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Diving tourism in Mexico – Economic and conservation importance

Ramiro Arcos-Aguilar [a,1], Fabio Favoretto [a,c,*,2], Joy A. Kumagai [b,d,3], Victoria Jiménez-Esquivel [a], Adán L. Martínez-Cruz [e,f,4], Octavio Aburto-Oropeza [b,5]

[a] Centro para la biodiversidad Marina y la Conservación A.C., 430 Calle del Pirata, La Paz, BCS 23090, Mexico
[b] Scripps institution of Oceanography, University of California San Diego, 9500 Gilman Drive, La Jolla, CA 92093, USA
[c] Universidad Autónoma de Baja California Sur, carretera al sur km 5.5., 23090 La Paz, BCS, Mexico
[d] Senckenberg Climate and Biodiversity Research Centre, Senckenberganlage 25, 60325 Frankfurt am Main, Germany
[e] Department of Forest Economics, and Centre for Environmental and Resource Economics (CERE), Swedish University of Agricultural Sciences (SLU), Skogsmarksgränd 27, SE, 901 83 Umeå, Sweden
[f] Department of Economics, Centro de Investigación y Docencia Económicas (CIDE), Carretera México-Toluca 3655, Álvaro Obregón, 01210 Ciudad de México, Mexico

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ABSTRACT

Global coastal environments are highly vulnerable to degradation due to anthropogenic pressures as they host close to half of the world's population in addition to having rich marine and terrestrial biodiversity. Worldwide degradation of coastal environments causes marine biodiversity to become an increasingly scarce resource. Consequently, locations with rich marine biodiversity have become attractive destinations for non-extractive activities such as diving tourism. For instance, since the invention of SCUBA in 1942, diving tourism has evolved from a niche activity to a thriving industry that lures practitioners with the promise of experiencing pristine wildlife encounters. Despite the number and popularity of diving destinations in Mexico, no study has previously estimated the economic importance of this industry for the Mexican case. This study calculates for the first time the gross and net revenues generated by the Mexican diving industry. We first created the most comprehensive and up-to-date list of diving sites in Mexico. Secondly, via a face-to-face survey, we gathered data on revenues and operation costs from diving operators. The resulting dataset includes 864 diving sites that together generate gross revenues ranging from (2019) USD 455 million and USD 725 million annually which are comparable to those generated by the artisanal and industrial Mexican fisheries together. Mexico simultaneously has high untapped ecotourism potential and the need for a sustainable strategy that delivers growth in both the economy and environmental conservation. Therefore, Mexico is in a position to become a beacon for community-led management through ecotourism, stimulating a sustainable use of marine resources.

1. Introduction

Coastal environments contain between 40% and 70% of the estimated value of our planet's ecosystems [1]. They are economically important due to their high touristic potential which represents the main income source to most inhabitants of coastal communities [2,3]. However, both marine biodiversity and the health of coastal ecosystems are in peril due to increasing human pressures [4–10]. Coastal environments host most of the world's megacities and around half of the world's human population [2]. Extractive economic activities, along with climate change, are threatening these ecosystems [11–13]. The degradation of these ecosystems, in turn, threatens economic activities in coastal environments. For instance, while fisheries are essential to sustain livelihoods of coastal communities, human-induced degradation is expected to produce revenue losses of up to USD 10 billion to fisheries worldwide by 2050 [14].

* Corresponding author at: Universidad Autónoma de Baja California Sur, carretera al sur km 5.5., 23090 La Paz, BCS, Mexico.
E-mail addresses: arcos.aramiro@gmail.com (R. Arcos-Aguilar), favoretto@uabcs.mx (F. Favoretto), joy.kumagai@senckenberg.de (J.A. Kumagai), adan.martinez.cruz@slu.se (A.L. Martínez-Cruz).
[1] ORCID: 0000-0003-3713-3184
[2] ORCID: 0000-0002-6493-4254
[3] ORCID: 0000-0001-7820-516X
[4] ORCID: 0000-0001-7865-5339
[5] ORCID: 0000-0002-8173-1432

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However, there is the possibility of reversing this cycle. Coastal environments that hold a higher abundance of marine life and are sustainably managed, have been shown to have a higher degree of resilience [15,16] and recovery potential [17,18]. Thus, marine tourism, if sustainably managed, can potentially enhance biodiversity conservation and economic development. Specifically, the SCUBA diving industry has the potential for such a double dividend. SCUBA diving and snorkeling activities have emerged as a billion-dollar global industry [19,20]. This industry includes a wide range of services–e.g. accessibility to recreational sites, tourist information, transportation, lodging and food [21]. The lure of SCUBA diving originates from the experience of witnessing pristine marine nature. Consequently, tourists' willingness to pay is positively associated with the biodiversity and health of reefs [22,23]. Therefore, the promotion of marine-based tourism may represent an economic incentive for communities to protect coastal areas rather than engage in practices that damage biodiversity.

In 2018, Mexico ranked seventh in terms of international tourists received, and 8.7% of its gross domestic product was generated by tourism [24]. With a coastline spanning 11,122 km and distinct marine habitats located in different biogeographic provinces and ecoregions, Mexico's potential for sustainably managed marine-based tourism is high. These provinces are characterized by a high level of endemism and biological diversity as well as different geomorphological and hydrographic features [25]. Mexico's SCUBA diving destinations are famous worldwide –e.g. Cozumel, Cabo San Lucas, Isla Guadalupe. However, efforts to estimate the magnitude of the economic contributions of the diving industry at a national scale do not exist. There are studies estimating the economic importance of marine-based tourism for specific Mexican regions [26–29], but a nationwide estimation has been overlooked.

This study fills this gap by first developing a comprehensive database of diving operators and diving sites in Mexico. Next, gross, and net revenues for the Mexican diving industry are calculated based on information provided by diving operators via a face-to-face survey. By collecting and analyzing these data, we aim to inform diving operators and policy makers about the economic importance of preserving the biodiversity that supports diving tourism in Mexico.

2. Methods

2.1. Diving sites web search

In Google's search engine, we searched for diving sites using the keywords "Diving" OR "Dive sites" AND "Mexico" in English, and "Buceo" OR "Sitios de buceo" AND "Mexico" in Spanish. All searches were conducted from January to March 2018. After a search on a national level, we narrowed it down to a state level by substituting "Mexico" with the name of each Mexican coastal state (n = 17, states: Quintana Roo, Veracruz, Tabasco, Oaxaca, Guerrero, Baja California Sur, Jalisco, Colima, Baja California, Sonora, Sinaloa, Michoacán, Tamaulipas, Chiapas, Tampico, Yucatan and Campeche). We considered only results from tourism and diving operators' websites, websites for diving-related magazines, peer-reviewed scientific publications, and gray literature. We also recorded how many times the same site appeared in our search results to create a "frequency of appearance" variable. We then grouped the diving sites into four different regions: The Northwest Mexican Pacific (NMP), Mexican Pacific (MP), the Yucatan Peninsula (YP), and the Gulf of Mexico (GM). The diving site database containing the organization and regional information of dive sites is available under request at [30].

2.2. Diving operators web search

In Google's search engine, we searched for diving operators using these search terms: "SCUBA diving" AND "diving operators" AND "Mexico"; and "Buceo" AND "Operadores de turismo" AND "Mexico" in Spanish. All searches were conducted from January to March 2018. We then searched at a state level substituting the word "Mexico" with each of the 17 Mexican coastal states as keyword. We considered only operators with a valid business address that offered SCUBA diving or snorkeling activities in their advertisements. We excluded those who only advertised through social media platforms since these are often freelance operations or did not list a formal business location. We also excluded liveaboards (diving cruises) because they behave differently from the average local diving operator (see Supplementary materials). When a business was identified as a potential diving operator, we explored their website and contacted them to ascertain eligibility, confirm their mailing addresses, and to ensure that they offered diving or snorkeling trips as advertised.

We put together a diving operator's database that included 408 operators in 13 out of the 17 Mexican coastal states. To conclusively corroborate that the online information collected was correct and updated (e.g. location and activities promoted), we visited each of the diving operator's offices, from May to July 2019. The list of diving operators was then adjusted to exclude those which did not fit the criteria listed above. This search and selection process produced a final database of 264 active diving operators in Mexico, which were then organized into regions. The database is available under request at [31].

2.3. Surveying diving operators

Following international ethical standards (see ethical statement in Supplementary materials), we asked diving operators to complete a survey. Of the 264 operators identified, 106 responded, representing 40.1% of the operators in our dataset. All participants gave their informed consent to publish the data. The survey gathered information the following information: country of origin, address, years working as a diving operator, number of owners, number of employees, activities offered, number of tourists served per week, number of operational days per week, price of the services, number of snorkel and diving trips per week (trips are local and offered on a daily basis and one trip can include more than one dive), and percentage of their gross revenues used in operational expenses (payroll, commissions, rent, repairs, and taxes). For a full list of collected variables, see the survey format available in the Supplementary materials. These data have been stored in a database organized into the same regions as for the diving sites. The database is available under request at [30,31].

2.4. Economic importance

To estimate the economic importance of the scuba diving and snorkel industries in Mexico, we calculated diving operators' revenues per region as described in Section 2.1. These estimates are based on the number of diving operators, the average number of clients per year, and the average price of one trip. The number of clients had the highest variation among and within regions mainly due to differences in business size. Therefore, we have classified businesses according to the number of owners, the number of employees, and their weekly capacity to receive tourists. We grouped diving operators in two categories: small and medium businesses –i.e. those that are owned by one or two owners, with less than 10 employees, and receiving less than 500 clients per week—and large businesses—i.e. those owned by three owners or more, with more than 10 employees and more than 500 clients per week. Our calculations are separated based on this classification into two revenue metrics: 1) the Total Mean (TM) which refers to the average (net and gross) revenues considering all surveyed diving operators; and 2) the Mean Excluding Large Businesses (MELB) which refers to the average (net and gross) revenues considering only small and medium size diving operations. We use the MELB as a conservative measure of average revenues obtained by a diving operator in Mexico.

Based on the data gathered from the 106 diving operators that completed our survey, we have calculated the gross revenues per region as follows:

$$Surveyed\ gross\ revenues = \begin{cases} \sum [N\ of\ operational\ weeks \times Average\ SCUBA\ or\ snorkeling\ clients\ per\ year\ (TM) \times Average\ SCUBA\ or\ snorkeling\ trip\ price\ (TM)] \\ \sum [N\ of\ operational\ weeks \times Average\ SCUBA\ or\ snorkeling\ clients\ per\ year\ (MELB) \times Average\ SCUBA\ or\ snorkeling\ trip\ price\ (MELB)] \end{cases}$$

The number of operational weeks is the reported number of working weeks per year per each diving operator corrected by the average number of weeks ports and marinas closed (e.g. due to weather) from 2010 to 2018 for each region in Mexico.[1] We calculated the average number of clients for SCUBA diving and snorkeling separately to have estimates for each activity. Based on the surveyed gross revenues, we have estimated the gross revenues of all the operators in our database (n = 264) by using a value transfer approach proposed by Cisneros-Montemayor et al. [27]. Considering that the percentage of surveyed diving operators varies across regions—26.21% for the Yucatan Peninsula; 54.02% for the Northwest Mexican Pacific; 60.00% for the Gulf of Mexico; and 68.18% for the Mexican Pacific—, we have obtained the estimated gross revenues per region as follows:

$$Estimated\ gross\ revenues = \begin{cases} \dfrac{Surveyed\ gross\ revenues\ per\ region (TM)}{Percent\ of\ diving\ operators\ surveryed\ per\ region} * total\ number\ of\ marine\ tourism\ operators\ per\ region \\ \dfrac{Surveyed\ gross\ revenues\ per\ region\ (MELB)}{Percent\ of\ diving\ operators\ surveryed\ per\ region} * total\ number\ of\ marine\ tourism\ operators\ per\ region \end{cases}$$

Surveyed and estimated net revenues are calculated by subtracting operational costs reported by diving operators in each region. These operational costs were reported by the operators as a percentage of gross revenues.

2.5. Accessibility index to the dive sites

An adapted suitability analysis was performed to develop an accessibility index for diving sites in Mexico. We worked on two components —land and ocean accessibility. The resulting index is used to estimate how physically accessible diving sites are in Mexico. Marinas were used as the connection between these components. We created a dataset on marinas from two sources: MarineTraffic port data and digitized marinas from ESRI ArcGIS Pro 2.3 satellite imagery basemap. The ocean component was based on the number of marinas around each diving site and the distance to each diving site from the closest marina. The land component of the accessibility index was calculated from equally weighting the accessibility of airports, roads, hotels, and dive shops in Mexico (see Supplementary materials). We found and downloaded the data from the sources listed in Table S1. Using ArcGIS Pro 2.4, all data were projected into GCS WGS 1984 projection and if converted into raster, the cells were 0.25 km^2 in size throughout.

[1] This information was obtained at https://www.gob.mx/puertosymarinamercante/acciones-y-programas/informes-anuales-de-cierres-de-puertos; https://www.gob.mx/semar%7Cunicapam/acciones-y-programas/reporte-de-cierres-y-aperturas-de-puertos-mexicanos.

2.6. Diving sites under a protection status

To obtain how many of the diving sites are located inside a Marine Protected Area (MPA), we downloaded the polygons of MPAs from the National Commission for Protected Areas in Mexico's (CONANP) website.[2] MPAs in Mexico have several designations. Only one prohibits fishing called a "No-Take zone", therefore we selected the sites that were within this type of zone. We then reprojected both diving site coordinate points and the protection polygons to the GCS WGS 1984 coordinate system and performed a spatial merge on the two files.

2.7. Statistical analyses

We tested differences between SCUBA diving and snorkeling tourists using a *t*-test, and an analysis of variance (ANOVA) to understand differences between the accessibility index from one region to another using region as a fixed factor with 4 levels (Yucatan Peninsula, Northwest Mexican Pacific, Mexican Pacific and Gulf of Mexico). We ran diagnostics for parametric tests assumptions, before running these tests, using Shapiro-Wilk, and visually using a quantile plot for normality of the distributions. We also plotted residual versus fitted values to explore homogeneity of variance and we tested it using a bartlett test. We were interested in exploring differences in the diving industry across regions in Mexico, and whether these differences are associated to variables characteristic of the industry itself, including the protection status of the diving sites. We focused our attention on the following variables: site popularity (as the frequency of occurrence in web searches), trip price, site accessibility, the number of sites within a No Take Area, number of diving operators, and net revenues. To investigate the relationship among those variables, we used a permutation Pearson's correlation method. The analysis was completed using R programming language v. 4.0 [32].

3. Results

3.1. Diving sites in Mexico

Through our web searches, we compiled the most comprehensive dive site database in Mexico, with a total of 860 diving sites registered across 14 out of the 17 Mexican coastal states. For three states (Tabasco, Chiapas, Tamaulipas) we found no diving site promoted on the web. The region with the highest number of dive sites was the Northwest Mexican Pacific (n = 415, 48.26%), followed by the Yucatan Peninsula (n = 240, 27.91%), the Mexican Pacific (n = 106, 12.33%), and the Gulf of Mexico

[2] http://sig.conanp.gob.mx/website/pagsig/info_shape.htm.

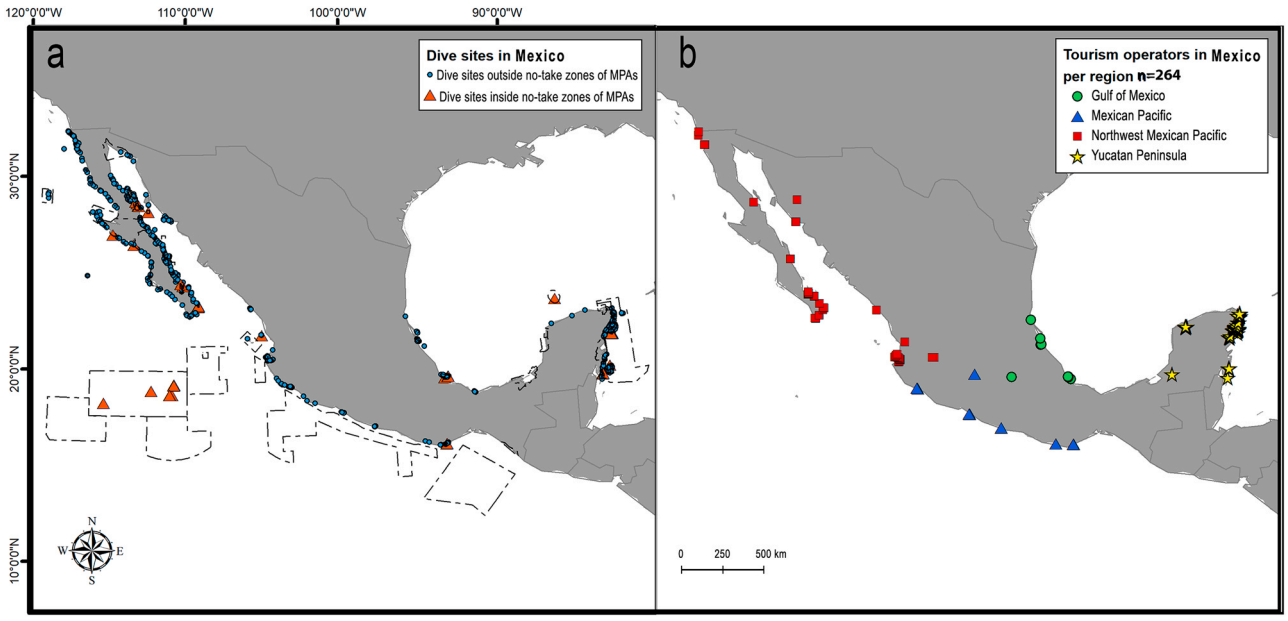

Fig. 1. Maps indicating the locations of diving sites and diving operators in Mexico. a) The 860 dive sites found in Mexico divided by colors according to the protection status, blue circles represent dive sites located in open access areas, and red triangles indicate dive sites inside No-Take zones corresponding to MPAs sub-zoning (White polygons, outlined in black) in Mexico. b) Shows the 264 diving operators registered in Mexico by region: Gulf of Mexico (GM), Mexican Pacific (MP), Northwest Mexican Pacific (NMP), and Yucatan Peninsula (YP) (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

(n = 99, 11.51%) (Fig. 1a). Of the total dive sites found, 443 (51.51%) are located inside protected natural areas, 58 (6.74%) within a No-Take zone, and 359 (41.74%) lack any protection. The Northwest Mexican Pacific has the greatest number of dive sites located in No-Take zones (n = 26, 3.02 (Fig. S1). We also found statistical differences in the dive sites' popularity among regions ($F = 23.24$, $p < 0.01$), with the Yucatan Peninsula being the most popular (Fig. S2)..

3.2. Diving operators in Mexico

We identified 264 active diving operators in Mexico in 2019 (Fig. 1b). Of the 264 operators, 106 agreed to take our survey. These 106 businesses are owned mostly by Mexican nationals (82) while the rest (24) have foreign owners. However, all of these foreign owners are residents in Mexico. According to the survey responses, the diving industry is mainly formed by small businesses (n = 97, 90.65%), along with a few large businesses (n = 9, 9.34%). These large businesses provide services to 1600 tourists weekly on average compared to 74 tourists weekly on average by small businesses. Of those large businesses 5 were owned by foreign owners, whereas 4 had Mexican owners. Based on the total number of diving operators at a national level, no significant differences were found between the weekly number of tourists SCUBA diving versus snorkeling ($t = 0.3$, $N = 1271$, $p = 0.71$, Table S4). However, the number of tourists SCUBA diving on average was significantly higher than tourists snorkeling when large businesses were removed ($t = 10.7$, $N = 1211$, $p < 0.001$, Table S5).

Our estimates of SCUBA divers per year tended by all 264 operators in Mexico is between 1.33 million (MELB) and 1.70 million (TM). In contrast, the number of snorkelers per year is between 0.33 million (MELB) and 1.66 million (TM). The 9 large businesses represent around 80.17% of total snorkelers in Mexico and 21.43% of total SCUBA divers. More detailed comparisons among diving operators at a regional level are available in the Supplementary materials.

3.3. Gross and net revenues of SCUBA diving and snorkeling

Total estimated gross revenues based on the total number of diving operators in Mexico (n = 264) was (2019) USD 725.16 million (TM), or—removing the large businesses— (2019) USD 455.94 million (MELB), including snorkeling and diving. The estimated net revenues based on the total number of diving operators in Mexico (n = 264) were (2019) USD 227.70 million (TM) and—removing the large businesses— (2019) USD 140.41 million (Fig. 2).

When accounting for all diving operators in our estimates, SCUBA diving represents 67.39% of revenues, and snorkeling represents 32.61%. When focused on MELB estimates, the fraction representing SCUBA diving activities is 89.37% (2019 USD 125.49 million) of the total net revenues. These revenues also vary on a regional level. According to our results, in both, TM and MELB estimations, the Yucatan Peninsula has the highest number of SCUBA divers per year and the largest gross and net revenues (Fig. 2). Meanwhile, the Northwest Mexican Pacific had the highest number of tourist and gross revenues regarding snorkel activities when large businesses are accounted for (TM Fig. 2a and c), but it decreases to less than the Yucatan Peninsula when only smaller businesses are accounted for (MELB Figure b and d). The average price per SCUBA diving trip ($df = 3$, $p < 0.001$, Table S6) or snorkel trip ($df = 3$, $p < 0.001$, Table S7) was also significantly different among regions, but we did not observe significant differences in the average price per trip across an entire year. The region with the highest price per trip was the Northwest Mexican Pacific for both SCUBA diving ([2019] USD 131.50 Standard Deviation (SD) ± 37.17) and snorkeling trips (Table S8). Finally, the tourism operators declared an average operational expense of 67%, but there were significant differences in these costs among regions ($df = 3$, $p < 0.001$). The Yucatan Peninsula reported the highest costs (72.00% SD ± 21.73), followed by the Gulf of Mexico (70.00% SD ± 17.44), the Mexican Pacific (66.27% SD ± 17.84) and finally, the Northwest Mexican Pacific (63.20% SD ± 22.02).

3.4. Accessibility index

The accessibility index represents the infrastructure available to get access to the dive sites in the country (Fig. S3). According to our results there are significant statistical differences between the accessibility index from one region to another (ANOVA test, $F = 127.577$ and

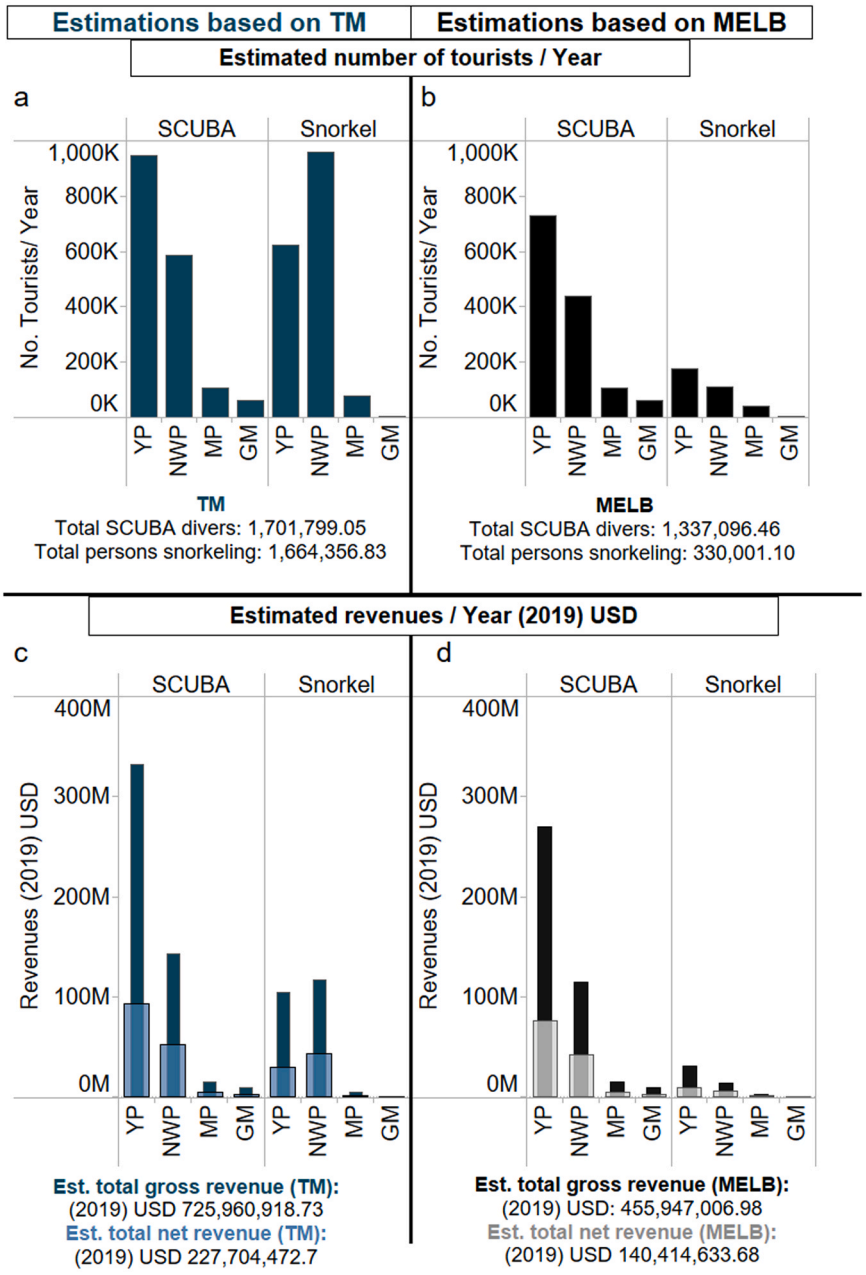

Fig. 2. Overview of the number of tourists (a-b) and revenues estimated from the SCUBA and snorkel sectors in Mexico (c-d). a) Estimated number of SCUBA and snorkel clients using the Total Mean (TM) estimation, b) number of clients using the Mean Excluding Large Businesses (MELB) estimation, with the total number of people on the *Y* axis; c) revenues estimated of tourist operators divided into gross (dark blue) and net (light blue) for both SCUBA and snorkeling activities per region using the TM estimation, d) estimated revenues with the MELB estimation divided into gross (black) and net revenues (gray), with the total net revenues estimates in 2019 USD million on the *Y* axis. The regions are represented on the *Y* axis as: Yucatan Peninsula (YP), Northwest Mexican Pacific (NMP), Mexican Pacific (MP), and Gulf of Mexico (GM) (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article)

$P < 0.01$). The Yucatan Peninsula presented the higher accessibility index (34.86), followed by the Mexican Pacific (28.19), the Gulf of Mexico (26.65) and in last place, the Northwest Mexican Pacific (12.93).

3.5. Drivers of trip prices and net revenues

We have found a statistically insignificant association between trip price and, respectively, site popularity, local competition (measured as number of diving operators), and environmental protection (Fig. 3). However, accessibility to the diving site is inversely related with trip price, where higher accessibility is associated with lower prices. The number of protected areas, specifically those with a no-take zone, and the number of diving operators are positively associated with popularity. Assessing net revenues against the same indicators, we found a significant association with site popularity and the number of diving operators. Therefore, while popularity is not associated to trip price, it is associated to net revenues –through its positive association with number of tourists. Lastly, site accessibility is not significantly associated with site protection (Fig. 3). (For a detailed explanation of the variables per region see the Supplementary materials and Fig. S4).

4. Discussion

4.1. The economic importance of the Mexican diving industry

We have estimated that Mexico's SCUBA diving industry generates gross revenues of (2019) USD 725.16 million, or (2019) USD 455.94 million when we exclude large businesses. These figures represent gross revenues directly arising from payments for SCUBA diving and snorkeling activities. These figures do not account for economic activities directly and indirectly linked to SCUBA diving tourism, such as accommodation, food, entertainment, etc., and are based only on formally registered diving operators. We have not produced estimates of how many informal operators offer diving services in Mexico. While diving tourism depends on how pristine an ecosystem remains, our estimates do not include the monetary value associated to current conservation of

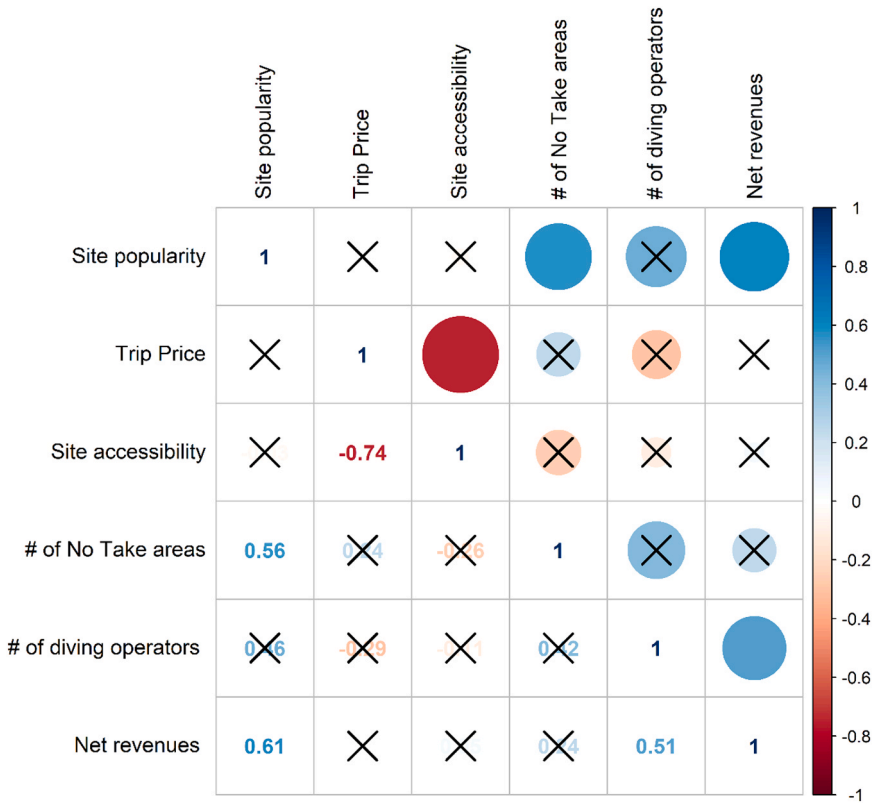

Fig. 3. Correlation plot showing the relationship between different variables used in this study. Point size and color is scaled according to the r correlation factor of the Pearson's test. Non-significant ($p > 0.05$) relationships are highlighted by a cross.

biodiversity that allows for existence and option values. Consequently, we suggest our calculation can be considered a lower bound estimate of the importance of preserving biodiversity embedded in the diving sites in Mexico.

The economic contribution of the diving industry in Mexico, measured in terms of gross revenues, is comparable to that of fisheries. Martinez Estrada et al. [33] report the gross revenues of the Mexican artisanal and industrial fisheries as (2019) USD 700 million (value of landings). Our estimate of the gross revenues of the Mexican diving industry are (2019) USD 725.16 million. When comparing these numbers however, it is necessary to recognize that informal business in the fisheries sector is estimated to be large and a similar situation may characterize the diving sector.

Our estimates of gross revenues can also be compared to those reported by Spalding et al. [34]. They gathered data from social media and crowd-sourced datasets to map global tourism derived from coral reefs. Once this tourism was mapped, they estimated gross revenues generated by "on-reef" activities, which include but are not limited to diving and snorkeling. For Mexico, they estimate that "on-reef" activities generate (2019) USD 1400.2 million annually. Our estimates of gross revenues –i.e. (2019) USD 725.16 million— are half of those reported by Spalding et al. [34]. This difference in magnitude is consistent with the differences in methodologies and items included in the calculations. While Spalding et al. [34] includes a fixed percentage of total expenditures at coral reefs destinations, we base our calculations only on the revenues generated from direct payments for snorkeling and SCUBA diving trips.

We compare our estimates to those of other countries with diving destinations, by referring to two international marine tourist hotspots: Hawaii and the Red Sea. The net economic value estimated from the direct use of the archipelago of Hawaii has been estimated at (2019) USD 489 million [35]. The net revenues estimated for the Red Sea in Egypt have been reported at (2019) USD 155 million [36]. In comparison, our estimate of net revenues generated by the Mexican diving industry is (2019) USD 227.70 million.

4.2. *Large-scale vs small-scale, or quantity vs quality*

Mexican rural communities that depend on fisheries for their livelihoods will likely be hit the hardest by climate change related events [14]. Therefore, sustainable alternative livelihoods need to be considered and put in place for their wellbeing. Developing a sustainable diving tourism industry is a strategy with the potential of both preserving Mexico's diverse marine resources and generating economic growth in coastal communities [37]. However, sustaining a marine ecotourism industry requires regulations that avoid or minimize negative ecological impacts which would eventually lead to a decrease in tourism interest in the area [7,38–40]. Therefore, it is important to consider growth strategies that will not undermine the natural capital.

Based on our data, we have identified two business models in the Mexican diving economy: a large-scale model, and a small-scale model. We characterize these business models as follows. The large-scale diving tourism is driven by a few operators with large numbers of clients, employees, and boats. Snorkeling is often the activity of choice for these large diving operators. It requires less investment than SCUBA diving in terms of specialized equipment or trained personnel, thus leading to lower operational costs. From the tourist's perspective, snorkeling is also the preferred activity for the same reasons, fostering a wider appeal and a larger market [19]. Snorkeling trips are also cheaper because diving operators lure larger numbers of people to increase their earnings rather than increasing trip prices. Our results show this seemingly attractive strategy may not pay off in sustainable terms, especially in the Northwest Mexican Pacific where even though snorkeling is a major activity, it still generates lower net profits at the end of the year compared to SCUBA diving (Fig. 2).

Two major insights can be elucidated from the large-scale strategy. First, a snorkeling-based, large-scale tourism operation will increase the

number of tourists over time, but it seems to generate smaller net revenues per trip. Higher numbers of tourists also translate into more environmental degradation when diving sites are poorly managed [5–7]. Secondly, as snorkelers are a heterogeneous category, it can become more difficult to enforce environmental regulations on them, and they tend to choose snorkeling based on factors other than the beauty of the seascape [41–43].

The small-scale diving business model, if sustainably managed and regulated, represents an opportunity to spread ecotourism across coastal ecosystems in Mexico. For example, Northwest Mexican Pacific has tremendous natural potential to be enjoyed by visiting its various diving sites (Fig. 1a). Total tourist expenditure (including diving activity) in the region was estimated to be (2019) USD 550 million, mostly associated with the attractiveness of ecosystem biodiversity [27]. While some locations (e.g. Cabo San Lucas) have derailed from the ecotourism perspective, remote areas like Cabo Pulmo remain natural wonders that draw the attention of many tourists and is now a worldwide reference for conservation through ecotourism activities [17,44,45]. We estimated that 36,760 tourists visited Cabo Pulmo in 2019, paying an average price ranging from (2019) USD 65.57–131.5 per dive trip, similar to what has been previously reported [27]. This small community is home to 8 diving operators run by local families that *each* generate, according to our data, (2019) USD 0.355 million in net revenues per year. When comparing these figures to those of 16 diving operators in Cabo San Lucas, we find that despite having more tourists visiting per year, they generate smaller net revenues of (2019) USD 0.260 million *each*. The small-scale tourism model, coupled with a focus on SCUBA diving, generates more net revenues in these examples. Compared to snorkelers, SCUBA divers are likely more concerned about the environmental conditions of dive sites and prefer places where their experiences with nature are more awe-inspiring [42]. Therefore, this archetype tourist is receptive to calls for actions that result in significant conservation outcomes in an area [46]. Additionally, SCUBA divers are more willing to travel longer distances to reach spectacular places, creating unique opportunities for remote and rural places that hold biodiverse dive sites [42,47]. Most SCUBA divers can afford to choose more expensive options since they often have well-paid jobs with higher earnings compared to the average income. They spend at least three times more than other segments of tourists [48] which promotes higher-quality accommodations, food, and general living [49]. This also explains why, despite the higher operational costs, SCUBA diving activities generate higher net revenues (Fig. 2). From a diving operator perspective, a SCUBA diving based business needs a higher investment than a snorkeling centered business, since it requires training, establishing and managing a business, and covering the higher costs of equipment and specialized boats [50]. Still, the higher initial investment can have a larger return in overall revenues with even larger benefits to the local economy [42].

Overall, large-scale tourism causes cascading ecological problems at local, regional, and national levels, and leads to overuse, and degradation, of natural ecosystems [39,51]. The resulting degradation can result in a lower ecotourism potential over time [5,52,53]. In contrast, small-scale tourism can potentially generate higher revenues without severely degrading marine ecosystems. Examples such as Cabo Pulmo may work as illustrations to encourage a shift from the appeal of the short-term gain of large-scale tourism towards more sustainable development. Therefore, we suggest that small-scale diving models are more promising when it comes to reaching sustainable ecotourism that can support steady economic growth in Mexico and expand into areas that have not reached their full ecotourism potential yet.

4.3. Diving operators as actors in conservation decision-making

Despite the economic and cultural importance of the diving industry, divers have been documented to be underrepresented in marine conservation initiatives [39]. We suggest that diving operators should consider becoming more involved in protection lobbying. They create large revenues for their local communities and their businesses are dependent on thriving marine habitats. Among many actions, diving operators could organize in cooperatives or collaborate with conservation groups with the goal of protecting the natural assets of their diving sites.

The trip price is related to the accessibility of the diving sites. Areas with low accessibility charge more per trip than areas with high accessibility (Fig. 3). The increase in trip price can be related to an increase in costs to reach the diving sites by operators (e.g. higher gasoline consumption per trip); thus, accessibility of the diving sites can represent an advantage to the operators. However, the dive sites close to shore are under more environmental pressures than remote areas and are harder to manage [54]. Whenever management measures are implemented, the support of the community is essential. The success of MPAs is linked to the involvement and support of local communities in MPA management [55].

Diving operators can increase revenues by supporting environmental protections that increase the chances of encounters with pristine wildlife. This is one of the top factors influencing travel decisions made by ecotourists, and such encounters have a higher probability of occurring within a No-Take Zone where biodiversity has full protection [47]. Establishing higher prices to access protected areas is not unheard of, especially when it can deliver an improved experience. Indeed, the number of No-Take Zones was found to be positively correlated with the popularity of a site, and in turn popularity drives revenues (Fig. 3). Tourists may be willing to pay more to ensure local conservation and to visit healthy habitats [23,26].

5. Conclusions

In Mexico, the diving industry is as economically important as the fisheries sector. However, in contrast to the fisheries sector, the diving industry has an ample margin for growth if environmental considerations are considered. In Mexico, diving activities are regulated by the Mexican Official Regulation (Norma Oficial Mexicana, NOM-012-TUR-2016).[3] Unfortunately, there is no public policy that encourage diving activities (e.g. with aid in starting the business, tax cuts, bonuses for environmentally friendly activities etc.), or stimulates them to be sustainable and aid in the protection of the marine environment while generating wealth. Thus, we suggest that policy makers and dive operators themselves initiate a conversation on the steps needed to encourage a sustainable diving industry in Mexico. There is high potential revenue and greater benefits to be had by promoting a system of small-scale diving operations that prioritize the quality of tourists' experiences, which can then translate into higher prices, increasing net revenues and decreasing pressure on biodiversity over time.

Preservation of biodiversity embedded in diving sites must take into consideration long-term effects to the environment, the economy, and the livelihood of people and communities. To achieve this, diving operators should actively participate in marine spatial planning decision-making processes due to their economic importance and the necessity of community-based management. As of now, Mexico has the opportunity to become a beacon for community-led management through ecotourism activities that stimulate a novel and profitable way of using marine resources sustainably.

CRediT authorship contribution statement

Ramiro Arcos-Aguilar: Visualization, Writing - original draft, Data curation, Investigation, Formal analysis. **Fabio Favoretto:** Visualization, Formal Analysis, Writing - original draft and Writing - review &

[3] Available at: https://www.dof.gob.mx/nota_detalle.php?codigo=5450981&fecha=02/09/2016.

editing, Project administration. **Joy A. Kumagai:** Methodology, Formal Analysis, Writing - review & editing, Visualization. **Victoria Jiménez-Esquivel:** Visualization, Formal analysis. **Adán L. Martínez-Cruz:** Methodology, Formal Analysis, Writing - review & editing. **Octavio Aburto-Oropeza:** Conceptualization, Supervision, Funding acquisition, Writing - review & editing.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.marpol.2021.104410.

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