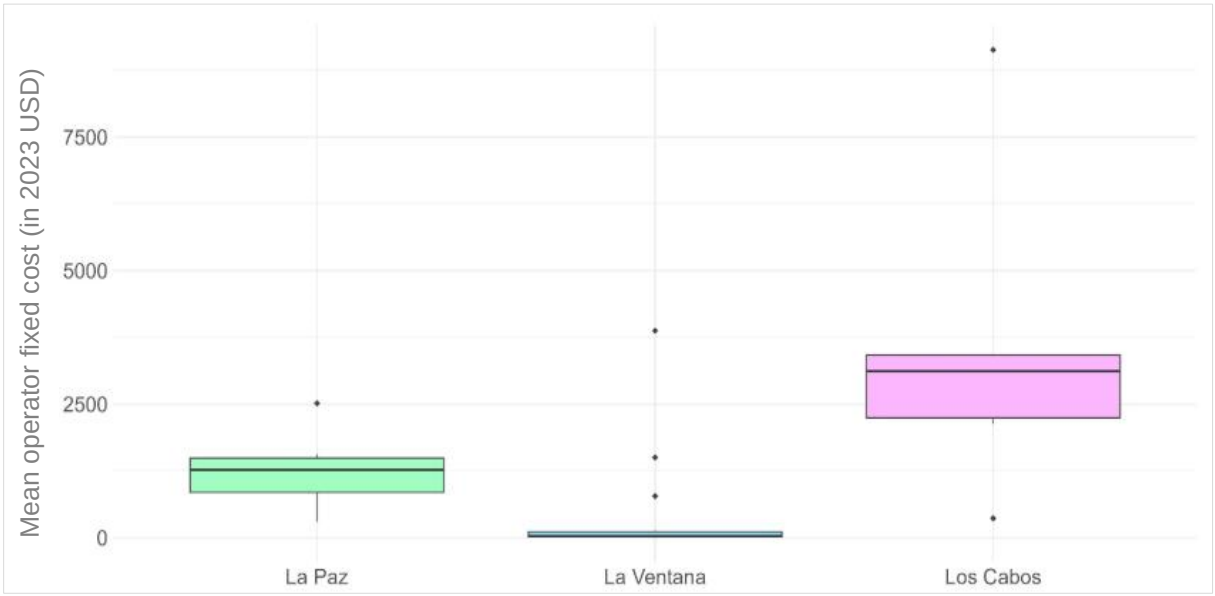

Figure 7: Mean operator fixed costs by locations based on interview data (2023 USD per unit).

The mean yearly direct use value (DUV) was estimated at USD 9,426 ± 10,134 for operators in La Paz, USD 6,117 ± 17,369 for operators in La Ventana, and USD 16,239 ± 52,089 for operators in Los Cabos (Figure 8). The differences in mean DUV per operator were not statistically significant (Kruskal-Wallis test; p-value = 0.3637). Furthermore, the total DUV

in 2023 for La Paz was estimated to account for USD 16,367, USD 12,990 for La Ventana, USD 68,321 for Los Cabos which would represent for the southern Baja California Sur region USD 97,678. This total is calculated from a total gross income of USD 878,026, a global opportunity cost of USD 95,345, global variable costs of USD 656,162, and global fixed costs of USD 28,841 (Table 7).

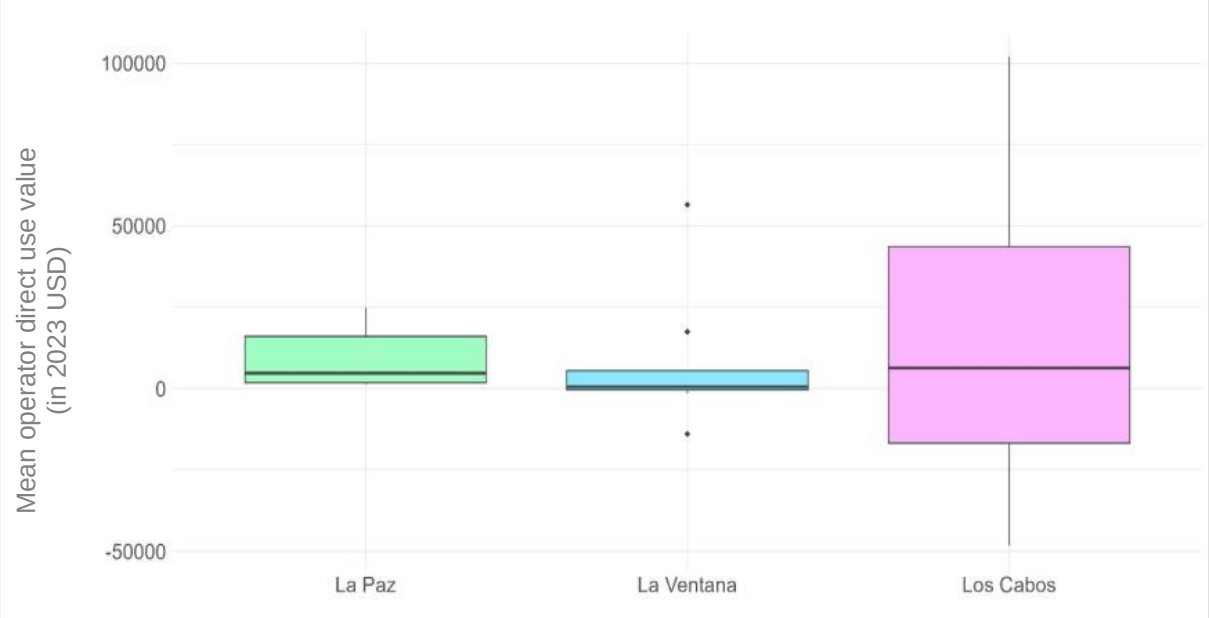

Figure 8: Mean operator direct use value by locations based on interview data (2023 USD per unit).

6.4 Indirect Use Value (IUV)

We determined that every tourist spend in mean each day USD 72 (± 37) in food, USD 201 (± 138) in accommodation and USD 39 (± 24) in transportation. Moreover, we estimated that in mean each tourist undertook 3.26 *M. munkiana* tours during their 7.85 (± 3.67) days visit and spend USD 35 (± 5) in the Airport Use Fee~~,~~ which would represent an associated expenses of USD 2,482 (± 1,724) per tourist per visit of approximately 8 days (Table 6; Figure 9). Accommodation was observed to be the highest cost, followed by food and transportation.

Table 6: Indirect expenditures of tourists participating in *M. munkiana* tourism during their stay in BCS

Location		La Paz	La Ventana	Los Cabos	BCS
Trip duration (days)		7.62	7.89	7.68	7.85
Number of tourists		699.96	1,661.17	952.08	3,313.21
Food (USD)		84.30	71.40	61.90	71.61
Accommodation (USD)		248.00	199.04	178.00	201.48
Transportation (USD)		36.70	39.70	34.60	38.92
Airport Use Fee – TUA (USD)		22.72	34.84	46.95	34.84
IUV (USD/stay)		2,765 ± 1,472	2,496 ± 1,797	2,104 ± 1,226	2,482 ± 1,724.15
IUV (USD/year)	1,982,844.53	4,126,296.80	2,051,463.78	8,213,082.83	

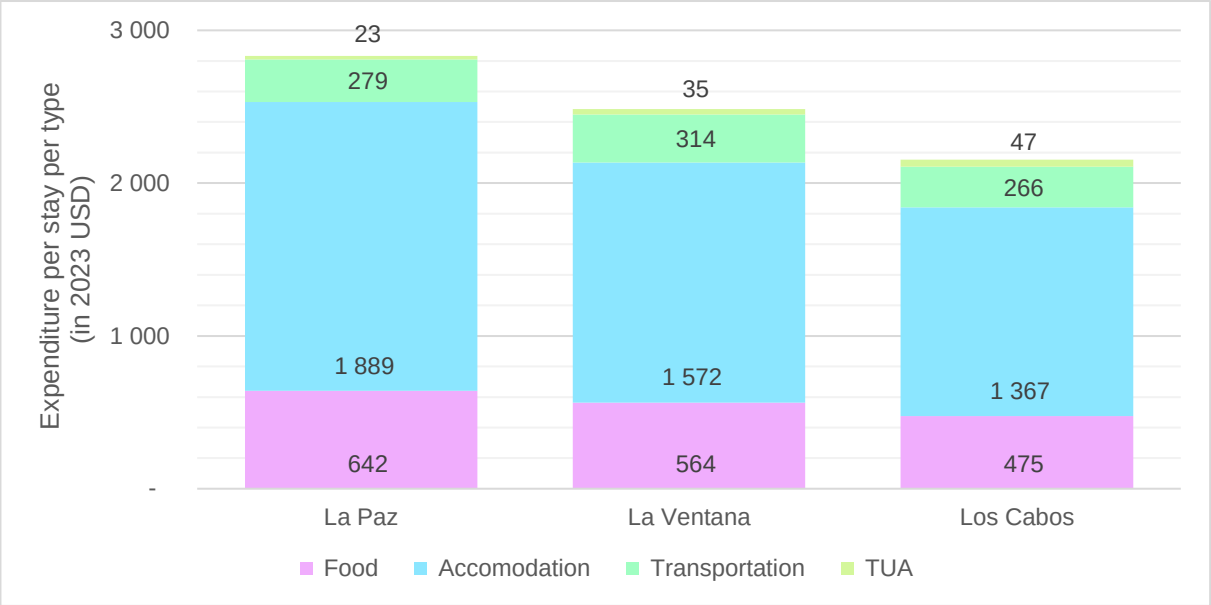

Figure 9: Expenditure per stay per type by locations based on interview data (2023 USD).

Using the information displayed on Table 6 and the number of tourists estimated per year we calculated the indirect use value (IUV) per tourist stay for each location and for BCS region (Figure 10). The IUV per tourist per stay resulted in USD 2,765 and a yearly IUV of USD 1,982,845 in La Paz, of USD 2,496 and USD 4,126,297 in la Ventana and of USD 2,104 and USD 2,051,464 in Los Cabos, respectively. The difference between the IUV per tourist stay value from the different locations was not significant (Kruskal-Wallis, P-value = 0.3399; Annex X). The global IUV for the whole region was estimated to reach USD 8,213,083.

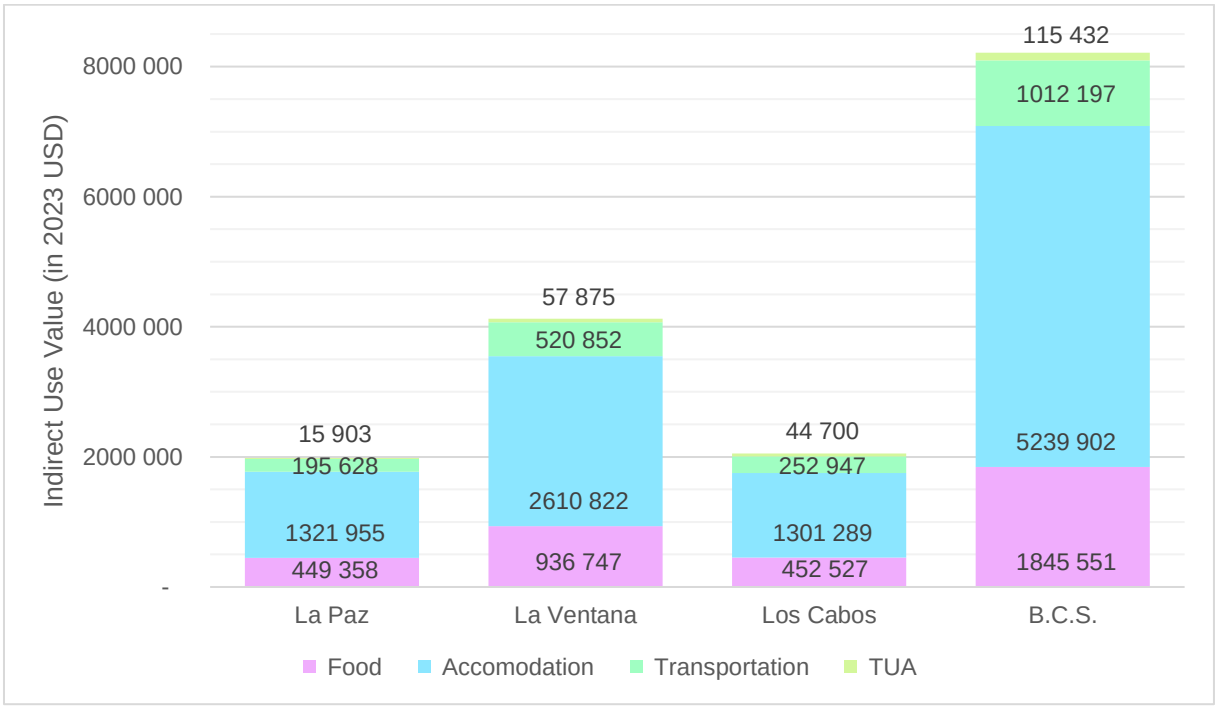

Figure 10: Indirect use value by Location and Region with Breakdown of Food, Accommodation, and Transportation Costs.

6.5 Non-Use Value (NUV)

The results from the survey monkey showed that 40% of tourist participants will not donate toward mobula conservation, the other 60%, who were willing to donate a mean of USD 57 ± 40, indeed 18,79% of the respondent would give between USD 51 and USD 100 to support the conservation of the species.

The donations varied slightly by location, resulting in USD 61 ± 40 in La Paz, USD 57 ± 40 in La Ventana, and USD 53 ± 34 in Los Cabos (Annex XI)

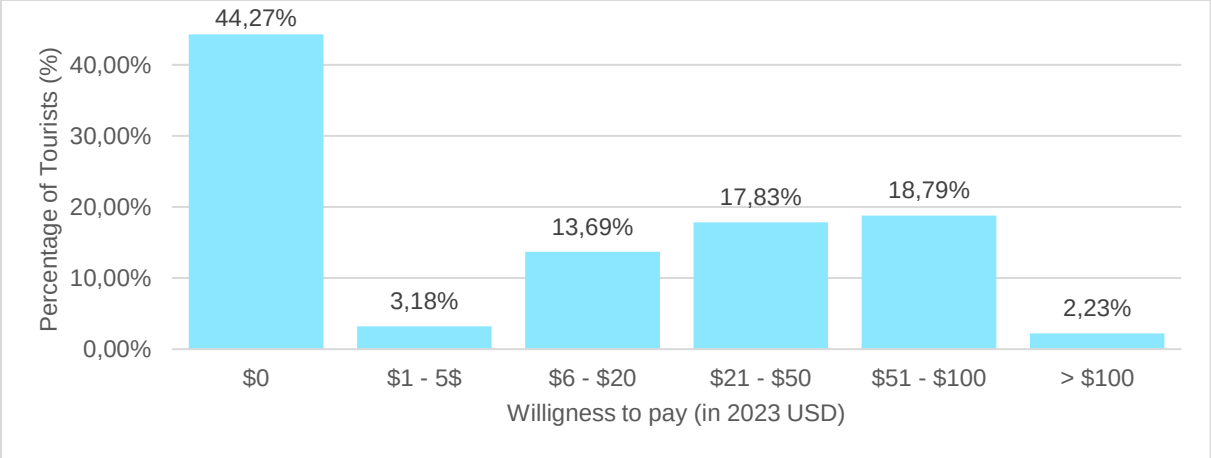

Figure 11: The fee preferences of tourists willing to donate for mobulids conservation.

Based on the number of tourists visiting each destination to participate in *M. munkiana* tourism , as shown in Table 6, and their willingness to pay for the conservation of mobulids, we calculated the non-use value (NUV) per tourists (Table 7), where there was no significant differences between the values (Kruskal-Wallis, p-value = 0.8623) and also an estimation of the yearly NUV for each location from our sample (Figure 12).

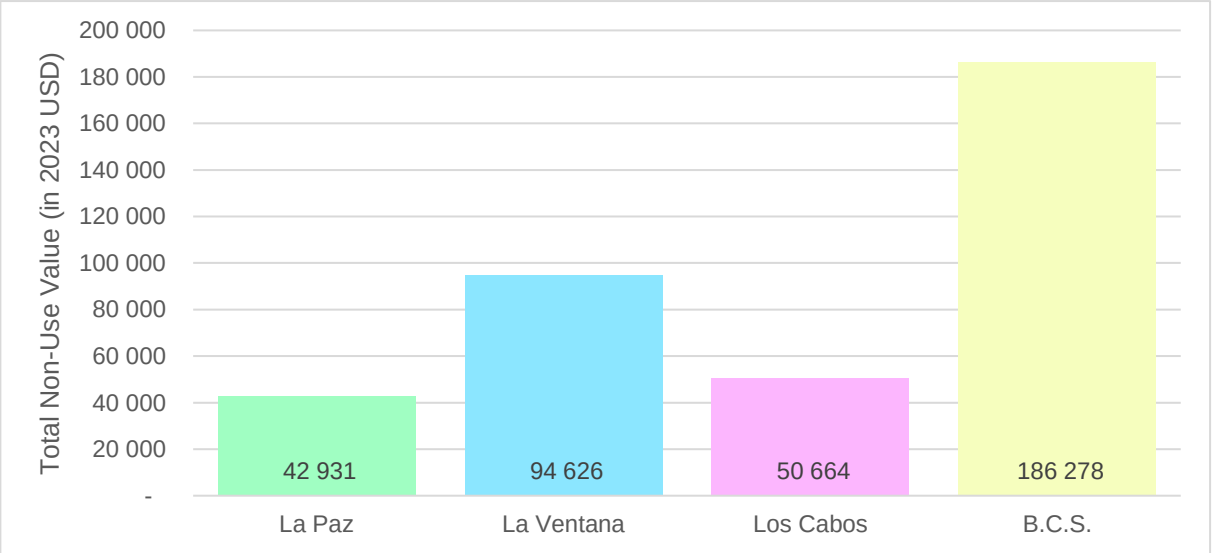

Figure 12: Total Non-Use Value by location based on interview data in US$ (2023 USD per unit).

Tourists in La Ventana expressed the highest willingness to contribute towards mobulids conservation, resulting in a NUV of USD 94,626. The total NUV per year for BCS was calculated in USD 186,278.

6.6 Total Economic Value (TEV)

The resulting total economic value (TEV) per location showed that La Ventana presented the highest TEV in BCS with USD 4,233,913, followed by Los Cabos and La Paz with USD 2,170,449 and USD 2,042,143, respectively (Table 5). TEV of the *M. munkiana* tourism in BCS resulted in USD 8,497,037 for 2023.

Table 7: Summary of total economic evaluation of *Mobula munkiana* tourism in B.C.S. in USD.

Location	DUV	IUV	NUV	TEV
La Paz	16,367	1,982,845	42,931	2,042,142
La Ventana	12,990	4,126,297	94,626	4,233,913
Los Cabos	68,321	2,051,464	50,664	2,170,449
BCS	**97,676**	**8,213,083**	**186,278**	**8,497,037**

7. DISCUSSION

The economic valuation of tourism in the observation activity of *M. munkiana* demonstrates a higher non-extractive value of the megafauna that inhabits the Gulf of California over the value generated by extractive use, such as fishing exploitation, with the former reaching an income of up to USD 8.5 million in BCS. It was also shown that the locality of La Ventana served as the main observation center for *M. munkiana*, receiving tourists from Los Cabos and La Paz, with the trade-off that La Ventana is lacking any activity regulation despite the fact that Cerralvo Island is part of the Islands and Protected Areas of the Gulf of California.

7.1 Demographic

Our findings showed that 61% of participants were women and 39% were men. This highlight a difference from whale shark tourism in La Paz and manta ray tourism where the gender repartition is more balanced and from the shark diving industry, dominated by male tourists (Huveneers *et al.*, 2017; Hani *et al.*, 2019; Pasos-Acuña *et al.*, 2020; Trejo, Gutiérrez and Lee, 2021). The age of the participants in *M. munkiana* tourism are in majority around 25 and 34 years old, which is consistent with manta ray tourism and for shark diving participant in other studies (Huveneers *et al.*, 2017; Hani *et al.*, 2019). The majority of participants in *M. munkiana* tours were foreigners (74%) while in Australia, shark diving is balanced between national and international tourists (Huveneers *et al.*, 2017).

We estimated that 79% of the *M. munkiana* tourism activity takes place in La Ventana between mostly the months of May and June, which is consistent with the previous

reproductive season determined by Palacios et al. (2024) between March and August. The aggregative behavior that the species present during these months and area, for courtship and mating, predator avoidance and/or feeding purposes, make it possible to almost guarantee sightings of the mobulid during each tour, explaining why it has become the epicenter of the tourism industry (Palacios *et al.*, 2023). consisting into one-day snorkeling trip, multi-day snorkeling trips and nigh diving. We observed that, among the operators in La Ventana, tourism companies and independent operators work differently. Independent operators have more capital investments but less types of fixed and variables costs because they only offer one day snorkeling trips and do not require an office to work. At the contrary, tourism companies employ independent operators on a day-to-day basis and have less capital investment as they offer multi-day trips, a more expensive activity, that generate more variables costs (hotel renting, expeditions chefs…). At the contrary, in other location, *M. munkiana* tourism represents a more opportunistic activity as it is less probable to see them or generate more logistic. Indeed, in La Paz, the Espíritu Santo archipelago was described as a nursery area for the species with the greater residency index during the month of September to December (Palacios *et al.*, 2021) explaining the seasonality of the night diving activity. However, as confirmed during the interview process, operators in La Paz are not actively promoting *M. munkiana* focused activities due to the additional logistical challenges (e.g.: navigating to the diving site; managing boats and tourists in low-visibility conditions; addressing increased labor costs due to nighttime operations) and permit requirements. Instead, they prioritize daytime diving activities (pers. comm.). In Los Cabos, the presence of *M. munkiana* is uncertain, unlike La Ventana, since the species migrates from the Pacific Ocean into the Gulf of California, only passing through the region. Operators in Los Cabos explained that while they offer one-day snorkeling trips, they also organize multi-day tours, taking clients to La Ventana to conduct *M. munkiana* tours. The snorkeling trips in Los Cabos are generally not dedicated to *M. munkiana* but are instead multi-species tours referred to as “Marine Safaris.”

7.2 DUV

Direct economic impact estimates from this study indicate that various operators rely on *M. munkiana* tourism activities during part of the year. Our findings are likely conservative, as we focused exclusively on tours specifically designated as *M. munkiana* tours, while numerous other operators also benefit from the presence of this species in their offerings. In BCS, particularly around Los Cabos and La Ventana, wildlife tourism has seen a significant increase since the COVID-19 pandemic (Operator survey). Many operators now promote marine wildlife tourism under the label "safari," focusing on different species throughout the year. During the months of April to June, for example, they highlight the presence of *M. munkiana* aggregations. Consequently, our estimates likely underestimate the true economic value of the *M. munkiana* tourism in the southern BCS region.

The diversity of methods for calculating an economic value is a barrier to comparing results between several studies. This is why we tried to evaluate the correspondence between the results of other articles with the parameters of the equation used in the present study (Table 2).

7.2.1Opportunity Costs

Among the three locations studied, La Ventana showed the highest capital investment and as a consequence the highest opportunity cost, primarily because it is the focal point for *M. munkiana* tourism activities in BCS, with local independent operators playing a key role in taking tourists out to see the species. Independent operators are responsible for the majority of capital investments as all of the independent operators repurpose their boat from fishing activities to tourism (e.g.: marine safaris; sportfishing). The majority of the tourism companies employ them to conduct the tours these companies offer. In La Paz, we found that half of the companies interviewed own boats while the other half do not, which contributes to the second highest opportunity costs. In Los Cabos, most companies relying on the *M. munkiana* tourism are renting boats to independent operators to the tours they are offering in La Ventana, a different location, where the sighting of *M. munkiana* is almost certain during the season. Indeed, the *M. munkiana* tourism in Los Cabos is more opportunistic, with operators occasionally taking advantage of their presence to include mobula sightings between dives for example; however, this is not their primary focus. In contrast, one operator stands out in the Los Cabos area, having recorded the highest opportunity cost of all operators. This can be attributed to the recent purchase of a high-end boat and motor, designed to meet the needs of the affluent clientele that this operator targets.

7.2.2 Variable Costs

As previously mentioned, variable costs depend on the level of activity, in this case, the number of *M. munkiana* tour per year a business engages in. Differences in variable costs across locations can be attributed to the specific activities offered to tourists and the intensity of promotional effort dedicated to these activities.

For instance, night diving, only providing by La Paz tourism companies, can create logistical challenges, such as sailing boats at night, which requires enhanced safety measures and experienced crew, incurring higher salaries for nighttime work and the need for specific permits to be authorized to carry out the activity. To mitigate these issues, operators often offer packages that include two daytime dives along with the night dive. This approach helps them control costs and avoid additional fuel expenses, as the boats are already at the dive location, making the activity more economically feasible. However, through personal communication, tourism companies explained that due to this logistical question, they put less effort on

promoting the night diving activity. While one-day snorkeling tour typically generate costs for fuel, boat rental, salaries, and provisions, multi-day snorkeling tour incur in additional costs, including hotel rentals, chef employment during expeditions, and employee travel stipends, resulting in higher variable costs. We observed that in Los Cabos, all of our respondents were established tourism companies while in La Ventana, 84% of our respondents were independent operators who only offered day snorkeling trips. This explains why the variable costs for operators in Los Cabos, are significantly higher than those for operators in La Ventana.

7.2.3 Fixed Costs

We found that dock expenses are higher in Los Cabos compared to La Paz, and a similar trend is observed for office rentals. In La Ventana, there are no docks, as independent operators store their boats at home, utilizing their vehicles and trailers for transport. Operators in Los Cabos tend to invest more in advertising than those in other locations. Interestingly, independent operators in La Ventana use social media to promote their independent activities, which coincidentally is the second most common way tourists discover *M. munkiana* tours. Fixed costs for independent operators in La Ventana are significantly lower than those in Los Cabos, primarily because they do not need the latter dock expenses, office rentals, or advertising costs. However, the three tourism companies interviewed in La Ventana exhibit the highest fixed costs for the area, highlighting the differences in cost structures between tourism companies and independent operators. This disparity arises because the tourism companies incur additional expenses, such as office rentals and investments in advertising, which independent operators typically do not.

7.2.4 Total DUV

The total DUV estimates accounted for USD 97,678.01 for 2023 in this study, while numerous studies report higher economic value for other charismatic marine megafauna, these are often not directly comparable. For instance, Huveneers *et al.* (2017) estimated a USD 25,571,174 DUV for shark tourism in Australia, and Cisneros-Montemayor *et al.* (2013) reported USD 12,412,000 for Mexico. These DUV encompass tourism for multiple shark species across entire countries, whereas our study focuses on one species within a localized region and a relatively recent activity. Whale shark tourism gross income was estimated to account for USD 9,400,000 in 2013 in Maldives taking into account the 72,000 to 78,000 tourists/year, while we only estimated the visit of 3,140 tourists to see *M. munkiana* (Cagua *et al.*, 2014). Moreover, Cagua *et al.*, did not took into account the expenses generating by the activity nor the opportunity costs, consequently it would be more effective to compare solely the gross income generating for the *M. munkiana* tourism which accounted for USD 878,025.80 for the 3,140 tourists estimated. This would result in USD 125 (2013 value) per tour for the

whale shark tourism in Maldives versus USD 280 (2023 value) for *M. munkiana* tour. In La Paz Bay, BCS, Mexico, the whale shark tourism accounted for a direct income of USD 3,292,000 in 2017 with an estimated 50,000 visitors during the season (Trejo *et al.*, 2021). This activity being regulated and needs to declare the number of tourists visiting the area each day, the study results is more exhaustive than our estimate. The price for a whale shark tour in La Paz was estimated to cost in average USD 73.50 while the *Mobula munkiana* tour were estimated to be higher with an average of USD 262 per tour. The operator relying on the whale shark tourism in La Paz reached an agreement on the tour price, with a discounted rates for La Paz resident. In the case of the *M. munkiana* tourism, prices are not fixed and with one-day snorkeling tours costing upwards of USD 250. Additionally, there is no specific discount for particular client groups. Finally, the average *M. munkiana* price tour is influenced by the multi-day tours; more expensive than single-day tours as they include accommodation costs.

Additionally, our study in BCS reveals a greater economic value of the *M. munkiana* tourism compared to bull shark tourism in Cabo Pulmo National Park, which was estimated to represent USD 7,595,097 (Pasos-Acuña *et al.*, 2020) and grey whales tourism in Magdalena Bay, estimated to reach USD 260,000 over a three month period per year (Schwoerer *et al.*, 2016).

Regarding mobulids species, the DUV of *Mobula birostris* tourism in Revillagigedo, Mexico, was estimated at USD 3,597,156 per year (Ruiz-Sakamoto, 2015). This value is likely exhaustive, as Revillagigedo is a remote area accessible only via liveaboard, with precise travel calendar and easier accessibility to the number of tourists engaging in the tourism (1026 tourists/year). In contrast, our study faces challenges in determining the total number of tourists. However, Ruiz-Sakamoto estimate only accounts for the gross income generating by the tourism without considering the rent of the activity.

7.3 IUV

We estimated an IUV per tourist per stay from *M. munkiana* tourism in BCS is higher in La Paz compared to other locations, consistent with its broader tourism offerings and more elevated pricing compared to smaller destination like La Ventana. Conversely, the total IUV per location is greater in La Ventana, primarily because more tourists visit this destination to see the species.

The IUV for the *Mobula birostris* and *M. alfredi* tourism determined by Venables *et al.*, (2016) in the Inhambane Province, Mozambique was estimated to account for USD 23,065,947 considering a longer average stay (14.82 days) but lower daily expenditure compared to our study. On average, tourists in Inhambane spent USD 76 per day on all expenditures related to

manta tourism, whereas in B.C.S., they spend approximately three times more–USD 316 per day during their stay to observe *M. munkiana*. These difference in trip expenditure price can be explained by the few years separating the two studies where inflation has to be taken into account and the fact that Baja California Sur is an expensive Mexican area.

In the Revillagigedo archipelago, Mexico, the IUV related to *M. birostris* tourism was estimated to represent USD 10,170,358 per year for 1026 tourist (Ruiz-Sakamoto, 2015) or approximately USD 9,912/tourist. This contrast with the lower value of USD 2,615.63/tourists estimated in our study. It is important to note that the methodologies used to calculate these values differ between the two studies. Ruiz-Sakamoto's estimation included plane travel costs, the tourist opportunity cost of time (calculated as the average income tourists would have earned during the 15 days they devoted to the tourism activity in the archipelago) and the DUV of tourists whose participation was not primarily motivated by the presence of the manta rays. In comparation, our estimated IUV was solely based on travel expenses associated with the *M. munkiana* tourism.

The mean expenditure and length of stay for tourists involved in *M. munkiana* tours were notably higher than for whale shark tourism in La Paz. Specifically, tourists spent a mean of USD 2,482.39 in BCS and USD 2,765.00 in La Paz, with stays averaging 7.85 and 7.62 days, respectively. In contrast, those participating in whale shark tours in La Paz spent an mean of USD 993 for a 6-day stay (Trejo *et al.,* 2021). This suggests that *M. munkiana* tourism attracts visitors who are more willing to spend both time and money compared to other wildlife tourism activities in the region. This is further supported by our findings, where 74% of *M. munkiana* tourists were international, in contrast to whale shark tourism, where 74% of participants were national tourists.

7.4 NUV

The WTP for the conservation of *M. munkiana* underscores its value as a charismatic and ecologically significant species. In this study, the WTP for an additional sum as a donation ranged from USD 5 to USD 180, with an average of USD 56.22. This value is consistent with findings for manta ray tourism in Indonesia ((Hani *et al.*, 2019)), where similar interest in conserving charismatic marine species was observed. Comparatively, studies in other regions show lower WTP values for conservation efforts For example, households in South Korea were willing to give approximately USD 2.32 annually for the management and protection of the endangered finless porpoise–a charismatic specie but less directly engaged with through tourism–which was considered significant (Kim et al., 2020). In Japan, a study of over 10,000 respondents evaluated WTP for coral reef conservation by presenting scenarios in which higher donations would secure greater levels of coral reef area and species preservation.

Results showed that 60% of respondents in the highest income class were willing to pay between USD 3,200 and USD 4,100 over their lifetime which would approximately correspond to USD 74.42 to USD 95.35 per year. Another 30% of respondents indicated a WTP of about USD 22.79 to USD 27.91 per year, while the remaining 10% were unwilling to give any amount. Additionally, information about the coral reef increased WTP values by 11.7-19.1% (Imamura *et al.*, 2020). Similarly, our study observed that 97% of operators provide educational content on mobulas, and tourists reported a notable increase in their knowledge of mobulids by the end of their tours. This educational component may promote conservation attitudes and explain the relatively high WTP for *M. munkiana* in BCS. Interestingly, the relatively high WTP in BCS may reflect the unique opportunities for close encounters with *M. munkiana*, which enhances its appeal to tourists. This high WTP also emphasizes the value tourists place on the species, recognizing its experiential significance. The variation in WTP values could be influenced by tourists' income levels, perceptions of the species' conservation status, or the quality of the experiences offered (e.g.: the clarity of the water may influence the perceived quality of the snorkeling experience).

In Fiji, Murphy *et al.* (2018) asked tourists if they would be willing to increase their financial contribution through snorkeling trips to support sustainability and conservation efforts in the area. They found that tourists were willing to increase their existing donations by nearly 86% to help local conservation and education initiatives. In our study, we found that more than 60% of the respondent would also make a donation towards conservation, highlighting the strong support for sustainable tourism practices and the value tourists place on preserving the natural environment they visit.

Ruiz-Sakamoto estimated a willingness to pay of USD 153 for the conservation of *M. birostris* in Revillagigedo, demonstrating tourist highly interesting in the specie and the survival of its population. Nevertheless, the author stresses the fact that the WTP only show the tourists preference for the and it represents only a fraction of the real NUV. The NUV value reflects the ecosystemic services from an anthropogenic point of view and the potential futures use of the species of interest, very hard aspect to traduce into an economical value. Furthermore, the WTP is highly influenced by the charismatic aspect of a species to the respondent while the ecosystemic services provided by the said species do not depend on its charismatic traits (Richardson and Loomis, 2009). Sousa *et al.* (2019) stress that overlooking non-use values in economic valuation may lead to misguided public decision-making. For example, in Cabo Pulmo, the fishing ban combined with the conservation effort of the local communities helped the successful recovery of most species population within the Park, including top predators (Aburto-Oropeza *et al.*, 2011). Only 70 inhabitants live all year in the village and the majority

of the population is working in the tourism industry as the park receives 8,000 tourists each year (Pérez, Boncheva and Bentacourt, 2010; Mader, 2021).

However, while tourism can promote conservation, it is essential to note that unregulated tourism can harm species and have drawbacks (e.g.: La Ventana). Some operators in the manta ray tourism industry have raised concerns that overcrowding at popular viewing sites may be impacting manta behavior and reducing sightings. Such changes not only affect the quality of the experience for visitors but also pose a risk to the wellbeing of the manta populations. Tourist interactions have been shown to disrupt essential behaviors, such as feeding and cleaning, thereby posing a significant risk to the species' health and survival (O'Malley *et al.*, 2013; Venables, 2013; Venables, *et al.*, 2016; Stewart *et al.*, 2018). *M. munkiana*, being a smaller and more sensitive species compared to *M. birostris* and *M. alfredi*, could face an even greater impact from overcrowding by tourists and boats. As they help maintain a balanced food web, the presence of *M. munkiana* can indicate a healthy ecosystem, and they contribute to biodiversity, which is essential for the resilience of marine habitats. To support the long-term sustainability of *M. munkiana* tourism, it is essential to implement effective management strategies, such as regulations on the number of boats in the area, as already practiced in the Espíritu Santo Archipelago National Park. Limiting the number of boats allowed for a group of *M. munkiana* and enforcing existing guidelines and codes of conduct for snorkeling activities could help mitigate potential risks. These measures are particularly important in unregulated locations like La Ventana.

7.5 TEV

In this study, the *M. munkiana* tourism was estimated to generate approximately USD 8,5 million. In comparison, the whale shark industry in La Paz, BCS, was estimated to generate an economic benefit of USD 3.3 million for the 2016-2017 season, which would be equivalent to USD 4.51 million in the 2023 season, adjusting for an inflation rate of 5.28% over the period between the two studies (INEGI, no date; Trejo *et al.*, 2021). Several factors could explain this difference. Firstly, the *M. munkiana* tourism's value was derived using the Total Economic Value (TEV) approach, which includes both use and non-use values. The whale shark tourism value, however, was calculated using a travel cost method that focuses only on use value and does not take into account the non-use value, likely resulting in a lower estimate. Another factor may be related to site management. In La Paz, whale shark tourism is regulated, with restrictions on the number of boats and tourists allowed in the designated area, maintaining a controlled environment. In contrast, La Ventana, the hub of *M. munkiana* tourism, currently lacks regulations, leading to potential overcrowding. This lack of restrictions could contribute to a higher economic estimate for *M. munkiana* tourism.

We can observe that the recent growth of the *M. munkiana* tourism in BCS seems to be reach comparable economic value to other local megafauna tourism activities, such as the whale shark tourism in La Paz, the grey whale tourism in Magdalena Bay and the Bull shark tourism in Cabo Pulmo.

Anderson *et al.* (2011) estimated the economic impact of *M. alfredi* tourism reaching USD 8.1 million by multiplying the mean annual number of tourists diving with manta rays across various Maldivian locations by the mean dive price. While both the present study and Anderson *et al.* (2011) provide similar economic valuation estimates, the manta ray tourism in the Maldives would be likely underestimated as their valuation is representing only a part of the TEV in comparation to the present study. In Baja California Sur, *M. munkiana* tourism is unregulated with no centralized database listing all operators practicing this activity and also relatively new, making it challenging to fully understand the tourism dynamics, consequently our estimated DUV of USD 97,678.01 only reflects the specific sample used in this study. In contrast, Anderson *et al*.'s study in the Maldives was supported by over 39 years of diving experience and a specific interest in the studied species, enabling a detailed understanding of the tourism industry. Furthermore, manta ray tourism has grown substantially since 2011, suggesting that Anderson *et al*.'s estimates are likely outdated. While 1,026 *Mobula birostris* tourists were estimated to generate USD 14,111,414 in Revillagigedo against 3,140 tourists *Mobula munkiana* tourists generate USD 8,497,036, it is important to note the effect of the accessibility of the tourism area to compare the value (Ruiz-Sakamoto, 2015). Indeed, the Revillagigedo archipelago is a remote area offering diving activity with the oceanic manta ray, explaining a mean price tour of USD 3506. In contrast, the *M. munkiana* activity price is in average USD 262 is more easily accessible, being in majority a snorkeling activity in coastal area.

Numerous studies on the economic value of manta ray tourism (including *Mobula birostris* and *Mobula alfredi*) demonstrate that these species generate millions of dollars annually. For *M. munkiana*, which is a protected species in Mexican waters, there is no legal retail price, making its non-consumptive DUV the only legitimate form of DUV. Although illegal fishing persists (Palacios, unpubl. data), the market value of mobulids taken through illegal means is limited to “tecolote” meat as *M. munkiana* meat is a darker color and almost always sold dried at approximately 5 USD/kg. Moreover, the gill plate market, with greater value, has never existed in Mexico (Heinrichs *et al.*, 2011; Croll *et al.*, 2016). This further underscores that the *Mobula munkiana* species has significantly greater economic value when alive, benefiting the local communities in BCS through sustainable tourism rather than through exploitation for meat or gill plates.

7.6 Limitations

Among the limitations in our study we can note that option values reflect the use value (direct and indirect) that may be realized in the future, as described by Torras (2000). For example, in estimating the Amazon's value, researchers focused on potential future medicinal and agricultural applications due to a lack of reliable ecological data. Similarly, given that *M. munkiana* tourism is a relatively new activity and has yet to demonstrate long-term sustainability, estimating its value presents challenges, which is why it was not considered in this study.

Moreover, it is important to note that after the first interview stages of our study, an effort was made to include the wider range of stakeholders involved in the *M. munkiana* tourism activity, indeed we refined our survey to better capture the perspective of the independent operators and interview them directly, gaining deeper insights into the tourism industry. Despite efforts to reach out to various freelance guides for additional data, the response was limited. Only a few individuals replied, all of whom were contracted by tourism companies during the peak season, which could result with redundant data. Larger freelancers who advertised their tours on social media did not respond making it not possible to represent this part of the activity. These limitations caused un underestimation of the final TEV value for the *M. munkiana* tourism in BCS.

7.7 Recommendations

When comparing the TEV with other studies, it becomes clear that *M. munkiana* tourism offers a sustainable source of income for local independent operators, enabling them to generate earnings through non-consumptive activities centered around a protected species. While nearly all tourism companies (75%) involved in *M. munkiana* tourism are foreign-owned, all the independent operators leading these tours are Mexican nationals, indeed many of these independent operators have transitioned from traditional fishing or shark fishing industries to focus part of the year (one fourth of the year) on eco-tourism centered around marine megafauna, including mobula rays. This shift underscores the growing significance of sustainable tourism as a livelihood for local communities (Pham, 2020). Additionally, this form of tourism generates significant economic benefits not only for direct users but also for the broader tourism industry in southern BCS, with La Ventana being the most important area. As seen in other mobulids species, intense tourism activity can affect marine wildlife negatively, consequently it is recommended to take into account every stakeholder of this industry while implementing conservation measures in order to promote a sustainable activity (Hani *et al.*, 2019; Hani, 2021). For example, a part of the MPA of Nusa Penida, Bali, is allocated for marine wildlife tourism and the government has implemented a policy in order to integrated local communities into the tourism activity, as operator and businesses working the tourism industry

must hire 50% of their staff from these local companies (Hani, 2021). We recommend following the example of similar successful initiatives by establishing management measures that involve all stakeholders in the *M. munkiana* tourism industry, particularly in La Ventana. This approach could help regulate the industry effectively, providing a sustainable alternative to shark fishing while protecting *M. munkiana* during its seasonal presence and reproductive period. Developing a comprehensive management plan would enable a full inventory of companies and independent stakeholders involved in this tourism. Future research could focus on a more exhaustive analysis of all operators in the industry and on tracking growth trends over time. Such efforts would support the development of conservation policies that help preserve *M. munkiana* populations while allowing local communities to thrive.

8. CONCLUSION

We have determined that 30+ operators are taking advantage of the *M. munkiana* presence in B.C.S. to develop a focused tourism with the species, offering one-day and multi-day snorkeling tour as well as night diving.

The TEV of the tourism with *M. munkiana* was estimated to reach in 2023, USD 2,042,142.51 in La Paz, USD 4,233,912.92 in La Ventana and USD 2,170,448.89 in Los Cabos.

The economic value of *Mobula munkiana* tourism for Baja California Sur was estimated to represent USD 8.5 million in 2023 with direct revenues from tour operators (DUV) accounting for 1.1% of the value, indirect spending by tourists (IUV) for 96.7 % and the NUV for 2.2%. While there were no significant differences in DUV, IUV, or NUV across locations, La Ventana emerged as the hotspot for this activity.

While the DUV and IUV results highlight the economic significance of *M. munkiana* tourism for the local economy, emphasizing its value for both individual operators and the tourism companies, the NUV results highlight the strong environmental value that tourists place on *M. munkiana*, viewing it as a significant and charismatic service. This combination of economic benefits and environmental appreciation emphasizes the importance of maintaining and sustainably managing *M. munkiana* tourism for the long-term benefit of both local communities and the ecosystem.

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ANNEX I

Tourists Survey

Lógica de página | Más acciones

Mobula Economic Value Survey II

ANONYMOUS SURVEY

Mexico Azul, CICMAR, and Mobula Conservation need your help to prove mobulas are worth more alive than killed by illegal fisheries or as incidental catch in non-selective fishing gear.

Date / Time

Date

DD/MM/YYYY

La encuesta se compartió automáticamente

Guardando cambios...

2. Where was the location of your Mobula Tour?

- ◯ Cabo San Lucas/ San José del Cabo
- ◯ Cabo Pulmo
- ◯ La Ventana
- ◯ Los Barriles
- ◯ La Paz
- ◯ Magdalena Bay
- ◯ None of the above

3. What is your country of residence?

5. What is your profession/ occupation?

La encuesta se compartió automáticamente

Guardando cambios...

6. How old are you?

- ◯ Under 18
- ◯ 18-24
- ◯ 25-34
- ◯ 35-44
- ◯ 45-54
- ◯ 55-64
- ◯ 65+

7. Sex

- ◯ Female
- ◯ Male

- ◯ Whales
- ◯ Whale shark
- ◯ Sea lion
- ◯ Other Sharks

La encuesta se compartió automáticamente

Guardando cambios...

- ◯ Orcas

9. When did you decide to participate in a Mobula Tour?

- ◯ Before I left home
- ◯ Once I was in Baja California Sur

10. How important was seeing Mobulas in your decision to visit Baja California Sur?

- ◯ Not at all important

11. If Mobula tours were not present in Baja California Sur, would you still have v

La encuesta se compartió automáticamente

- ◯ Yes
- ◯ No
- ◯ Yes, but fewer days

Guardando cambios...

12. How many species of Mobulas did you expect to encounter?

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ Yes
- ◯ 4
- ◯ 5
- ◯ I didn't know there was more than one

La encuesta se compartió automáticamente

Guardando cambios...

14. Where did you he

- ◯ Social Media
- ◯ Internet
- ◯ Magazine
- ◯ TV/ Radio
- ◯ Someone told me

15. Were you SCUBA diving or snorkeling/freediving with Mobulas?

- ◯ SCUBA diving
- ◯ Snorkeling / Freediving

Big aggregations of Mobulas	◯	◯	◯	◯
Underwater photography opportunities	◯			
Participate and help with Mobula Conservation	◯	◯	◯	◯
Expand my knowledge on Mobulas	◯	◯	◯	◯

La encuesta se compartió automáticamente

Guardando cambios...

17. How important are the following features during your Mobula experience?

	Not at all	Important	Fairly important	Very importa
Good underwater visibility	◯	◯	◯	◯
Proximity to Mobulas	◯	◯	◯	◯
Accurate information of the species during the tour	◯			
Abundance and variety of marine life	◯	◯	◯	◯
Crowdedness of the Mobula tour	◯	◯	◯	◯

La encuesta se compartió automáticamente

Guardando cambios...

18. How would you describe your level of knowledge about mobulas before & after your tour?

	None	Little	Intermediate	Advanced	Expert
Before your Mobula	◯	◯	◯	◯	◯

19. How many days w this trip?

La encuesta se compartió automáticamente

Guardando cambios...

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 6 or more
- ◯ I don't know

20. Are there more aquatic activities you undertook / plan t undertake during your trip to Baja California Sur?

- ◯ Yes
- ◯ No

22. How many days a

La encuesta se compartió automáticamente

Guardando cambios...

* 23. What was your average expenditure per DAY per PERSON for FOOD during your stay in Baja California Sur i American Dollars (USD)?

* 24. What was your average expenditure per DAY per PERSON for ACCOMMODATION during your stay in Baja California Sur in American Dollars (USD)?

* 25. What was your average expenditure per DAY per PERSON for TRANSPORTATION during your stay in Baja

* 26. What was your average expenditure per PERSON for FLIGHT to Baja California Sur in American Dollars (USD)?

La encuesta se compartió automáticamente

Guardando cambios...

* 27. What was the co (per day) in American Dollars (USD)?

28. Rate the quality of your Mobula Tour (service, information, gear). (On a scale from 1 -Bad- to 5 -Excellen

1 2 3 4 5

29. Rate the quality of your in-water experience with the mobulas (On a scale from 1 -Bad- to 5 - Excellent-)

- ◯ Yes
- ◯ No

La encuesta se compartió automáticamente

Guardando cambios...

31. Would you be willing to make a donation for to be used in mobula research and conservation? If yes, how much ir American Dollars (USD)?

- ◯ No
- ◯ Yes

Yes (How much USD?)

La encuesta se compartió automáticamente

33. Do you believe M Mobula conservation

Guardando cambios...

- ◯ Yes
- ◯ No

ANNEX II

Tourism Companies Survey




Encuesta sobre el Valor Económico de Mobula Munkiana

Gracias por su tiempo en participar en este importante proyecto de investigación realizado por el Centro Interdisciplinario de Ciencias del Mar – Instituto Politécnico Nacional en colaboración con el Centro de Investigaciones Biológicas del Noroeste (CIBNOR. La información estadística recopilada de esta encuesta se utilizará para mejorar la comprensión de los valores económicos de las actividades turísticas de Mobula munkiana. El Consejo Nacional de Ciencia y Tecnología (CONACYT) de México apoyó este proyecto de investigación a través de fondos de investigación ambiental.

Su información individual será confidencial.

Informaciones sobre la empresa

1. Nombre de la empresa: _____
2. Nacionalidad del propietario de la empresa: _____
3. Dirección de la oficina: _____
4. ¿Es usted un operador turístico registrado o propietario de un barco que ofrece recorridos por la vida silvestre? _____
5. ¿Cuál era su ocupación antes del turismo? _____

Descripción laboral

6. ¿Cuántas personas trabajan actualmente en la empresa? _____
7. ¿Cuáles son sus roles laborales específicos? (Por favor especifique el número y el salario por mes o por dia)
   - Recepción/reservas _____
   - Gestión _____
   - Guía _____
   - Capitán _____
   - Oficina/Contabilidad _____
   - Marketing/redes sociales _____
   - Otro (Por favor explique) _____

Descripción de la operación durante una expedición Mobula

8. Qué servicios ofrece su empresa a los turistas en general y especificar en caso de expedición en Mobula:

Servicios	Servicio específico Mobula:	Precio por persona (En **$USD**)
Expediciones de varios días		
Dia de Snorkel		
Medio día de Snorkel		
Buceo		
Buceo Nocturno		
Viaje en Barco		
Otro:		

9. ¿Ofrecen contenido educativo durante los tours que ofrecen? Yes___ No___
10. ¿Cuántos viajes (embarcaciones) de mobulas se reservan por día durante la temporada de Mobulas? _____
11. ¿Cuántos días a la semana realizan tours durante la temporada de Mobulas? _____
12. ¿Cuántas semanas al año ofrecen viajes específicos de Mobula? _____
13. ¿En qué meses del año ofrecen los servicios relacionados con mobulas? _____
14. Puerto o lugar de salida más frecuente para viajes en mobula (encerrar la respuesta): San Lucas, San José del Cabo, Los Barriles, Sargento, La Paz, Otro: _____
15. Área(s) visitada(s) más frecuente(s) para la exploración de mobulas (encerrar la respuesta): Cabo San Lucas, San José del Cabo, Cabo Pulmo, La Ventana, La Paz; Otro: _____
16. ¿Cuál es su tripulación habitual por barco para los tours Mobula? _____

17. ¿Cuál es el número promedio _____ y máximo _____ de turistas que puede llevar en cada tour de mobula?
18. ¿Cuál es la proporción de viajes perdidos debido a malas condiciones climáticas u otros factores durante le temporada de mobulas?
    0-10% - 10-20% - 20-30% - 30-40% - 40-50% - > 50%
19. ¿Cuál fue el porcentaje promedio de pérdida de actividad por COVID-19 durante las temporadas 2020: _____; 2021: _____ y 2022: _____.
20. ¿Siente que el nivel de actividad ha vuelto completamente a la normalidad? _____

Costo de Operación y Precios de Tours

21. ¿Qué porcentaje de los ingresos anuales/estacionales de la empresa representan las actividades turísticas relacionadas con las expediciones Mobula?
    0-9% - 10-19% - 20-29% - 30-39% - 40-49% - 50-59% - 60-69% - 70-79% - 80-89% - 90-100%
22. ¿Podría estimar el porcentaje de ventas de cada servicio Mobula que ofrece? (por ejemplo, expedición de varios días = 20 %, viajes de un día = 70 % y buceo nocturno = 10 %, etc.) _____
23. ¿Qué porcentaje de los ingresos se destina a pagar los gastos operativos del negocio?
    0-9% - 10-19% - 20-29% - 30-39% - 40-49% - 50-59% - 60-69% - 70-79% - 80-89% - 90-100%
24. Por favor detalla los diferentes costos para los tours en mobula:

Inversiones de capital en **$USD**:

	Personal (numero de unidades)	Renta por salida (precio + número de unidades)	Precio Estimado (por unidad y especificar la moneda)
Embarcación			
Motor			
Transporte de panga			
Transporte para turistas			
Remolque			
Equipo de Snorkel			
Equipo de Buceo			
Tanques			

- Tipo de embarcación (yate, panga, velero…): _____
- Tamaño del barco: _____ Caballos de fuerza: _____ y marca del motor: _____
- ¿Otras inversiones de capital? _____

Costos variables en **$USD**:

- Salarios/Salarios (ejemplo, recepcionista: 1000$/mes; capitán: 60$/día de viaje; guía: 50$/día de viaje):
  - Salario mensual de oficina (recepcionista, vendedor, etc.): _____
  - Salarios diarios de viaje (azafata, capitán y guía): _____
- Publicidad (costo mensual o anual): _____
- Frecuencia de mantenimiento de embarcaciones: Semanal ____ Mensual ____ Anualmente ____ Otro _____ y precio: _____
- Combustible (costo del viaje por embarcación; establecer duración del viaje, por ejemplo, por día, por semana, etc.): _____
- Suministros totales (comida/bebidas/hielo; costo de viaje por barco por viaje):): <99$ 100-199$ 200-299$ 400-499$ Other: _____
- Renta de hotel: _____
- Alimentación ofrecida a los turistas: _____
- Guías contratados: _____
- Capitanes contratados: _____

¿Algún otro costo variable? Por favor especifica: _____

Costos fijos en **$USD**:

- Gastos de muelle (dock) (costo mensual): _____
- Renta de oficina (costo mensual): _____
- Costos contables (costo mensual: _____
- Seguridad (costo mensual): _____
- Impuestos (porcentaje de la ganancia o valor): _____
- Costo del seguro (por viaje ___, por mes ___, por año ___, otro _____)
- Permisos de empresa: (p. ej., "permiso de turismo náutico" costo _____ y duración _____):
- ¿Algún otro costo variable? Por favor especifica: _____

Valor de Mobula para la Empresa

25. ¿Qué importancia económica estima que tiene la presencia de las mobulas para su negocio?

    Nulo Bajo Medio Alto Máximo

26. ¿Puede estimar el número de empresas que ofrecen servicios de turismo móvil en tu localidad/ciudad?

    <9 10-19 20-29 Otro: _____

Acuerdos

27. ¿En el caso de tener alguna duda, podría contactarlo?
28. ¿Está de acuerdo en dar su consentimiento para publicar los datos de esta encuesta? (Es decir los resultados del conjunto de todas las encuestas de los diferentes operadores de servicios. Los datos individuales de cada operador serán confidenciales.)

ANNEX III

Independent Operators (Captains) Survey




Encuesta sobre el Valor Económico de Mobula Munkiana

Gracias por su tiempo en participar en este importante proyecto de investigación realizado por el Centro Interdisciplinario de Ciencias Marinas – Instituto Politécnico Nacional en colaboración con el Centro de Investigaciones Biológicas del Noroeste (CIBNOR). La información estadística recopilada de esta encuesta se utilizará para mejorar la comprensión de los valores económicos de las actividades turísticas de *Mobula munkiana*. El Consejo Nacional de Ciencia y Tecnología (CONACYT) de México apoyó este proyecto de investigación a través de fondos de investigación ambiental.

Su información individual será confidencial.

Informaciones generales

1. Localidad: _____
2. Nombre o contacto: _____
3. Nacionalidad del propietario de la empresa: _____
4. ¿Es usted un operador turístico registrado o propietario de un barco que ofrece recorridos por la vida silvestre? _____
5. ¿Desde cuándo se dedica a la prestación de servicios turísticos?: _____
6. ¿A qué se dedicaba antes de ser prestador de servicios turísticos? _____

Descripción de la operación durante una expedición Mobula

7. Qué servicios ofrece usted a los turistas en caso de expediciones dirigidas a la observación de mobulas:

Servicios	Servicios Inespecíficos:	Servicio específico Mobula:
Día de Snorkel		
Medio día de Snorkel		
Otro;		

8. ¿Podría estimar el porcentaje relativo de ventas por cada servicio dirigido a móbulas que ofrece? (por ejemplo, expedición de varios días = 20 %, viajes de un día = 70 % y buceo nocturno = 10 %, etc.) _____
9. ¿Cuántos días a la semana realizan tours? _____
10. ¿Cuántas semanas al año ofrecen viajes específicos de mobulas? _____
11. ¿En qué meses del año ofrecen los servicios relacionados con mobulas? _____
12. ¿Cuál es su tripulación habitual por viaje en su barco para los tours mobula? _____
13. ¿Cuál es la proporción de viajes perdidos debido a malas condiciones climáticas u otros factores durante la temporada de Mobulas?

    0-9% - 10-19% - 20-29% - 30-39% - 40-49% - > 50%

14. ¿Qué porcentaje de los ingresos anuales/o por temporada de la empresa representan las actividades turísticas relacionadas con las expediciones Mobula?

    0-9% - 10-19% - 20-29% - 30-39% - 40-49% - 50-59% - 60-69% - 70-79% - 80-89% - 90-100%

15. Puerto o lugar de salida más frecuente para viajes en mobula: Cabo San Lucas, San José del Cabo, Los Barriles, Sargento, La Paz, Otro: _____
16. Área(s) visitada(s) más frecuente(s) para la exploración de mobulas: Cabo San Lucas, San José del Cabo, Cabo Pulmo, La Ventana, La Paz; Otro: _____
17. ¿Ofrecen contenido educativo durante los tours que ofrecen? Si____ No____
18. ¿Qué importancia económica estima que tiene la presencia de las mobulas para su negocio?

    Nulo Bajo Medio Alto Máximo

Ser capitán contratado por Guías y Empresas registradas

19. ¿Qué porcentaje de sus ingresos anuales son representadas por ser capitán contratado por guías freelance _____ y por empresas de turismo registradas _____?

20. ¿Dónde están ubicados los guías freelance _____ y las empresas registradas _____ que le contrata?

21. ¿Cuáles son los valores promedios de los siguientes durante salidas de avistamiento de mobulas?

	Capitán solo	Guías Freelance	Empresas Registradas
a. Salario Mínimo			
b. Salario Promedio			
c. Salario Máximo			
d. Porcentaje de actividad durante la temporada de Mobula			
e. Número de Turistas Mínimo			
f. Número de Turistas Promedio			
g. Número de empresas en su localidad			
h. Número de empresas en el Estado			

22. ¿Usted está a favor de regular el turismo con las Mobulas en su localidad? _____
23. ¿Usted piensa que el turismo con las mobula representa un mejor ingreso económico que pescar y venderlas si no fuera ilegal? _____

Costo de Operación y Precios de Tours

24. Por favor detalla los diferentes costos para los tours en mobula:

Inversiones de capital en **$USD**:

	Personal	Renta por salida	Precio Estimado
Tipo de embarcación			
Embarcación			
Motor			
Transporte de panga			
Remolque			
Equipo de Buceo / Snorkel			
Tanques			
Baños portátiles			
Chalecos			
Boyas			
Sombra			

- Tamaño del barco: _____ Caballos de fuerza: _____ y marca del motor: _____ y costos (por unidad declarada): _____
- ¿Otras inversiones de capital? _____

Costos variables en **$USD**:

- Salarios/Salarios de otros empleados (especificar cuáles son sus labores si hay): _____
- Frecuencia de mantenimiento de embarcaciones: _____ y precio: _____
- Combustible (costo del viaje por embarcación; establecer duración del viaje, por ejemplo, por día, por semana, etc.): _____
- Suministros totales por salida (comida/bebidas/hielo; costo de viaje por barco por viaje):

  <99$ 100-199$ 200-299$ 400-499$ Other: _____

  ¿Algún otro costo variable? Por favor especifica: _____

Costos fijos en **$USD**:

- Gastos de muelle (costo mensual): _____
- Costos contables (costo mensual: _____
- Impuestos (porcentaje de la ganancia o valor): _____
- Costo del seguro (por viaje ___ por mes ___ por año ___ otro _____) _____
- Publicidad (costo mensual o anual): _____ _____
- Permisos de empresa: (p. ej., "permiso de turismo náutico" costo _____ y duración _____)
- ¿Algún otro costo fijo? Por favor especifica: _____ _____ _____ _____

25. ¿Qué porcentaje de los ingresos se destina a pagar los gastos operativos del negocio? _____
26. ¿Cuál fue el porcentaje de pérdida de actividad por COVID-19 durante la temporada 2020: _____; 2021: _____ y 2022: _____.
    ¿Siente que el nivel de actividad ha vuelto completamente a la normalidad? _____

Acuerdos

27. ¿En el caso de tener alguna duda, podría contactarlo?
28. ¿Está de acuerdo en dar su consentimiento para publicar los datos de esta encuesta? (Los datos serán anónimos)

ANNEX IV

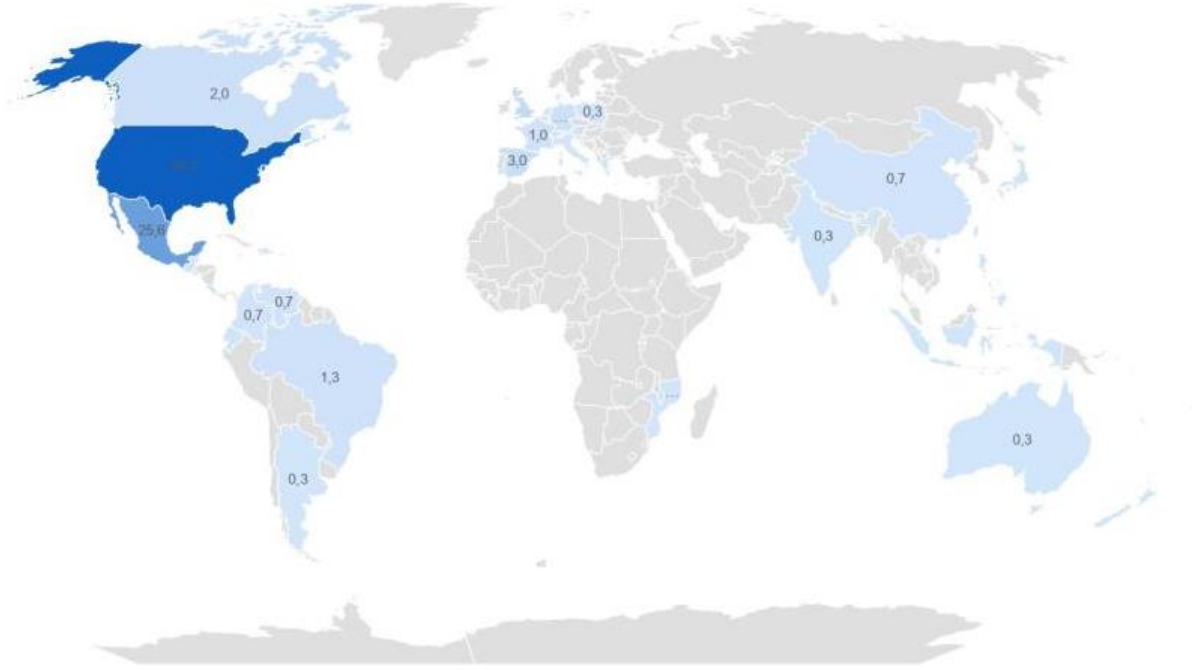
Data Summary for the estimation of the IUV by Location and Activity Category

Variable	Location	N° Mobula Tour	N° People Accompanying	N° Days of the Stay	Food Price *	Accommodation Price*	Transportation Price*	Mobula Tour Price	WTP
Other (0)	n=16	n=12	n=15	n=14	n=14	n=14	n=14	n=16	n=9
Los Cabos (1)	n=29	n=29	n=29	n=28	n=28	n=28	n=28	n=28	n=14
La Ventana (3)	n=242	n=231	n=237	n=235	n=235	n=230	n=230	n=240	n=137
La Paz (5)	n=27	n=24	n=27	n=26	n=24	n=23	n=23	n=23	n=15

*USD/Person/Day

ANNEX V

Worldwide and Mexican Distribution of Tourists Participating in *Mobula munkiana* Tourism



Annex V A

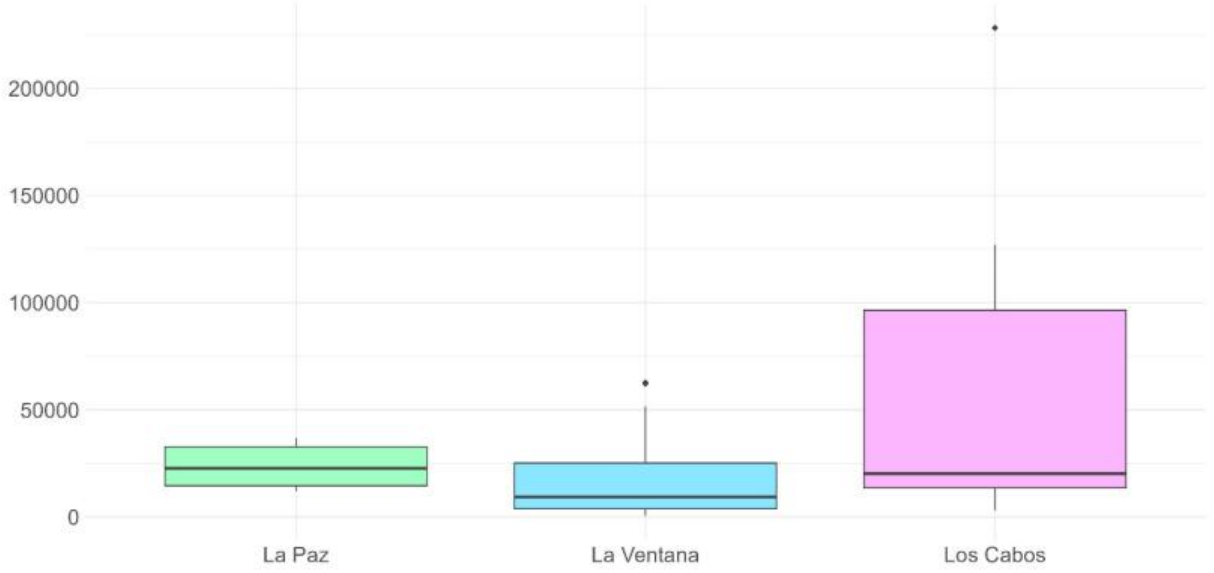
Worldwide Distribution of Tourists Participating in *Mobula Munkiana* Tourism

Annex V B

Mexican Distribution of Tourists Participating in *Mobula Munkiana* Tourism

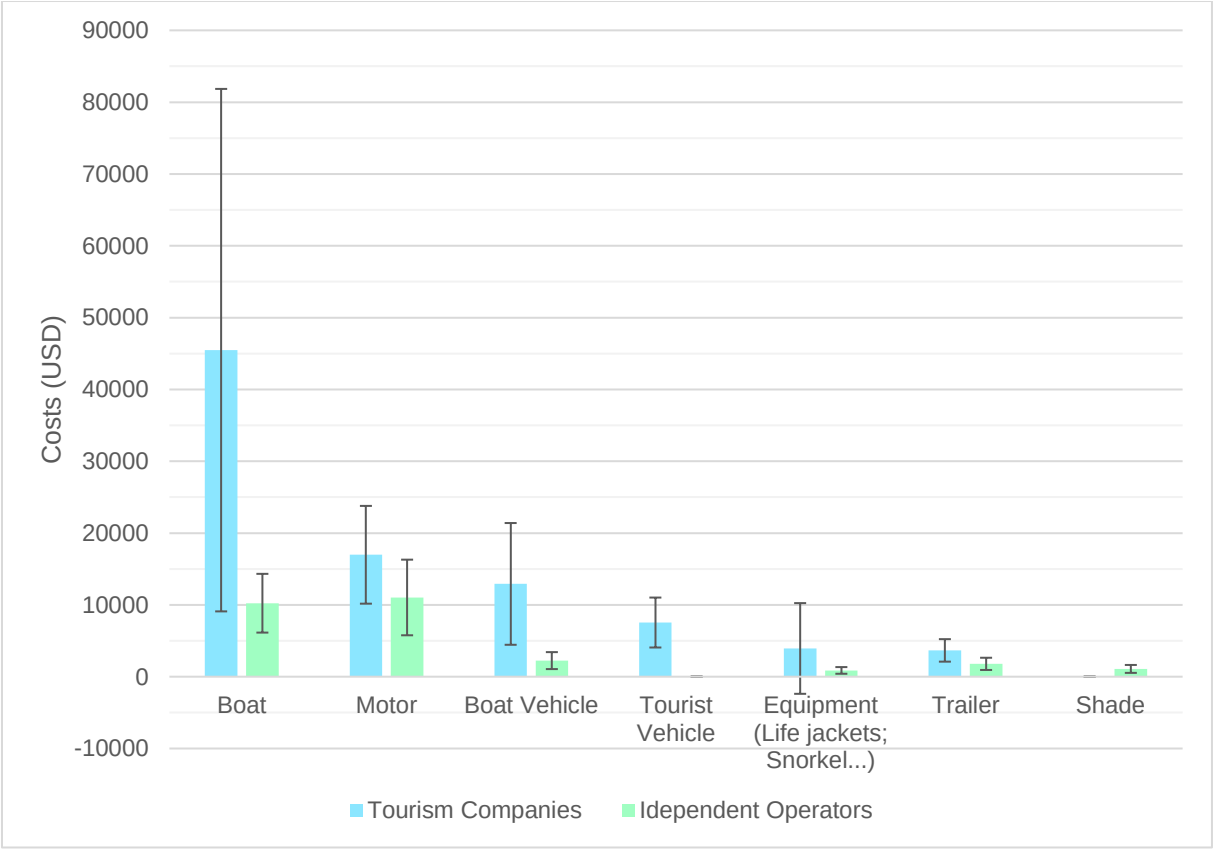
ANNEX VI:

Mean operator income distribution across locations and *M. munkiana* watching activity types (in USD).



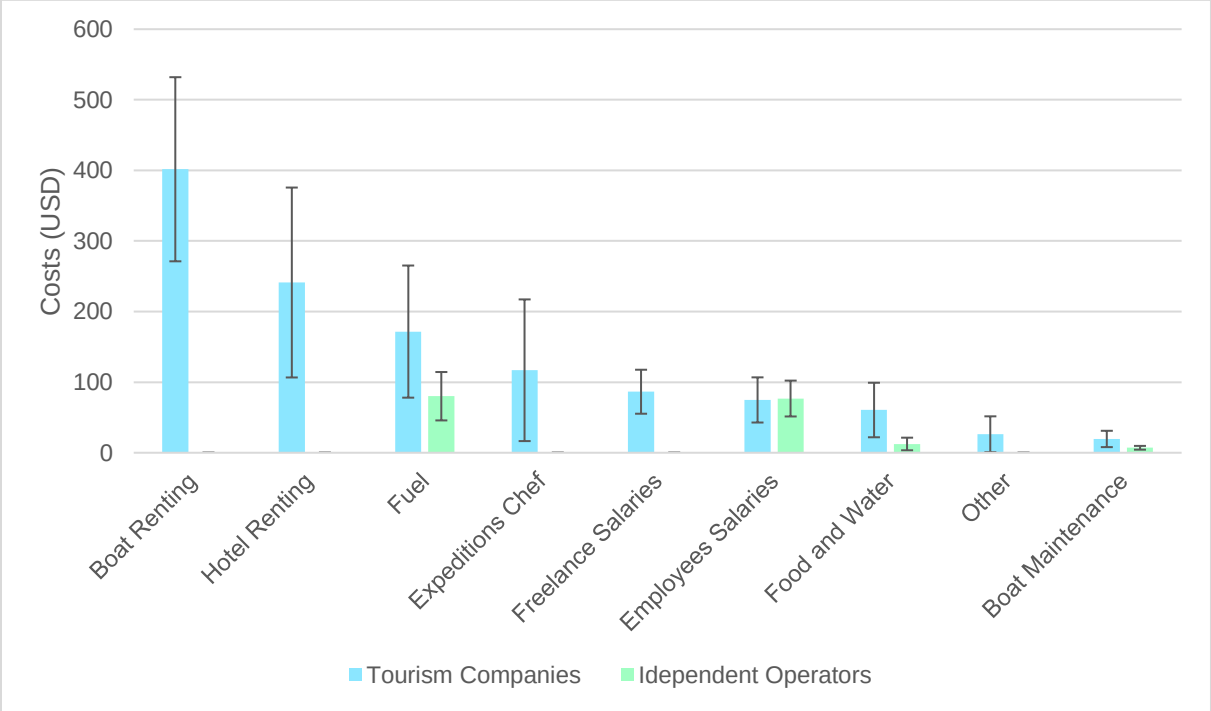
ANNEX VII:

Opportunity Cost Comparison between Tourism Companies and Independent Operators (IN 2023 USD)



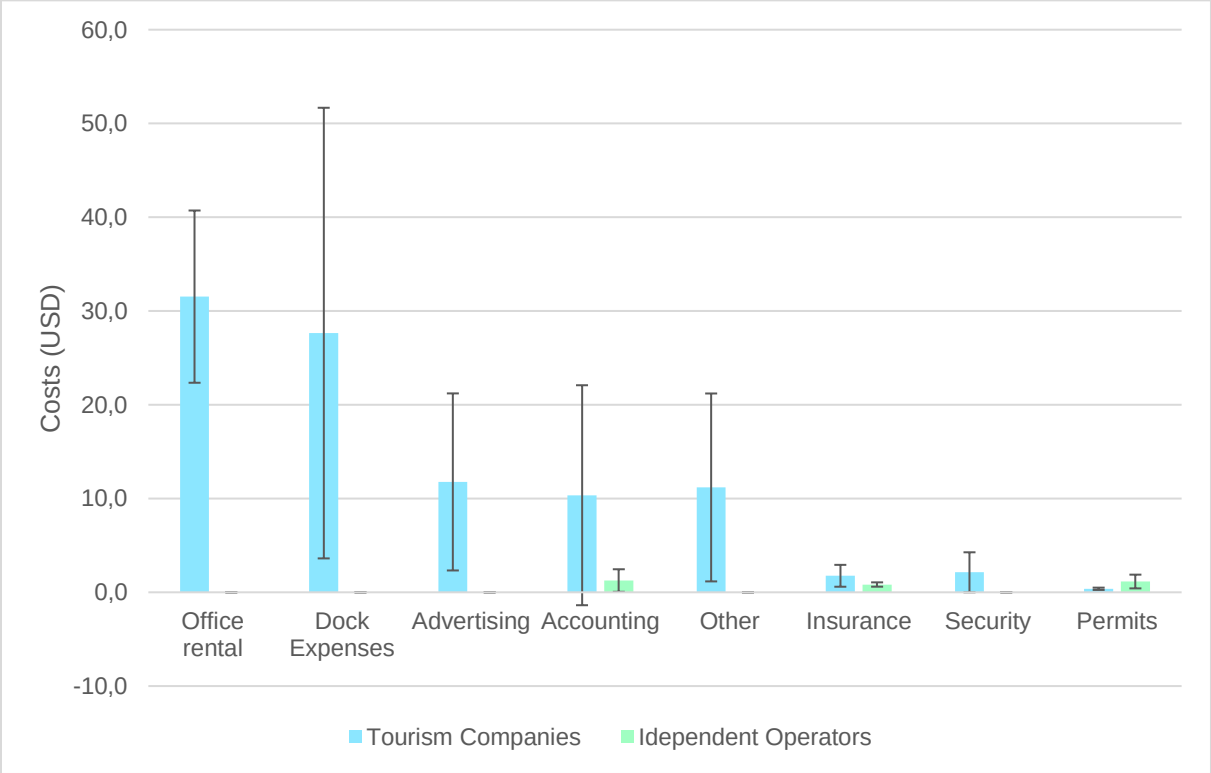
ANNEX VIII

Variable Costs Comparison Between Tourism Companies and Independent Operators per tour (IN 2023 USD)



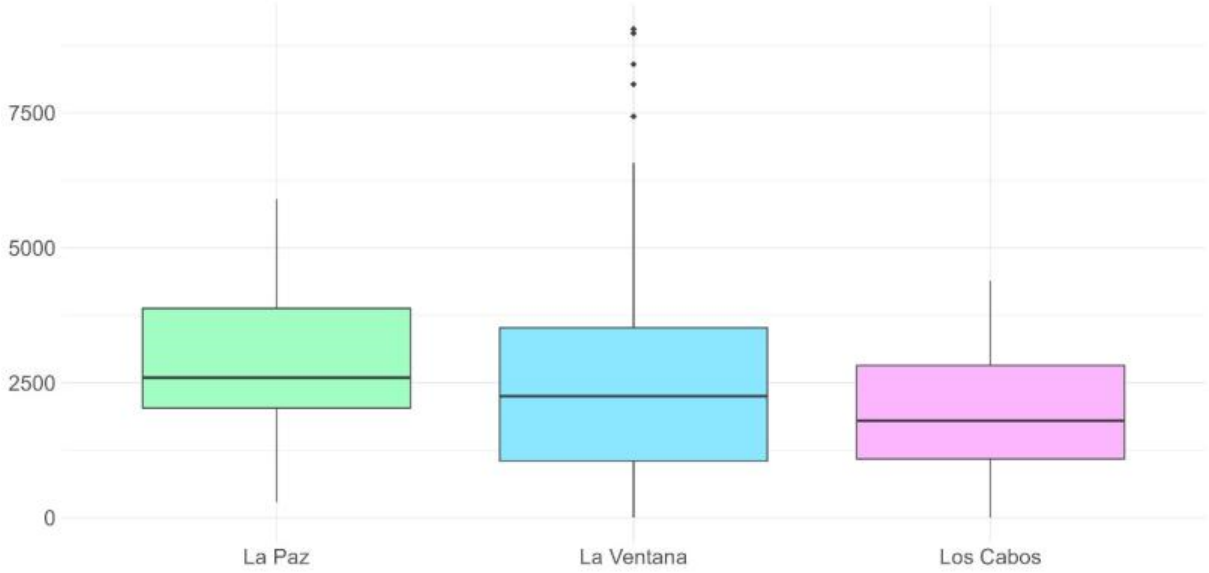
ANNEX IX

Fixed Costs Comparison Between Tourism Companies and Independent Operators per tour (IN 2023 USD)



ANNEX X

Mean IUV per tourist across locations and *M. munkiana* watching activity types (in USD).



ANNEX XI

Mean WTP per tourist across locations and *M. munkiana* tourism activity types (in USD).