

A decade of whale watching in an important tourist destination in the Pacific coast of Colombia: Challenges for proper management

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Abstract

Uramba Bahía Málaga Natural National Park is one of the most important places visited by tourists to see humpback whales (*Megaptera novaeangliae*) in Colombia. Humpback whales arrive from Southern Chile and the Antarctic Peninsula every year between May and December to reproduce, give birth and rear calves. To evaluate the current state of whale watching in Málaga we analyzed tourist visitation data from 2011 to 2019 during the peak whale-watching season (July–October), and during one week in October 2020. We found that whale-watching activity has increased considerably. In 2019, 21,186 tourists realized whale watching in Málaga. Whale watchers per month increased by 108% and monthly whale-watching boat trips increased by 140%, in the last decade. Currently there are in average 19 boat trips per day (± 18.0), and most boats are small (≤ 15 m). Tourists came mainly from Colombia (90%). August was the most important month for whale watching. Although environmental education activities are undertaken, currently responsible whale-watching guidelines are overlooked. At present, whale-watching activity produces important economic benefits for local people and neighboring sites, with a monthly expenditure of at least \$362,409 USD, but to ensure the sustainable continuity of this activity, negative impacts on whales need to be minimized. We classified management challenges into social, economic

and biological aspects. From a social perspective, operators should form a whale-watching community association; this would improve cooperation amongst operators, promote good practices in whale-watching and reduce pressure on whales. Economic recommendations include 1) whale-watching trips handled mainly by local people; 2) ticket prices unification; and 3) investment in tourist facilities. Biological recommendations focus on the welfare of whales and include: 1) follow the current whale-watching recommendations strictly; 2) reduce transit speeds to below 10 knots in the area during whale season; 3) use propeller guards; 4) promote land-based whale watching; 5) implement acoustic whale tourism; 6) reinforce environmental education programs; and 7) support long-term monitoring and scientific research. Based on these three aspects, we urge environmental and ethnic authorities, conferring with relevant stakeholders, to determine the whale-watching carrying capacity of the area and to promote a responsible tourism. Authorities need to strengthen the monitoring, oversight and control of this growing tourist activity in order to ensure its long-term persistence.

Introduction

Whale watching is a growing tourism activity worldwide. Commercial whale watching began in South America in the 1990s (Hoyt and Iñíguez, 2008; Hoyt and Parsons, 2014). In Colombia, whale watching started in Bahía Málaga (Valle del Cauca Department) in 1994 (Arias-Gaviria *et al.*, 2011). Since August 2010, this area is part of the Uramba Bahía Málaga Natural National Park (Málaga NNP) (Avila *et al.*, 2015). Whale-watching activities then spread to Tribugá and Cupica gulfs (Chocó Department) in 1997, and Tumaco (Nariño Department) around 2010 (Arias-Gaviria *et al.*, 2011). Whale-watching tourism generates income and employment in coastal communities and raises awareness on whale and dolphin conservation needs (Zeppel and Muloin, 2008). In 2008, more than 13 million people took part in whale watching tours in 119 countries worldwide, generating an estimated total expenditure of \$2.1 billion USD (O'Connor *et al.*, 2009). For the same year, in Bahía Málaga 6,663 whale watchers and 267 boat trips were recorded, generating \$99,954 USD in direct expenses (only ticket expenses) (Avila *et al.*, 2015). However, this activity can generate disturbance resulting in changes in behavior, collisions with boats, and pollution, which may have an impact on the whales' reproductive

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success, habitat choice and survival (Parsons, 2012; Avila *et al.*, 2015). In fact, in Málaga NNP and other breeding areas, humpback whales changed their behavior with the beginning of boat-based whale-watching activity (e.g. Scheidat *et al.*, 2004; Morete *et al.*, 2007; Avila *et al.*, 2015; Fiori *et al.*, 2019; Amrein *et al.*, 2020). Humpback whales engage in complex acoustic behaviors producing social sounds and songs, some of which are associated with reproduction (Payne and McVay, 1971; Oña *et al.*, 2019). Therefore, boat noise could disturb and mask these vocalizations (Southall, 2005; Dunlop *et al.*, 2010). Negative impacts caused by whale watching are likely a consequence of the combination of the presence of boats and the underwater noise they produce (Lusseau and Bejder, 2007; Weilgart, 2007; Wright *et al.*, 2007). Currently, whale watching using boats is one of the main threats to marine mammals worldwide and is affecting 58 marine mammal species - almost 50% of all marine mammals - in 82 countries (Avila *et al.*, 2018).

The humpback whale, *Megaptera novaeangliae*, is the main target of most whale watching operations worldwide (55% of countries performing whale watching) (O'Connor *et al.*, 2009). Humpbacks arrive annually into Colombian waters from May to December from Southern Chile and the Antarctic Peninsula to reproduce, give birth and rear their calves (Avila *et al.*, 2020). Málaga NNP is one of the most important breeding sites for this species in the Southeast Pacific, with more than 70% of observed groups containing calves (Avila, 2006; Flórez-González *et al.*, 2007). Málaga's economy is based primarily on fishing, tourism, timber extraction and subsistence farming¹ (Escobar, 2017). One of the most important tourist attractions in the area is the presence of humpback whales, making Málaga NNP the main whale watching destination in Colombia (Hoyt and Iñiguez, 2008; Arias-Gaviria *et al.*, 2011). However, due to fishing, whale-watching activities, and its proximity to the major Buenaventura Port, Málaga NNP has an intense boat traffic, which overlaps spatially and temporally with areas used by humpback whales (Avila *et al.*, 2017). Since whales are known to be affected by whale-watching boats, a series of recommendations and rules have been generated for the proper observation of whales worldwide (IWC, 2020). Colombia has established some (non-enforceable) recommendations since 2001 to minimize negative impacts on whales by whale-watching in the Colombian Pacific (Avila *et al.*, 2015; MADS, 2017). These recommendations stipulate that: 1) boats must not approach the whales closer than 200 meters; 2) boats must approach whales slowly (≤ 5 knots), in parallel and slightly from behind; 3) boats can stay for a maximum of 30 minutes with a group of whales; 4) a maximum of three boats can stay simultaneously with a group of whales; 5) boats should avoid following animals with calves; and, 6) swimming with whales is not allowed (MADS, 2017). Furthermore, because of the collision risk and other potential disturbance from boat traffic in the whales' area, boat speed should not exceed 10 knots and propeller guards should be used (Avila *et al.*, 2017). In addition, operators who want to run whale-watching boat trips in Málaga NNP have to be certificated annually by the environmental authorities and have to depart from Juanchaco dock (Fig. 1), where they receive specific instructions by the environmental authorities. Although the recommendations

control whale-watching activities at Málaga NNP, there has been great concern in recent years about the increase in number of boats and whale watchers in the area. Besides, knowledge on whale-watching tourism in Colombia is scarce, as there are currently only a few studies (e.g. Avila *et al.*, 2015; Zapetis *et al.*, 2017; Soto-Cortés *et al.*, 2021). Therefore, the purpose of this research was to evaluate the current state of whale watching in Málaga NNP, how it has changed in time, evaluate the levels of compliance with whale-watching recommendations and identify challenges for the conservation of whales.

Materials and Methods

Research was conducted during nine breeding seasons, from 2011 to 2019 during the whale-tourism season in Málaga between July and October. In addition, although Málaga NNP was closed for tourism in 2020 because of the Covid-19 pandemic, we made observations from 2-6 October. Uramba Bahía Málaga Natural National Park is located at the Bay of Málaga in the Pacific coast of Colombia between 03°51' N and 03°57' N, and 77°19' W and 77°25' W, 36 km north of Buenaventura city, the main commercial port in the Colombian Pacific, and near the Naval Base Bahía Málaga (Naval Base) (Fig. 1). This region is characterized by high rainfall (6000 mm per year) and warm surface waters (25 to 27 °C) and relative humidity around 90% (Rangel, 2004). The average water depth in the study area is 30 m. Málaga NNP is 100% marine and covers an area of 471 km². Málaga NNP is characterized by a great diversity of flora, fauna and a variety of habitats such as rivers, marine bottoms (sand and mud bottoms, and rocky reefs), beaches, islands, rocky cliff areas, and an estuary bordered by mangrove forests¹. The region has six settlements: Juanchaco, Ladrilleros, La Barra, La Plata-Bahía Málaga, Chucheros-El Tigre and Puerto España-Miramar, with a population of 4000, mainly afro-descendants, and to a lesser extent by indigenous and mestizo people² (Escobar, 2017). To get to Málaga NNP, people take a 45-minute boat ride from the port of Buenaventura to Juanchaco, which is the largest village in the area and whale-watching trips set off from its dock.

Operators and tourists who participate in whale-watching boat trips in Málaga NNP have to arrive to Juanchaco village (Fig.1) to attend a talk offered by the Park staff, who provide information about whales, whale watching and conservation actions. In Juanchaco dock, before each whale-watching boat trip, the operator takes a local guide or "interpreter" onboard and receives a whale-watching flag from the environment authority that they are obliged to place in a clearly visible location on the boat. Only boats with flags are permitted to do whale watching in the Park. Boat operators who want to take whale watchers have to get a certification by attending an annual workshop led by Park rangers, with the collaboration of other organizations (Regional Autonomous Corporation of the Valle del Cauca - CVC, maritime authority - DIMAR, Community Councils of Black Communities and NGOs) to educate them about whale biology, ecology and behavior, as well as best practices for whale watching. Only certified operators receive the whale-watching flag from the Park's office. Also, interpreters have to be trained and certified annually

1. INVEMAR, UNIVALLE and INCIVA (2006) *BIOMÁLAGA: Valoración de la biodiversidad marina y costera de Bahía Málaga (Valle del Cauca), como uno de los instrumentos necesarios para que sea considerada un área protegida*. Final Report. Cali, Colombia. 813 pp.

2. MAVDT- Ministerio de Ambiente, Vivienda y Desarrollo Territorial (2010) Resolución Número 1501 "Por medio de la cual se declara, reserva, delimita y alindera el Parque Nacional Natural Uramba Bahía Málaga". Ministerio de Ambiente, Vivienda y Desarrollo Territorial, Bogotá, Colombia. 17 pp.

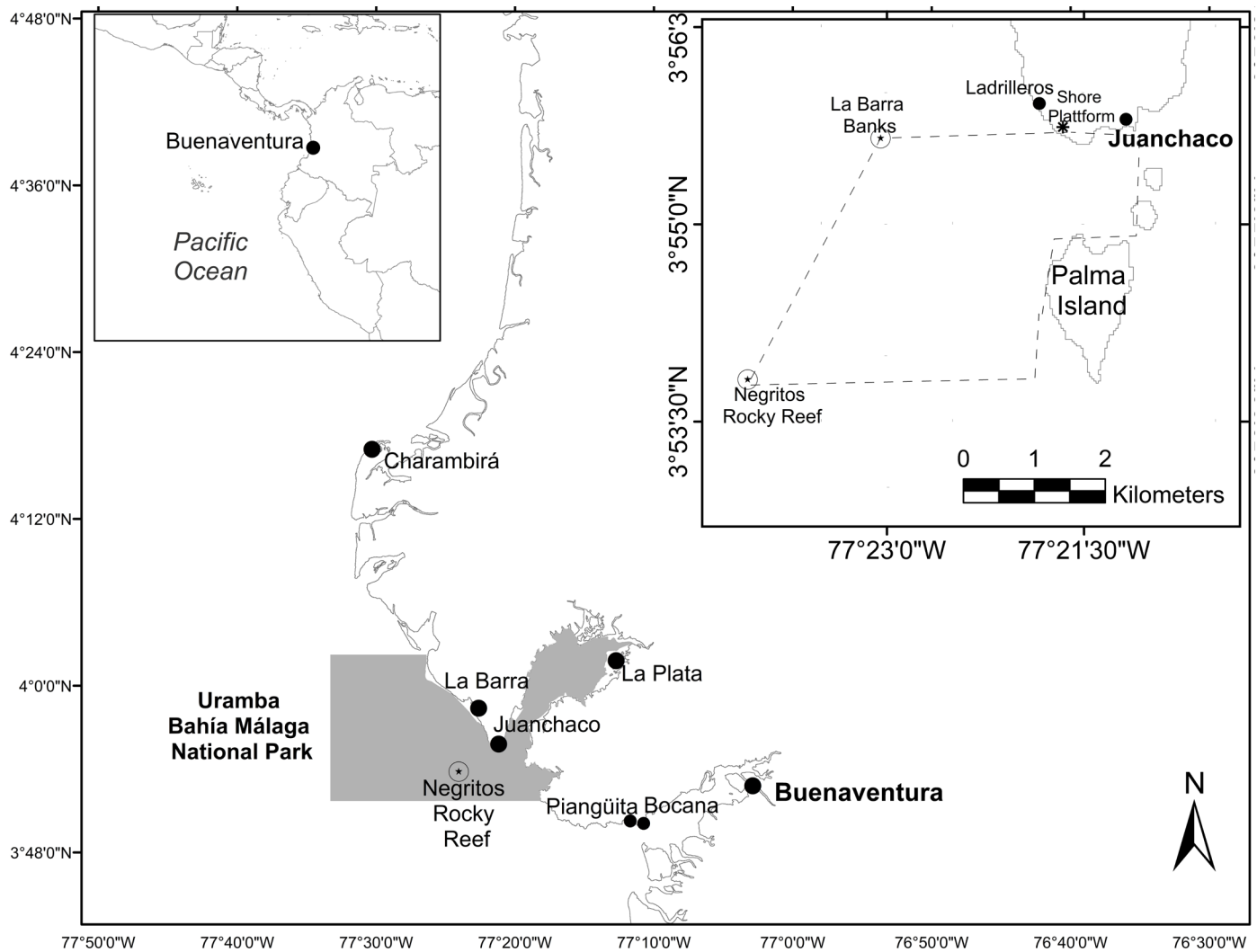


Figure 1. Study site in Urumba Bahía Málaga Natural National Park, in the Colombian Pacific, South America. The area of the Natural National Park is denoted in the shaded area. Observations were made from a shore platform between the towns of Juanchaco and Ladrilleros at a height of 20 m above the mean lowest tide water level. The area of observation is shown within the dotted lines.

by the Park. The staff at Urumba Bahía Málaga Natural National Park have several assignments during whale-watching seasons (Fig. 2). We obtained total number of boat trips, information about the origin of boat operators and whale watchers from the Urumba Bahía Málaga Natural National Park's official records. Information about name, age and origin of tourist participants is registered in the Park's official records.

To evaluate compliance of whale-watching boats with the recommendations, two Park staff members trained in whale watching made observations from a 20-meter-high land-based platform using 7x50 binoculars. The effective area of observation was 14 km². The observation area was delimited by the Negritos rocky reef, La Barra sand banks and Palma Island (Fig. 1). The observations were conducted between 8:00h and 17:00h when conditions were optimal: no rainfall, good visibility (6 km) and Beaufort wind strength/speed less than four. From the land-based platform, groups of whales and tourist boats were monitored. Whales were detected by blows or aerial behavior. For each encounter, observers recorded the approximate location of whales and boats (using the azimuth position), the time that each boat spent with a group of whales and the speed of the boats when approaching the groups of whales. Boat speed was roughly estimated in relation to the speed of whales as 'fast' (more than 200 m/min or >5 knots approx.), or 'slow' (less than

200 m/min or ≤5 knots approx.). In addition, number of boats following whales was counted.

To estimate the expenditures of whale-watching tourists in the Málaga NNP area, costs were obtained using the number of tourists per month, and then calculating the annual cost of transport, whale-watching trips, average accommodation, and average food costs. As this was a rough estimation based on the average costs of transport, food and accommodation in the area each year, we assumed that all the persons expended similar amount of money for going whale watching. The Colombian peso (COP) is the unit of currency in Colombia, and we converted costs to US dollars, where \$1 USD is equivalent to \$3,281 COP (average value for 2019; DW, 2020). The direct expenses generated by whale watching in the area were estimated based on the number of whale watchers and the cost of a whale-watching tour. Total expenses in the region included transport from Buenaventura to Juanchaco (round trip), food and accommodation for a weekend (two days, one night). We also estimated the number of direct jobs generated by whale-watching activities in Málaga NNP, which was estimated from the number of whale-watching boats, hotels and restaurants in the area.

Table 1. Characterization of whale-watching activity in Urumba Bahía Málaga National Natural Park from 2011 to 2019 (July to October). ND = no data available. Local boats = refers to boats from Málaga NNP area.

Whale-watching activity	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of total whale watchers	10,197	11,071	11,035	10,995	11,957	15,929	16,255	23,122	21,186
Average whale watchers per month	2,549±1,868	2,768±1,790	2,759±1,452	2,749±2,010	2,989±2,100	3,982±2,589	4,064±2,853	5,781±2,729	5,297±3,482
Total number of boat trips	701	855	791	848	932	1,123	1,277	1,792	1,678
Average boat trips per month	175±119	214±128	198±104	212±138	233±167	281±159	319±196	448±195	420±252
Average boat trips per day	ND	ND	8.9±7.1	ND	10.4±8.5	12.5±11.8	14.2±13.4	16.5±17.2	18.6±18.0
Maximum number of boat trips per day	ND	ND	76	ND	93	115	108	139	118
Percent of the trips on weekends	ND	ND	ND	ND	75	ND	75	70	62
Number of different boats	ND	ND	ND	ND	ND	ND	64	154	173
Percent of small boats used in the trips (of the total boat trips)	ND	ND	ND	ND	ND	ND	98	99	98
Percent of local boats used in the whale-watching trips (of the total boat trips)	ND	ND	ND	ND	44.8	ND	38.5	45.1	54.4
Month with most whale-watching activity	Aug.	Aug.	Aug.	Aug.	Aug.	Aug.	Aug.	Aug.	Aug.
Number of certified interpreters	ND	18	20	25	21	17	27	30	16
Number of certified operators	ND	ND	ND	ND	ND	ND	44	54	53
Direct expenses (USD thousands)	77.7	84.4	84.1	83.8	91.1	121.4	123.9	176.2	161.4
Average monthly direct expenses (USD\$ thousands)	19.4±14.2	21.1±13.6	21.0±11.1	20.9±15.3	22.8±16.0	30.3±19.7	31.0±21.7	44.0±20.8	40.4±26.5
Total expenses (USD thousands)	419.6	539.9	544.9	536.2	590.4	805.9	847.2	1497.5	1449.6
Average monthly total expenses (USD thousands)	104.9±76.9	135.0±87.3	136.2±71.7	134.0±98.0	147.6±103.7	201.5±131.0	211.8±148.7	374.4±176.7	362.4±238.3



Figure 2. Urumba Bahía Málaga National Natural Park' staff assignments during whale-watching seasons; (A) Workshop with boat operators about whales and whale-watching good practices; (B) Training volunteers (Volunteer Ranger Program) in watching whales and boats from the shore platform; (C) Boat operators' control before the whale-watching tour and filling of the Park's official records; (D) Pre-whale-watching tour talks to tourists; (E) Observation of whales and boats from the shore platform; and (F) Training environmental interpreters (guides) in biology of whales and conservation actions.

Results

Data on whale-watching activity at Urumba Bahía Málaga National Natural Park was obtained from the Park's official records for a 9-year period (2011-2019) from July to October with a total of 36 months (Table 1). Due to the abnormal situation of season

2020 and lack of enough data, this season was not included in the data analysis (a description on what we found in October 2020 is made at the end of this section). During 2011-2019, number of whale watchers and boat trips in the area increased considerably, from 10,197 tourists in 2011 to 21,186 in 2019. Number of boat trips also increased, from 701 in 2011 to 1,678 in 2019 (Table 1). Number of whale watchers per month increased by 108% in the last nine years, from 2,549 ($\pm 1,868$) in 2011 to 5,297 ($\pm 3,482$) in 2019 (Fig. 3A). Additionally, monthly numbers of whale-watching boat trips increased by 140% in the area, from 175 (± 119) in 2011 to 420 (± 252) in 2019 (Fig. 3B). Currently there are in average 19 boat trips per day (± 18.0). However, the number of boat trips per day increased, from a maximum of 76 in 2013 to 118 in 2019 (Table 1). The number of different boats conducting whale-watching activities increased from 64 in 2017 to 173 in 2019 (Table 1, Fig. 3A-B). The season with most whale watching activity in the last decade was 2018, with 23,122 visitors and 1792 whale-watching boat trips.

The majority ($\geq 98\%$) of boats used for whale watching were small (≤ 15 m length; Fig. 4), and the rest were medium sized (~ 60 m length). Most of the boats were from people of Buenaventura area, e.g. Buenaventura, Pianguita, La Bocana ($>54.8\%$), except for 2019, when there were mainly local boats from the Bahía Málaga area (54.4%), i.e. Juanchaco, Ladrilleros, La Barra, La Plata (Table 1). Local whale-watching boats were small (~ 7 m length), with a passenger capacity of 10-20 people, typically powered by two 40 hp outboard engines, while Buenaventura whale-watching boats were larger in size (~ 15 m length), with a passenger capacity of 30-40, and typically powered by two 100 hp outboard engines. A few (three) larger boats were also from Buenaventura (~ 60 m length, with a 60-80 passenger capacity and powered by 400 hp engines). During the study period, 64% of the boats coming from Buenaventura arrived to Juanchaco dock before the whale-watching trip, so

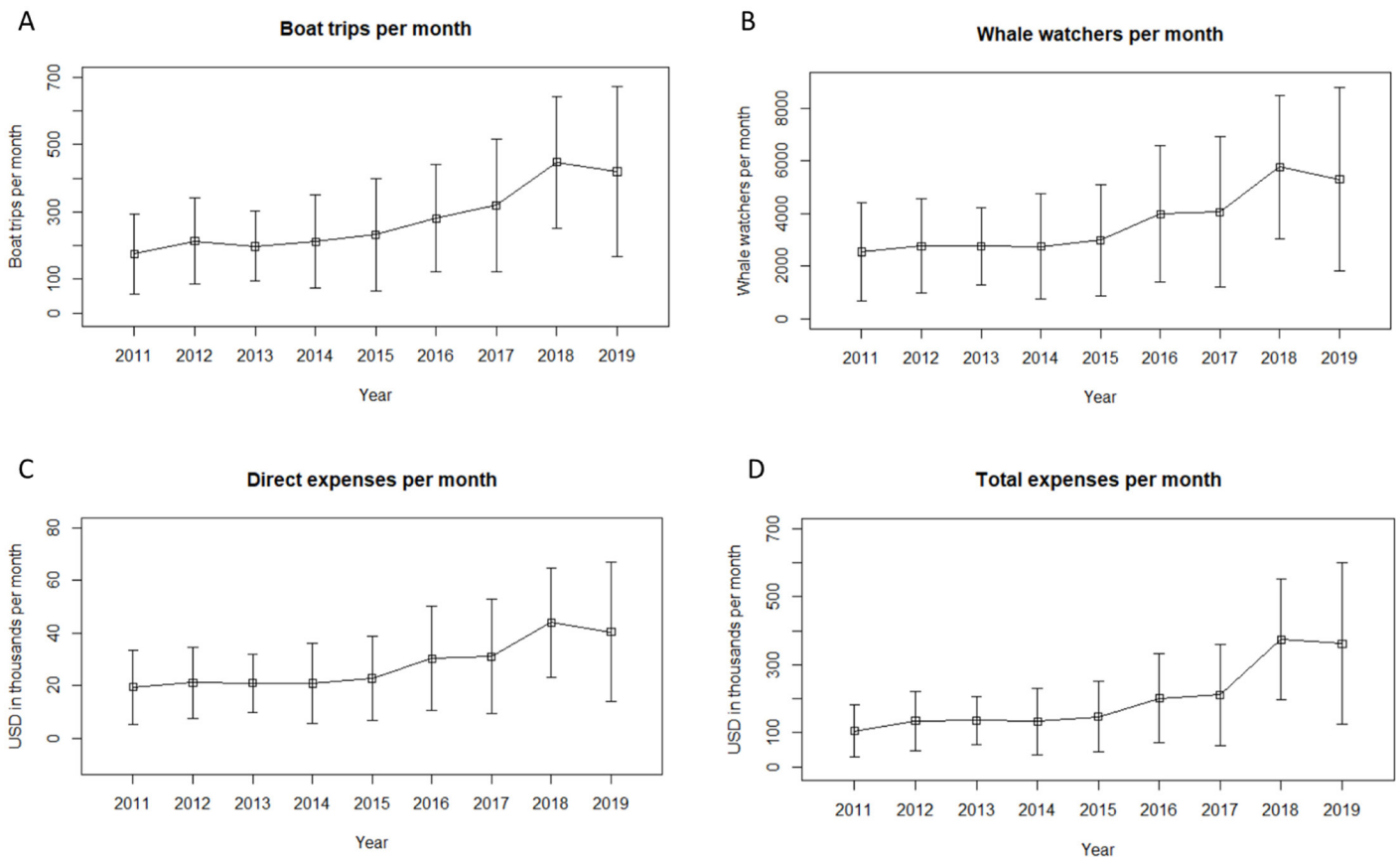


Figure 3. Whale-watching activity in Uramba Bahía Málaga Natural National Park, Colombia, from 2011 to 2019 (July to October); (A) Average number of whale watchers per month; (B) Average number of boat trips per month; (C) Average “direct expenses” generated by whale watching in US dollars per month (i.e. from ticket sales); and (D) Average “total expenses” generated by whale watching in US dollars per month (i.e. from local transport, food and accommodation for two days). Bars show the standard deviation.



Figure 4. Typical whale-watching boats at Uramba Bahía Málaga Natural National Park, Colombia, between 2011 and 2020.

36% of Buenaventura boats run directly to do whale watching without attending the talk offered by environmental authorities, without taking any interpreter and without receiving any flag.

Whale watching was more popular during weekends and holidays (more than 60% of boat trips). August was the most important month for whale watching, which coincides with the greatest density of whales in the area and Colombian school holidays. Whale watchers came mainly from Colombia (90%), while the rest visited from Argentina, Belgium, Brazil, Chile, Curaçao, Germany, France, Israel, UK, USA and Venezuela. At least 174 local environmental interpreters (an average of 21 per year) and 151 boat operators (50 in average per year) were trained and certified (Table 1).

Whale-watching activities in the Málaga NNP, as of 2019, generated several jobs in the area: 76 people employed in whale-

watching boats, 150 people employed in hotels and 70 people employed in restaurants. So, 296 local people have benefited by humpback whales in Málaga NNP. The cost per ticket of a whale-watching tour oscillated around \$8 USD and this cost has changed very little in the last decade. Direct expenses increased from \$77,697 USD in 2011 to \$161,429 USD in 2019 (Table 1); average monthly direct expenses increased by 107.8% in the last nine years, from \$19,424 USD in 2011 to \$40,357 USD in 2019 (Fig. 3C). Total expenses went from \$419,566 USD in 2011 to \$1,449,636 USD in 2019 (Table 1), and monthly total expenses increased by 245%, from \$104,891 USD in 2011 to \$362,409 USD in 2019 (Fig. 3D). As observed with whale watchers and boat trips, expenses were similar between 2011 and 2016, and an increase occurred for 2017 and 2019 (Fig. 3C-D).

In addition, there was a lack of a whale-watching operators’ community association. It was noted that whale watching operators prioritized competition amongst themselves, keeping whale-watching tour prices low and expanding participant level to increase revenue. The market for whale watching in the Málaga NNP had two forms of marketing: 1) operators with capacity to invest in advertising and sell tourist packages that include accommodation, food and whale watching, 2) offered directly by local operators to tourists who have not purchased a tour package beforehand. The sale of tourist packages has created conflicts in several cases since, according to the local people, the first model leaves very few benefits in the community. Another conflict occurred due to competition in ticket prices, where discounts were being made to attract more tourists. However, this generated loss of service quality, since this competition focuses on economic gain and neglects service quality.

In relation to operator compliance with whale-watching recommendations, we only used data of 2019, as enough field data were available for this year. In 2019 during 228 hours of observation over the 4-month period of the whale watching season, 144 whale pods were followed by boats, 55% of them being mother-calf pairs. There was a minimum of two and a maximum of 14 boats simultaneously with group of whales. The majority of boats (76.5%) approached whales at a “fast” speed (≥ 5 knots). Duration of an individual boat’s encounter was 42.8 min in average (± 6.8). Variables as distance of boats to the whales and behavior of whales were not measured.

Finally, in respect to the season 2020, although Málaga NNP was closed to tourism because of the Covid-19 pandemic, from 2-6 October we observed 10 different boats practicing whale watching in the area. Boats were small (≤ 15 m length), and were mainly from Buenaventura (70%). On a weekend, we registered nine whale-watching boat trips per day and estimated 150 whale watchers per day. There was a minimum of two and a maximum of five boats simultaneously with a group of whales. Boats followed mainly groups with calves (80%). During this season no control, surveillance and education activities were carried out by the environmental authorities. In addition, the local community told us about their economic problems due to the lack of whale-watching tourists.

Discussion

Uramba Bahía Málaga National Park is an important tourist destination for whale watching in Colombia. Whale-watching activity in the area has increased considerably since 2011. Number of whale watchers per month increased by 108% in the last decade, and the current 5,297 tourists for 2019 represent 32% of the monthly number of tourists that visit the region of the Valle del Cauca Department³. This increase allows us to assume that humpback whales have now become an important tourist attraction in the region, and every year more people are traveling to watch them. This activity has a significant potential for further growth; however, the growth in whale watching has led to management problems and challenges, including social, economic and biological aspects.

Social aspects

Currently around 300 local people and 21,000 visitors are directly benefited by humpback whales in Málaga NNP. Although visitors are mainly Colombian, whale-watching activity in Málaga has also benefited people from various parts of the world (e.g. the Americas and Europe). In Málaga NNP many authorities converge (i.e. six communities of Málaga, National Parks, DIMAR, CVC), so the main challenge is to achieve an agreement of understanding between these authorities for the administration, planning and responsible management of whale-watching activity, respecting their administrative autonomies, but with the common purpose of conservation and responsible use of whales and other marine life. The regulation of the whale-watching activity should be based on the following precepts: a) the principle of joint responsibility of all parties in the ordering of the activity; b) access to the

benefits derived from the activity and the well-being of local communities must be equitable; c) the need to incorporate an associative model that allows for organizational strengthening, cooperative work, that favors the reduction of pressures and the promotion of good whale-watching practices. A recent published study showed that for 2015, humpback whale-watching activity in Bahía Málaga met only 16% of the conditions for sustainable governance, and it was characterized by unevenness in connections with markets (i.e. price variability and connections with intermediaries), income inequality, the lack of a whale-watching operators’ association, and the lack of support from government organizations (Soto-Cortés *et al.*, 2021). Therefore, we encourage the environmental authorities and local people to facilitate the formation of an association. Forming a whale-watching community association would improve cooperation amongst operators, which should reduce pressure on the whales, promote more equitable benefits for local communities and enhance best whale-watching practices.

Economic aspects

Whale-watching activity in Málaga NNP produces important economic benefits to local people and neighboring communities (e.g. Buenaventura, Pianguita, La Bocana), and since 2017 these benefits have increased substantially. Our results indicate that humpback whale-watching in Málaga is currently worth an estimated \$1.4 million USD annually as a tourist attraction, an economic input that did not exist in the region two decades ago. As fisheries are declining worldwide (Pauly and Zeller, 2015) and mining and timber extraction are restricted and limited in Málaga (Escobar, 2017), whale watching may serve as a viable economic alternative for people of Uramba Bahía Málaga National Park and neighboring coastal communities. In addition, currently boats used for whale watching are half from Buenaventura (54.4%), while in 2008 boats were mainly local (70.3%), i.e. from Málaga NNP area (Avila *et al.*, 2015). So, whale-watching activity in Málaga NNP is now benefiting not only local people but neighboring communities as well. However, we identified conflicts that arise by price competition, where operators are forced to sell very unexpensive tickets to get enough tourists on their boats. Even the costs per ticket for whale watching have changed very little in the last decade, and are well below prices paid in the rest of the world⁴ (e.g. Hoyt and Iñiguez, 2008) minimizing economic benefits for local communities. We do not have enough information to calculate if under those circumstances the whale-watching operations are financially viable in the long-term (i.e. are tickets paying for decent wages and boat/motor maintenance and depreciation?), but it certainly undermines the potential economic benefits of the activity for local people. Therefore, to resolve such problems it is important to: a) unify ticket prices and establish a roster system to avoid competition that brings social conflicts and loss of service quality; b) make an adjustment in prices in order to be able to reinvest in the care and maintenance of boats; c) operators that sell tourist packages should exclude the whale-watching tour, leaving it in the hands of local operators, so this resource goes directly to the local community; d) to invest in the adequacy of tourist facilities, e.g. in tourist service room, information and

3. Gobernación del Valle del Cauca (2017) *Análisis y diagnóstico turismo Valle del Cauca*. Gobernación del Valle del Cauca and Alcaldía de Cali, Secretaría de Turismo, Colombia. 104 pp.

4. Castro, C., Kaufman, G. and Hamilton, P. (2015) Whalewatching growth and socioeconomic development of communities in the Machalilla National Park—Ecuador. Paper SC/66a/WW/18 presented to the Scientific Committee, International Whaling Commission, San Diego, USA, May-June 2015. [Available from the Office of the International Whaling Commission, The Red House, 135 Station Road, Impington, Cambridge, Cambridgeshire CB4 9NP, UK, <<http://iwcoffice.org/>>]

land-based control checkpoints, land-based whale-watching kiosk, and cleaning of the beaches; e) to generate an emergency mitigation fund to address possible economic crises, such as those generated in year 2020 by the Covid-19 pandemic. Finally, the marketing used by tour operators, the national and departmental government for the promotion of the destination, must be articulated with the regulatory actions defined by the Park, since generally visits are encouraged without considering the regulations associated with the system load capacity and compliance with regulations. Best practices reduce impacts on whales, but also ensure the long-term sustainability of this economic activity for local communities.

Biological aspects

Málaga NNP is an important breeding and calving ground for the Southeast Pacific population of humpback whales (Avila, 2006; Flórez-González *et al.*, 2007). However, we identified that whales are currently at risk because whale-watching recommendations have been often overlooked (in 2019 as happened in 2008; Avila *et al.*, 2015) and because of the increase in numbers of whale-watching boats in the area. We identified that contrary to what is stipulated in Colombian whale-watching recommendations (MADS, 2017), boats followed mother-calf groups more often than other groups, approached at speed higher than recommended, and stayed longer than 30 minutes with whales. Although only three boats are allowed to be around whale groups simultaneously (MADS, 2017), there were times when there were up to 14 in 2019. Previous work in Málaga NNP has shown that not following recommendations for humpback whale watching affected whales' behavior negatively, with whales modifying their behavior by decreasing their breathing rate, moving faster and more erratically, increasing breaching frequency, and decreasing their period of resting behavior (Avila *et al.*, 2015). Therefore, prevention and control and compliance with current recommendations need to be strengthened on land and in water. To advance in this item it is necessary to have an inter-institutional alliance between the environmental authorities (CVC, National Parks), as well as the support of the maritime authority DIMAR, and ethnic authorities (afro-descendant and indigenous communities of Málaga).

Moreover, as Málaga NNP is a breeding site for humpback whales, where more than 70% of sighted groups are with calves (Avila, 2006; Avila *et al.*, 2015), we acknowledge that it is difficult to avoid following mothers with calves. So, we recommend to revise this statement and evaluate an alternative, e.g. avoid following these kind of groups when a) calves are newborn i.e. three times smaller than the size of the adult, white color on the flanks and ventrally, and with scars and fetal folds on the caudal fin (Ferreira *et al.*, 2011; Faria *et al.*, 2013); b) animals are resting, e.g. floating on the surface, or/and c) display an evasive behavior when the boat approaches.

Currently in Málaga NNP there is more traffic of whale-watching boats than a decade before, as number of boat trips per month increased by 140% in the last decade. Besides, boat trips per day went from an average of six in 2008 (Avila *et al.*, 2015) to 19 in 2019, and in 2019 a maximum of 118 boat trips per day were recorded in the area. Consequently, the impact of such traffic over the whales and their habitat is of major concern. Our study did not include other boat traffic, like fishing, Navy boats, merchant ships, and local transport; the latter also has increased (from Buenaventura to Málaga) to transport the growing number of tourists. However, previous studies identified that vessel traffic

(tourism, transport, fishing and Navy) in this area is relatively high (4.5 vessels per hour; Avila *et al.*, 2017), and that in recent years, the number of fishing boats has increased due to a growing fishing effort (Castellanos-Galindo *et al.*, 2011). An increase in boat traffic during whale season is a major concern, as maritime traffic is one of the greatest global threats to whales, due to the high frequency of boat-whale collisions and noise pollution (Van Waerebeek *et al.*, 2007; Avila *et al.*, 2018; Schoeman *et al.*, 2020). Based on stranding records, between 1986 and 2006, approximately 1.6% of the humpback whale population in Colombia was affected by collisions, and at least 5% of these collisions happened in Bahía Málaga (Capella *et al.*, 2001; 2007). All boats used in Málaga NNP for whale watching are motorized and produce underwater noise. Several studies demonstrated that whales appeared capable to detect and recognize boat sounds at distances of up to 8-10 km (e.g. Corkeron, 1995). Noise pollution cause auditory damage, behavioral responses and stress, and disturb and mask their communication (Southall, 2005; Southall *et al.*, 2008; Dunlop *et al.*, 2010; Gomez *et al.*, 2016). Boat presence generates behavioral changes (e.g. Watkins, 1986; Corkeron, 1995; Scheidat *et al.*, 2004; Avila *et al.*, 2015; Zapetis *et al.*, 2017). The number and speed of boats, as well as directional changes were correlated with changes in behavior including respiration rates, diving intervals, swimming speed and aerial behavior, and such changes were elicited when boats were 0.5 - 1.0 km away (Bauer and Herman, 1986; Bauer *et al.*, 1993). In the Northwest Atlantic, humpback whales co-occur with boat traffic and anthropogenic noise (Stimpert *et al.*, 2011), as well as in the Gulf of Panama (Guzman *et al.*, 2012) and in Málaga NNP in Colombia (Avila *et al.*, 2017). In order to mitigate the risk of collisions and related noise pollution threats, we support Colombian recommendations to reduce vessel speed to 10 knots in the area during whale season, and when in the vicinity of whales to five knots or less and switching the engine to neutral when whales are close. Propeller guards for boats that transit in the area of whales are especially recommended, and it should be mandatory for large boats (> 80 m), since most collisions are with this type of boat (Laist *et al.*, 2001). Large boats as tourist cruise ships (with more than a thousand passengers and >150 m length) for example, represent a high risk of collisions with whales and high noise pollution (Carić, 2016). In this sense, it is important to note that current tourism in Málaga NNP is using small and medium boats (~7 to 60 m length), so we suggest that this prevalence should be maintained, to reduce risk to whales and to maximize economic benefits for local communities. We also recommend promoting alternative land-based whale watching, which eliminates negative effects of boats on humpback whales. However, it is important to consider that this modality might not be as profitable as whale watching from boats. The land-based platform used in this study is located between the towns of Juanchaco and Ladrilleros at 20 msnm (Figs 1 and 2E). This platform provides a magnificent view of humpback whales, especially using binoculars, and visitors could stay the whole day enjoying their presence, without causing any impact to the whales. Also, as humpback whales display sounds and songs in the area (Avila, 2000), we recommend the implementation of acoustic whale tourism. With the use of a hydrophone, this activity can be done at distances greater than 200 m from the whales, mitigating negative impacts from boats.

In addition, environmental education should be continued and reinforced, as the use of education in tourism activities

could promote an environmentally sensitive attitude in tourists (Orams, 1995). In such tourist locations like Málaga NNP, permanent and continuous training efforts of both operators and interpreters is fundamental to promote the conservation of whales and their environment. However, in Málaga NNP its scope must be assessed and adjusted if necessary, so that the objective of enforcing best practices for whale watching is met. Environmental education should generate the necessary awareness so that in cases where the area is closed to tourism and there is no control and surveillance by environmental authorities, for example as happened in 2020 season, people follow the rules and recommendations. Besides, it is a major concern that boats coming from Buenaventura to run whale-watching trips are not arriving to Juanchaco dock for specific instructions and the company of a local interpreter. Therefore, we recommend authorities strengthen control and surveillance. In addition, it is necessary to formalize and qualify this training process in a technical, professional way by educational and training entities such as universities and the National Learning Service of Colombia- SENA. In addition, it is important to move towards greater articulation with local schools since they have an ecotourism profile, providing the possibility for students to carry out their internships in whale-watching monitoring. Whale-watching activities coupled with education experiences increase environmental awareness and when such experiences are led by adequate interpreters, they can serve as a source of inspiration and education, and raise conservation awareness (Orams, 1995; García-Cegarra and Pacheco, 2017).

Moreover, it is important to support and promote long-term studies, which will contribute to whale scientific research and to generate key information for decision-making for the management of the area. Formulation of priority lines of research and alliances with universities and institutions within the framework of the strategy for the conservation of the humpback whale of the Southeast Pacific (Flórez-González et al., 2007) and National Action Plan for the Conservation of Aquatic Mammals of Colombia 2020-2035 should be identified.

Finally, based on these social, economic and biological aspects, we urge environmental authorities, conferring with relevant stakeholders, to determine the whale-watching carrying capacity of the area, which includes the number of boats per day in the area, as well as number of operators, guides and tourists on board. As in Málaga NNP many activities use boats, like fishing, whale-watching and transport, carrying capacity should include all types of boats. An assessment of whale-watching carrying capacity requires an understanding of the biological, social and economic dimensions (Fernandes and Rossi-Santos, 2018). Meanwhile, we suggest following the recommendations (MADS, 2017) as a precautionary measure, until more data and management capacity become available. Surveillance and reinforcement must be strengthened to ensure compliance with best practice recommendations. Ideally instead of whale-watching recommendations in the area, an enforceable legal instrument should be designed to ensure the ecological, social and economic sustainability of the activity. Progress in the social, economic and biological aspects should result in the maintenance of the conditions for the whales' welfare to maintain their breeding, birthing and rearing processes, the well-being of the communities, and an improvement of the tourist experience.

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