Carrying Capacity Study Proposal of Whale Watching Tourism in the Golfo Dulce, South Pacific Costa Rica

As we develop our Whale Heritage Site carrying capacity comes to the forefront of necessity and while we begin the indepth process of research required to develop a full carrying capacity output/assessment, here we at least begin the journey by doing a preliminary review of the outcomes and effects of a carrying capacity study.

Introduction

Whale-watching is one of the fastest growing ecotourism industries and involves the observation of endangered wild cetacean species. However, this growth has raised concerns because of the negative effects this activity may have on the behaviour and survival of focal species (Garcia-Cegarra, 2018). A carrying capacity study on our specified area is of the greatest importance to ensure an adequate management plan for the years to come.

Study area

Golfo Dulce is a fjord-like embayment situated between 8°33'N and 83°14'W, 50 Km long and 10-15 Km wide. The climate is humid and tropical with a rainy season that extends from May to November, having an average monthly precipitation of about 100-700 mm. The main input of fresh water comes from the rivers Coto, Tigre, Esquinas and Rincon that have a direct influence in the circulation patterns of this strongly stratified estuary (Marques-Artavia et al. 2012). A sill area is localised to 20 Km from the mouth, dividing the gulf in two regions with different physical and oceanographic features: the inner and the outer basin. The maximum depth of the inner basin is approximately 215 m with an anoxic layer in the deeper zone. However, the sill has shallow depths reaching 60 m at the deepest point, preventing the free exchange with the adjacent coastal water masses. Additionally, the tidal range varies by 2-4 m in a lunar month cycle (Svendsen et al 2006).

Whale Watching Tourism

Whale-watching has been largely promoted by businesses and NGOs as an economically viable and sustainable use of cetaceans (Woods-Ballard et al. 2003), recognized as having significant social, economic and educational benefits (e.g. Stamation et al. 2007; Brumatti 2013).

Whale and dolphin watching boat tours are operational throughout the year in the Golfo Dulce. There are at least 20 different hotels and tour companies around the Golfo Dulce with their own boats There are at least 24 more boat captains who own their own boats, mainly for fishing, around the Golfo Dulce who and are willing to informally take out guests interested in cetacean watching (census updated in late September 2022).

In the Golfo Dulce, the whale watching industry has developed on the observation of common bottlenose and pan tropical spotted dolphins and humpback whales, and this has promoted an increase in ecotourism activities for more than 10 years.
Present Cetacean Species:

Humpback Whales

The Golfo Dulce is a suitable breeding and calving ground for humpback whales, promoting the arrival of migrant whales from the Northeast and Southeast Pacific populations. The arrival in different seasons is more frequent; the northern population migrates to the wintering grounds between December and April, whereas those from austral zones make their journey from June to October(Marques-Artavia et al. 2012). The migration route of the southern population has two important wintering grounds in Central American waters: Las Perlas Archipelago off the coast of Panama, and the Pacific coastline of Costa Rica, being The Caño Island, Drake Bay and Golfo Dulce, areas of greater concentration of sightings for this species (May-Collado, 2005). First records of southern Pacific humpback whales in Costa Rica, documented by Acevedo-Gutiérrez & Smultea (1995) are focused on humpback whales occurrence in Golfo Dulce.

Dolphins

In general terms, the common bottlenose dolphin is mostly distributed in coastal areas, whereas the pantropical spotted dolphin prefers deep waters (Jefferson et al., 1993). Based on those general tendencies and on previous results found by Acevedo-Gutiérrez & Buckhart (1998) for the two dolphin species in Golfo Dulce, different spatial distribution patterns were predicted for the two species, with a higher probability of finding the bottlenose dolphin close to shore. The small groups of bottlenose dolphins can accommodate themselves in the shallow areas; however, the big groups of spotted dolphins require greater areas in three dimensions. Deeper areas of the gulf allow cohesion in big groups. Differences found under these contexts seem to be the result of strong mechanisms for avoiding competition. However, because the balance between the two populations is based on extreme patterns, it seems to be fragile (Cubero Pardo et al., 2007).

Carrying Capacity

Carrying capacity has been defined as 'the maximum number of people who can use a site without an unacceptable alteration in the physical environment and without an unacceptable decline in the quality of experience gained by visitors' (Mathieson and Wall 1982, as discussed in Cooper et al. 1998). Since carrying capacity is a measurement tool that allows a partnership between management objectives of an area and the environmental impacts of the activity being undertaken on, it may be

useful in estimating the maximum level of visitors allowed within the Golfo Dulce for whale watching activities.

Methodology

Whale-watching carrying capacity should be assessed with a basis on a set of variables related to the three spheres of sustainable management, namely the impact on whales (Biological), on tourist experience (Social) and whale-watching companies (Economic) (Chion et al. 2012). Here we break down each section based on the above references recommendations:

Biological Sustainability – The Whales

Animals perceive tourism as a risk and may respond to interactions in the same way they would respond to predators (New et al. 2014). This can result in disruptions of their activity budget, displacement from the area and other sub-lethal effects that can lead to long-term consequences for the populations (Pirotta et al. 2014).
Boat behaviour around the animals and the number of vessels present have all been shown to change humpback whale behaviour (Stamation et al. 2010). Avoidance of disturbance is one of the most commonly used behaviour measures of disturbance, but there are other forms of behavioural responses to disturbance, for example, increased levels of vigilance, reduction in parental care or amount of time spent resting, that could potentially affect survival or fecundity (Gill et al. 2001).
Short-term effects of individual interactions between whale-watching boats and cetaceans are unlikely to result in any long-term effects for the animals, since they may be able to compensate for the effects of the disturbance once it is absent (Christiansen and Lusseau 2014). The problem is that the effects from whale watching disturbance may be cumulative when they become more frequent or target individuals within a population, certain areas, behaviours or age classes more frequently. Responding to disturbances has associated energetic consequences. One way to evaluate the energy cost of human disturbances is to analyse the amount of time the animals dedicate to different energy-relevant activities, such as swimming, feeding and resting, in the presence or absence of tourist vessels (Christiansen and Lusseau 2015).

The NGOs CEIC and Osa Ecology are monitoring cetacean behaviour differences with and without the presence of boat/s. Research will consider how soon whales come to rest after disturbance, as an additional indication of the strength of avoidance and whether this is likely to be biologically significant (Kessler et al. 2013). Also, as recommended by Lusseau (2004), population estimates, structure, reproductive rates and behaviour budgets will be analysed.

Social Sustainability – The Tourists

The social carrying capacity relates to visitor experience on whale-watching boats, including the time spent observing whales, time spent alone with the whales and satisfaction (Chion et al. 2012). There are many studies that have measured the satisfaction of whale-watching tourists (e.g. Avila-Foucat et al. 2013; Filby et al. 2015; Sitar et al. 2017). Generally, tourists prefer when whale-watching trips have educational elements (Bentz et al. 2016a), licensed boat operators, and boat operators that follow whale-watching regulations (Orams 2000) and are concerned about minimising harm to whales (Kessler et al. 2014).

Crowding is another potential indicator of social carrying capacity that can influence the probability of tourists returning to a site and has been increasingly applied to assess marine wildlife tourism carrying capacity (Bentz et al. 2015).

The NGO Osa Ecology will begin collecting questionnaires about satisfaction from tourists that have participated in whale-watching tours employing different companies and captains in the Golfo Dulce over the 2023 and 2024 seasons. The organisation will also record data regarding how many boats are present with an individual or group of cetaceans at any one time. Also, seasonal on-water hours and tracking distances covered by various tour boats will be used to broaden estimates of whale watching activity in Golfo Dulce.

Economic Sustainability - The Whale-Watching Companies

This aspect of whale-watching carrying capacity refers to the economic contribution the activity makes to coastal economies around the world (Mustika et al. 2012). It creates jobs and income for local communities. However, with the increase in numbers of operators in a specific locality, competition may lead to decreased economic viability, for example. So, in analysing this aspect of carrying capacity, factors such as number of jobs created as a result of whale-watching tourism, total income generated from tourism in the region and for the whale-watching operators can be considered (Parsons et al. 2003).
If tourist demand exceeds the capacity of the existing operators, then the activity is below carrying capacity. If, on the other hand, there are more operators than tourists wanting to go whale-watching, then the economic carrying capacity is exceeded.

An evaluation of the demand for whale-watching in the Golfo Dulce could contribute to the assessment of economic sustainability of this activity (Brumatti 2008). The local tourism committee has agreed to lead in this study by understanding the number of visitors to the area and of those how many plan on whale-watching.

Sustainable Management – The Enforcement Authorities

Sustainable management was proposed by Cifuentes (1992) and refers to the existence of policies, equipment, personnel, funding, infrastructure and facilities available in an important area to support the sustainable and effective management of the area and activities carried out within it. In the Golfo Dulce, sustainable management can be considered one of the main limiting factors of whale-watching carrying capacity.

Since there are already strict rules and regulations in place in Costa Rica, more official government patrols should be made to make sure the rules are adhered to in the specified area. Local NGO Osa Ecology along with whale-watching company Changing Tide Tours have agreed to hold regular meetings with the coast guard and MINAE who are in charge of official patrols and find out current frequency of patrols, what resources they are lacking and how this can be improved.

Further promoting the whale-watching operators assembly which we have discussed in our management plan could improve the activity's self-regulation and promote shared management along with the authorities, helping to give a sense of pride and leadership for the area.

Discussion & Recommendations

An in depth carrying capacity study of whale-watching for the Golfo Dulce is a necessity for this area. Based on the information presented in this study, we consider the current level of knowledge of both the impacts on the whale and dolphins, and the quality and effectiveness of the services provided for whale watching tourism in the Golfo Dulce is insufficient to allow the calculation of carrying capacity for the activity.

The Carrying Capacity study that we will undertake will involve different stakeholders, such as NGOs, tourism operators, local community and government authorities. Collectively, we propose an integrated framework to assess whale-watching carrying capacity of the Golfo Dulce, taking into account biological, social and economic factors, as well as management considerations for the area. This will be completed within 2 years (by the end of 2025).
This study will ultimately determine the maximum number of vessels allowed to operate simultaneously. This may fluctuate seasonally depending on the results. Additional management measures could include the use of specific boat and engine types, as well as regular maintenance requirements, to reduce the amount of noise around the cetaceans.

In turn, this study will also ensure the long-term monitoring of whale-watching, implementing specific studies to assess the possible changing impacts of

whale-watching on the whales and dolphins. It will also ensure the long-term monitoring of visitor feedback, educational value and attitudinal changes.

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