


**Complementing Local Ecological Knowledge with Population Monitoring:
Baseline assessment of presence and abundance of Eastern Pacific green sea
turtles, *Chelonia mydas*, surrounding Isla Espíritu Santo, Baja California Sur,
México**

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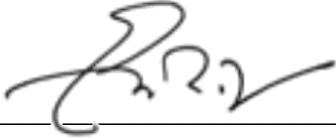
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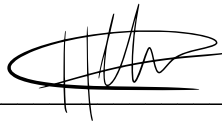
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Abstract

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To improve analysis of the Eastern Pacific green sea turtle population's status, a spatial assessment is needed on their presence and abundance in their frequented habitats. This study aims to develop a framework from which a baseline study could be undertaken focused on Eastern Pacific green sea turtles surrounding the waters of Isla Espiritu Santo.

Two years of data collected from Health Assessments in Sea Turtles from Baja California Sur (BCS) and a research survey focused on Local Ecological Knowledge (LEK) from ecotourism guides operating out of La Paz, BCS, México were used. Following the Institutional Review Board's (IRB) Protocol and due to the small same size or survey participants, survey data may not be used to extrapolate to the population of ecotourism operators in La Paz. Although past studies have integrated LEK from fishers, this is the first study to introduce LEK from the ecotourism sector to inform Eastern Pacific green sea turtle conservation efforts in México. The results from this project will contribute to a better understanding and further insight of how this species utilizes this area.

Key words: Eastern Pacific green sea turtles, Chelonia mydas, Local Ecological Knowledge, Isla Espiritu Santo México, conservation, ecotourism, anthropogenic activity

Introduction

Past studies have investigated the ecology of Eastern Pacific green sea turtles, *Chelonia mydas* (locally known as green sea turtles) while integrating Local Ecological Knowledge (LEK) to create a baseline of green sea turtle abundance prior to their exploitation during the 1950s to the 1980s (Early-Capistrán et al., 2020). LEK from fishers in Baja California, México, was important and critical in creating a baseline since they held “place-based empirical knowledge... about their surrounding environments and biota”, not attainable through research (Early-Capistrán et al., 2020). Additionally, past studies have focused on feeding grounds in the Gulf of California, bays, and coastal lagoons such as Bahía de Los Angeles (Seminoff et al., 2002).

The Espíritu Santo archipelago off the coast of Baja California Sur (BCS), is considered a Marine Priority Region and is a protected area of The Gulf of California UNESCO World Heritage Site (Parque Nacional Zona Marina del Archipiélago de Espíritu Santo [Marine Zone National Park of the Espíritu Santo Archipelago, 2020]). Its waters are considered foraging grounds for highly migratory species such as the Eastern Pacific green sea turtle (Reséndiz et al., n.d.), which migrate between their nesting and feeding grounds (Green Turtle, 2020), but can spend most of their lifetime in these areas while developing sexual maturity and during non-breeding periods (Limpus et al., 1994). This behavior leads to observing both juveniles and adults of different ages and sizes within their foraging grounds. As a result, data obtained from continuous monitoring around this island can inform changes in sea turtle health, population dynamics, and conservation efforts (Álvarez-Varas et al., 2021).

Isla Espíritu Santo (IES) became a monitoring site in 2008 due to its “optimal conditions for development and feeding” of the species (Asociación Mexicana de Veterinarios de Tortugas [Mexican Association of Turtle Veterinarians], n.d.). As of this date, Grupo Tortuguero de las Californias (GTC) has been recording biometric data and tagging through catch and release during bimonthly monitoring efforts. Health Assessments in Sea Turtles from BCS (HASTBCS) joined GTC’s IES monitoring in January 2020. Since then, HASTBCS researchers began to assess the health conditions of Eastern Pacific green sea turtles inhabiting the waters of IES through the collection of biological samples.

Recent studies on sea turtles found near IES have been focused on hawksbill sea turtles, *Eretmochelys imbricata* (Ávila & Reséndiz, n.d.), but none have made a baseline assessment of the presence and abundance of Eastern Pacific green sea turtles in that area, nor have used LEK from the ecotourism industry to do this. Currently, Eastern Pacific green sea turtles are considered an endangered species due to their “decreasing population trend” (Seminoff, 2004). Additionally, they are susceptible to anthropogenic activities during their different life stages and may suffer disease (Reséndiz et al., 2016). Therefore, it is of importance to create a precursor for a baseline study of them in IES.

Background and Problem Statement

To conduct health assessments via physical examinations and blood analysis (Reséndiz et al., 2018) of sea turtles, researchers from HASTBCS have been conducting bimonthly monitoring at IES. Although there has been monitoring of sea turtles in BCS México since 1965, there is limited information and knowledge on how sea turtles utilize these foraging grounds. There is

currently no study that focuses on the distribution of Eastern Pacific green sea turtles inhabiting the waters of IES (E. Reséndiz, personal communication, November 19, 2021). To investigate Eastern Pacific green sea turtles' distribution, LEK from the ecotourism sector will be applied to conduct a spatial analysis of this site. LEK is necessary to better understand how the presence and abundance of these organisms surrounding these waters have changed over time due to ecotour guides familiarity and knowledge about the island.

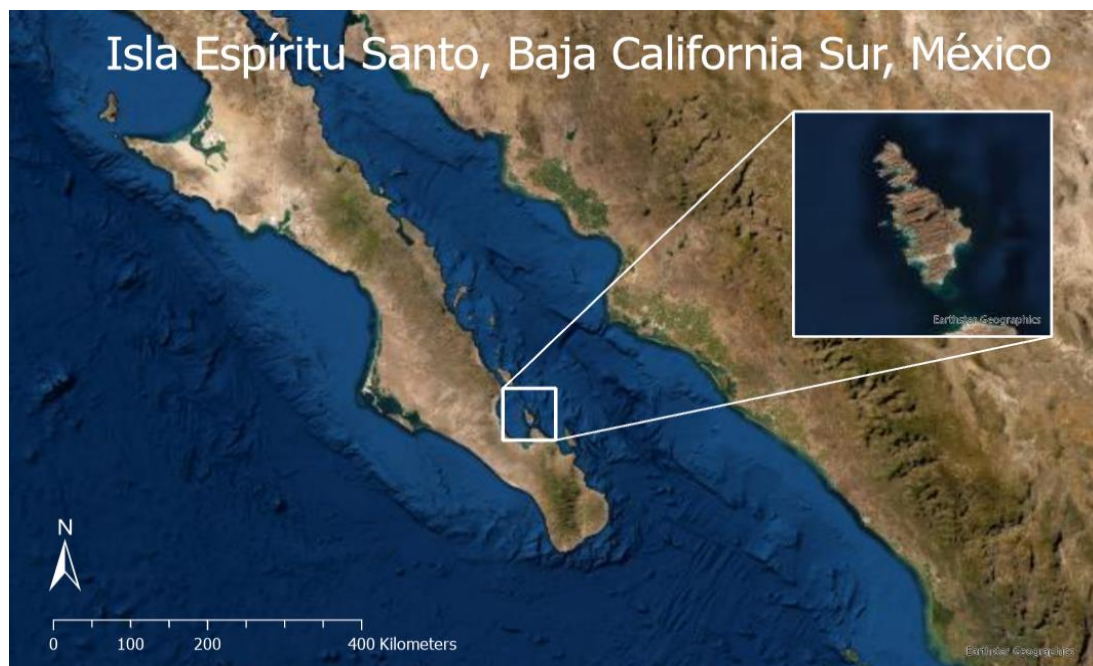
Therefore, four research questions will be explored:

1. Does the number of Eastern Pacific green sea turtle sightings differ between those from HASTBCS researchers and eco-tourism guides? (Measured by surveys administered on eco-tourism guides)
2. Are there potential untapped sites that could increase the monitoring efficiency of Eastern Pacific green sea turtles?
3. How does the amount of tourism activity compare with locations in which there are sick Eastern Pacific green sea turtles?
4. How has the presence and abundance of Eastern Pacific green sea turtles changed over the past 20 years at IES?

Study Site

La Paz, BCS, is a small coastal city whose population has increased by 25.3 percent since 2010 (de Filmaciones, n.d.). Ecotourism plays a major role in many countries in the global south attracting people that can pay for tours such as whale watching, scuba diving, and snorkeling (O. Aburto-Oropeza, personal communication, July 8, 2021). La Paz is one of the municipalities in México that attracts these tourists, and much of the ecotourism activities take place in IES (Olmos-Martínez et al., 2018). This capstone project will be focused on IES which is approximately 40 minutes away from the mainland and can only be reached by boat.

Figure 1: Map of study site: Isla Espiritu Santo



Results

A. Does the number of Eastern Pacific green sea turtle sightings differ between those from HASTBCS researchers and eco-tourism guides?

To determine the presence and abundance of green sea turtles, participants completed a research survey and were asked to mark locations in which sightings would occur while also providing an average of daily sightings per day. Markings that were made either fell in specific point locations or in regions that were digitized as polygons in ArcGIS Pro (Version 2.5) Appendix C, Figs. 10-14). A sum of their reported average daily Eastern Pacific green sea turtles' sightings was taken for each point location (Table 1 and Fig. 2).

Table 1: HASTBCS Monitoring and Sum of Eastern Pacific Green Sea Turtle Sightings

Site	HASTBCS: CPUE 2020, 2021, 2022	Ecotourism Guides: Sum of Average Sightings/Day	Total Number of Participants
Corralito	1	6	3
Ensenada de La Ballena	1	23	8
Ensenada de La Dispensa	9	22	6
Ensenada de La Partida	3	40	4
Ensenada El Cardonal	8	24	4
Ensenada El Gallo	12	196	18
Ensenada La Gallina	135	194	16
Punta Luponá	6	N/A	2
San Gabriel	63	61	18
Poza de La Gallina	4	0	0

Note: Data from both HASTBCS and survey participants was compiled. HASTBCS data represents the number of Eastern Pacific green sea turtles monitored during a two-year period. A sum of average sightings/day reported from participants corresponding to monitoring sites is shown. Total number of participants that reported sightings for each site is provided.

Based on both the data gathered from survey participants and HASTBCS, sites in which there are Eastern Pacific green sea turtles present and most abundant fall on the southwestern portion of IES (Figs. 2 and 3). Green sea turtle sites are broken into four categories in map Figures 2 and 3, with “most active site” displayed with a dark red circle indicating that there may be more than 60 green sea turtles. Secondary, tertiary, and quaternary active sites with less Eastern Pacific green sea turtle sightings are displayed as well.

In terms of the number of sightings and Eastern Pacific green sea turtles caught, Ensenada La Gallina and San Gabriel both are categorized as “most active site” in both maps. Corralito is another site that is grouped as “fourth active site” in both maps as well. However, there is a discrepancy in the rest of the sites. While Ensenada El Gallo is considered a “most active site” according to survey participants, it is ranked as a “second active site” in terms of Catch Per Unit Effort (CPUE). Additional monitoring sites that do not correspond in ranking are Ensenada El

Cardonal, Ensenada de La Partida, Ensenada de La Ballena, and Ensenada de La Dispensa. Survey participants reported Eastern Pacific green sea turtle sightings in locations that were not being monitored by researchers. Therefore, the number of sightings does differ between those from HASTBCS researchers and ecotourism guides in sites where monitoring efforts occurred.

Greater number of Eastern Pacific green sea turtle sightings than CPUE took place in the following sites: Ensenada El Cardonal, Ensenada de La Partida, Ensenada de La Ballena, Ensenada El Gallo, and Ensenada de La Dispensa. Indicating that these sites could potentially yield a greater CPUE than there is currently being produced.

Sum of Total Sightings Reported by Ecotourism Guides and Number of Green Sea CPUE

Figure 2: Total per Site Sightings by Ecotour Guides



Figure 3: Number of Green Sea Turtles Monitored

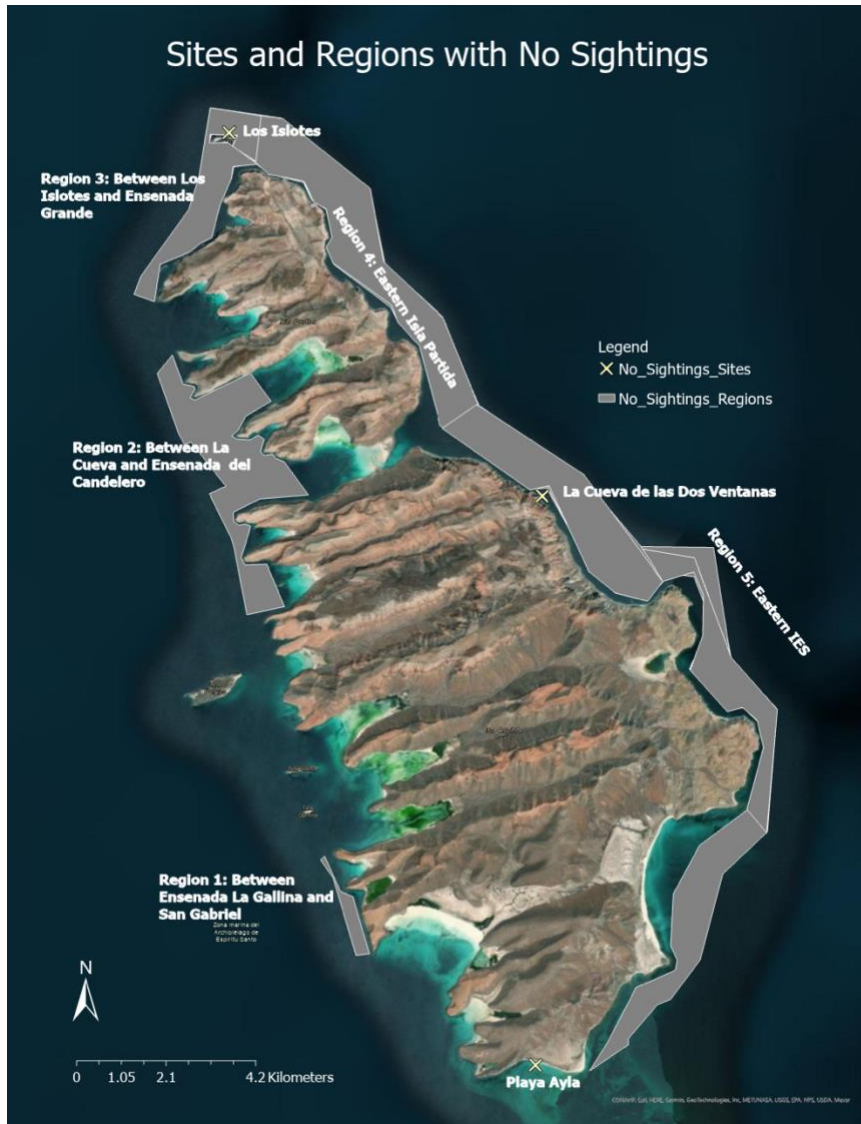


Note: The sum of total sightings and three years' worth of monitored Eastern Pacific Green Sea Turtles was taken. "Most active" sites are displayed in dark red. Locations in which sightings occurred, but no numeric value was provided is displayed with a gray circle and N/A (Figure 2).

Locations with No Sightings Reported

A map (Fig.4) was generated using ArcGIS Pro (Version 2.5) to establish points and polygons in which participants did not have Eastern Pacific green sea turtle sightings. Survey participants' answers varied in terms of providing point-locations, polygons, or a combination of the two.

Figure 4: Sites and Regions with No Sightings



Note: There are no interceptions between point locations and polygon regions where sightings did and did not occur.

Three point locations are labeled in Figure 4: Los Islotes, La Cueva de las Dos Ventanas, and Playa Ayla. Two participants selected La Cueva de las Dos ventanas, while 13 selected Los Islotes. There are five different gray polygon regions also displayed. Region 5 is composed of three parts: northern, central, and southern IES. Eight participants responded saying that they did not see Eastern Pacific green sea turtles in polygon regions around Los Islotes. Eight participants

included not seeing Eastern Pacific green sea turtles throughout the eastern regions of IES (Regions 4 and 5 in Fig. 4). These polygon regions consist of deeper waters further off the coast of IES.

A total of five participants selected the three distinct polygon regions located on western IES. Although these three regions are located near points in which sightings have occurred, there is no overlap between them. Five survey participants mentioned that Eastern Pacific green sea turtles could be sighted everywhere around the island, but less so on the eastern side. This information suggests that Eastern Pacific green sea turtle monitoring efforts are taking place within locations that coincide with most Eastern Pacific green sea turtle sightings and presence.

1. HASTBCS Monitoring at IES

HASTBCS performs bimonthly sea turtle monitoring at IES in pre-established areas that fit ideal conditions: shallow waters located in *ensenadas* or bays with sandy floors. From January 2020 to January 2022, HASTBCS frequented 10 sites that are determined to give the most CPUE while conducting bimonthly monitoring. Ensenada La Gallina yielded the greatest CPUE with 135 green sea turtles. Most of the monitored areas are concentrated in the southwestern portion of IES.

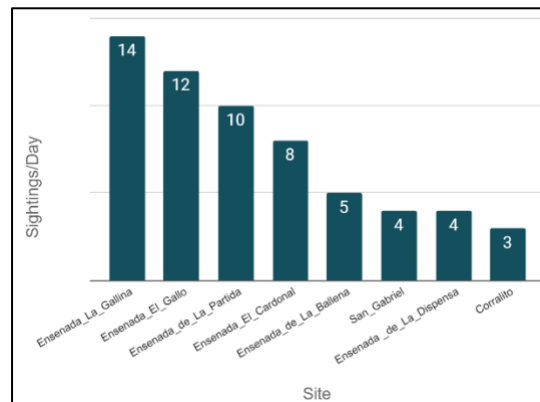
Points of Intersection: Sightings/Day vs CPUE

Average sightings were calculated from survey responses in which participants were able to provide a number. Some participants stated that they would see green sea turtles but were not able to give an average number of turtles sighted. Although Punta Lupona is also a point of intersection in which monitoring efforts and sightings occur, the two survey participants that saw sea turtles in this location were unable to provide an average number of sightings per day. Therefore, their answers are not included in the calculations in Figure 5.

Table 2: Participants that Reported Sightings

Site	Total Number of Participants
Ensenada La Gallina	16
Ensenada El Gallo	18
Ensenada de La Partida	4
Ensenada El Cardonal	4
Ensenada de La Ballena	8
San Gabriel	18
Ensenada de La Dispensa	6
Corralito	3

Figure 5: Average Sightings/Day by Site



Note: An average of Eastern Pacific green sea turtle sightings/day was taken from the total number of participants that reported them. Survey participants that did not provide a numeric value were not included in the calculation.

Eastern Pacific green sea turtles have been observed swimming, feeding, and resting within these *ensenadas* and bays located in the western part of IES by participants. Survey participant 2

described the region and sites from Ensenada de La Ballena to Ensenada La Gallina as *zonas de tránsito y descanso*, or “transit and rest areas” for Chelonians. Survey participants' testimonials coincide with this area being ranked as “most active sites” when reporting sightings.

B. Are there potential untapped sites that could increase the monitoring efficiency of Eastern Pacific green sea turtles?

Figure 6: Sightings Occurring Outside of Monitored Sites



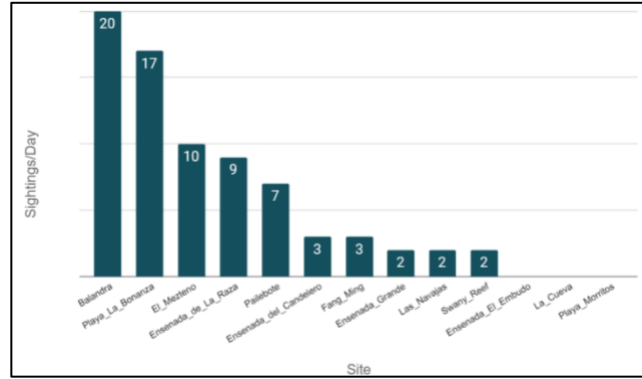
Note: Sites are labeled for point locations in which sightings occurred outside monitored areas.

In addition to sightings occurring within monitoring sites, there are 13 additional point locations that were mentioned by survey participants (Fig.6) that are not being monitored by HASTBCS and GTC. Individuals reported an average of 1-30 sightings per day, along with some N/A responses in these locations. After data was compiled, the average for each site was recorded (Fig.7) without including responses with N/A.

Figure 7: Participants Reporting Sighting Outside Monitored Sites

Site	Total Number of Participants
Balandra	2
Playa La Bonanza	2
El Mezteño	3
Ensenada de La Raza	7
Pailebote	1
Ensenada del Candelero	6
Fang Ming	4
Ensenada Grande	5
Las Navajas	3
Swany Reef	2
Ensenada El Embudo	1
La Cueva	1
Playa Morritos	1

Table 3: Average of Eastern Pacific Green Sea Turtle Sightings/Day



Note: An average of Eastern Pacific green sea turtle sightings/day outside monitored sites was taken from the total number of participants that reported them. Survey participants that did not provide a numeric value were not included in the calculation. Point locations where sightings occurred but no numeric value was provided are displayed without a bar.

The following places fit ideal conditions in becoming new monitoring sites due to their shallow waters providing more visibility for researchers, and allowing nets to be set on sandy substrate to prevent breaking of corals: Ensenada Grande, El Mezteño, Ensenada del Candelero, Ensenada de La Raza, Las Navajas, and Playa Morro. Ensenada de La Raza, which was mentioned seven times, and had an average of eight green sea turtle sightings per day, should be considered as a potential monitoring site of Eastern Pacific green sea turtles. It is located north of the current monitoring sites that yield the most CPUE and has mangroves within its waters suggesting that it may be used as a feeding ground.

C. What is the relationship between sites with sick Eastern Pacific green sea turtles and tourism activity?

Based on the answers from the sample size (n=27), 31 sites were frequented during ecotour trips to IES. 22 (70.9%) ecotour sites fall on the western portion of the island so that tourists can sightsee, visit beaches, snorkel, and dive.

Many of these locations are within a kilometer radius of HASTBCS monitored areas, where researchers take blood and skin samples of sea turtles to assess the health of the population. Special interest is taken when analyzing samples since green sea turtles have been documented to have fibropapillomatosis, which is a herpesvirus that may cause tumors (Reséndiz et al., 2016). Of the 10 monitored areas, 14 sick green sea turtles were captured in four sites: Ensenada El Gallo, Ensenada La Gallina, San Gabriel, and Punta Lupona. Nine sick individuals were found in La Gallina, three in San Gabriel, and one in El Gallo and Punta Lupona each.

Figure 8: Tour Boat Activity and Sick Green Sea Turtles



Figure 8: Tour boat activity around sick green sea turtles (represented by red triangles). The pink color buffer zone around the sick turtles captures the tour boats within a 0.5km distance. A 0.5km blue buffer zone was also applied to tour boats in proximity to sick green sea turtles.

Research done by Aguirre et al., (1995) has shown that individuals with fibropapillomatosis have high levels of chronic stress which may be due to environmental factors and is most prevalent in coastal habitats with anthropogenic activities (Herbst & Klein, 1995). Since these *ensenadas* are feeding grounds for Eastern Pacific green sea turtles, they may also act as points of high transmission.

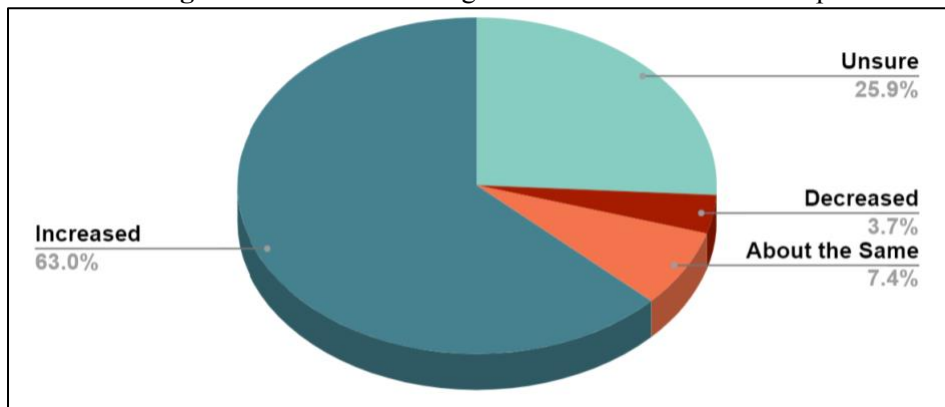
Fig. 8 displays sites in which Eastern Pacific green sea turtles were assessed are also places frequented by tour boats with Ensenada El Gallo, Ensenada La Gallina, and San Gabriel being

the ones displaying a higher amount of boat activity. Two data layers are shown: sick turtles and tourism boat activity. A 0.5km buffer was applied around sites in which sick Eastern Pacific green sea turtles were caught during monitoring IES and around ecotour boat activity. A color gradient and labeling were applied to demonstrate the amount of boat activity. Based on this, it may be suggested that points of high anthropogenic activity may be associated with the presence of sick Eastern Pacific green sea turtles. However, more data is needed to investigate this relationship.

D. How has the presence and abundance of Eastern Pacific green sea turtles changed over the past 20 years at IES?

Of the 27 participants, 17 (62.96%) answered that the presence and abundance of Eastern Pacific green sea turtles surrounding IES has increased over the past twenty year. The 17 participants consisted of those who have lived in La Paz between 4-59 years and have been working as ecotourism guides and/or captains between 7 months-35 years. 11 out of the 17 (64.7%) participants have lived for 20 years or more in La Paz, while working between 1-35 years in the ecotourism industry.

Figure 9: Perceived Change in IES Green Sea Turtle Population



Note: Eastern Pacific green sea turtle population over the past 20 years in IES based on anecdotal observations.

Three of the participants shared that they work as boat captains (Participants 8, 14, 22), but that they used to be fishermen and would fish in the surrounding water of IES. All three stated they have seen an increase in the number of Eastern Pacific green sea turtles during the past 20 years. Survey Participant 8 shared that since fishing regulations have been implemented at IES, there has been an advancement in the work that has been done towards sea turtle conservation efforts. In addition, he shared that green sea turtles were seen less twenty years ago, and that it was rare to see them when he was a young boy.

Based on anecdotal observations, IES' Eastern Pacific green sea turtle populations have increased making them visible to boats either on route to the island or while making tour stops. The lowest average number of green sea turtle sightings per day was one, while the highest reported was an average of 30 in specific point locations (Appendix C, Figs. 10-14).

Discussion

Most Eastern Pacific green sea turtle sightings are centered in a region from Ensenada de La Ballena to Ensenada El Gallo, in which Survey Participant 2 described as *El Paraíso de las Tortugas* [Turtle Paradise] due to the high concentration of these organisms that have been observed swimming in these waters. However, many of these organisms have also been sighted in San Gabriel, which is south of this area.

The environmental characteristics of IES' *ensenadas* and bays play a role in attracting Eastern Pacific green sea turtles. Two of these biotic characteristics are the seagrasses and mangroves that grow within these "active" Eastern Pacific green sea turtle regions (García & Lot, 1994). *Ruppia maritima*, a seagrass, has been found in San Gabriel (García & Lot, 1994) and may be acting as a primary food source (Lopez-Calderon et al., 2010) for Eastern Pacific green sea turtles in these foraging grounds. Additionally, a study done by Acosta-Velázquez et al., (2019) found that San Gabriel is considered as one of the sites of great importance regarding mangrove coverage. Mangrove nursery grounds' presence may influence the presence and abundance of Eastern Pacific green sea turtles as a result of providing "refuge and habitat" (García, 2014) in addition to food resources. Furthermore, Seminoff et al., (2002) shared that Chelonians have been consuming both marine vegetation and invertebrates, and may have a diet composed of animals and mangrove matter (Amorocho & Reina, 2007) due to their opportunistic feeding behaviors. Both food and shelter for green sea turtles may be found in these locations, making them sites that attract many Eastern Pacific green sea turtles. This may suggest why Eastern Pacific green sea turtles have not been sighted by many ecotourism guides and boat captains along the eastern portion of IES and deeper waters on the western side.

Reefs can also be found around IES, with San Gabriel having the highest number of reef structures. A study by Reyes-Bonilla (2003) found that San Gabriel has a higher reef coverage than that of Cabo Pulmo, which is known to be a site of high biodiversity and tourism (Programa de Manejo del Complejo Insular del Espíritu Santo, n.d.). Reef structures can act as feeding sites and refuge for Eastern Pacific green sea turtles and may account for recruitment of juveniles (Makowski et al., 2006). Other locations that also contain natural reef structures are Ensenada de La Ballena, Ensenada El Gallo, and Corralito (Sánchez-Caballero et al., 2021). All but Corralito fall within the region described as *El Paraíso de las Tortugas*. The presence of reef structures may provide further explanation for the number of sightings of these organisms in specific point locations.

Two points that are further off the coast but were also reported to have Eastern Pacific green sea turtle sightings are Fang Ming and Swany Reef. Swany Reef is composed of a natural reef, while Fang Ming is a wreck that serves as an artificial reef (Sánchez-Caballero et al., 2021). Four survey participants responded that they have seen Eastern Pacific green sea turtles on this wreck. Although these two locations are further off the coast and fall within deeper cooler waters, they may also serve as a point of refuge for Eastern Pacific green sea turtles that can be found near IES.

Additionally, abiotic characteristics of these locations that may also influence Eastern Pacific green sea turtle presence and abundance are wave action, depth, and temperature. Locations in which these organisms have been seen were described as calm and shallow waters that are

enclosed by IES' land mass (Proyecto ESTANCIAS SUBMARINAS: Colonización de vida marina y arrecifes rocosos en una escultura sumergida, n.d.). The islands' land mass may influence the waters' temperature and wave action it receives. Low wave action and warm waters can be ideal for green sea turtles in terms of their physiological demands.

Other contributing factors that may influence the presence of Eastern Pacific green sea turtles are anthropogenic activities such as snorkeling, swimming, fishing, anchoring of large vessels, boats, and harvesting activities (ACUERDO por el que se da a conocer el resumen del Programa de Manejo del Parque Nacional Zona Marina del Archipiélago de Espiritu Santo, n.d.). Although fishing activities have decreased since IES became a protected marine area, it has experienced increasing tourism pressure due to its growing demand and popularity (Olmos-Martínez et al., 2018). Some of the places that have experienced tourism pressure are within *El Paraíso de las Tortugas* region, which is composed of many small islands and *ensenadas* (Olmos-Martínez et al., 2018). 100% of the survey participants answered that they would either visit sites in this specific location or would pass through or by this region to reach locations further north. Of the 27 participants, 14 (51.85%) made stops at Ensenada El Gallo, 16 (59.26%) visited Ensenada La Gallina, and 23 (85.19%) answered that they would take tourists to San Gabriel. Despite the high amount of tourism activity in this region, many sightings of green sea turtles were reported by participants.

We would expect to have greater numbers of sightings and monitored Eastern Pacific green sea turtles in San Gabriel due to the presence of reef structures, mangroves, and seagrasses. However, activities permitted in this zone such as anchorage of small vessels, snorkeling, diving, and animal watching (ACUERDO por el que se da a conocer el resumen del Programa de Manejo del Parque Nacional Zona Marina del Archipiélago de Espiritu Santo, n.d.) may be decreasing the number of green sea turtles that visit this bay. Higher amounts of anthropogenic activities may imply that these organisms are being deterred by the presence of boat activity and tourists. While in other locations, where there is less anthropogenic activity in the *ensenadas*, there seems to be a higher number of them.

Moreover, survey data may provide insight into how tour activities may influence locations in which sick Eastern Pacific green sea turtles have been caught. It would be of interest to assess the health of green sea turtles in bays and *ensenadas* that have a high amount of tourism activities, such as Ensenada Grande and Ensenada del Candelero. Further research would need to be done to establish a relationship between sick green sea turtles and environmental factors.

In respect to potential untapped monitoring sites, Ensenada de La Raza may become a monitoring site which may also yield high CPUE due to the high number of daily sightings occurring in this location. Furthermore, Ensenada de La Ballena was a site that was only monitored once during the two years despite eight survey participants (29.6%) experiencing sightings in this location. Further monitoring efforts would need to be allocated to this site to see if there may be a greater yield of CPUE that may be accomplished.

Communication between IES ecotourism guides, boat captains, and researchers need to be established and maintained so that CPUE yields greater numbers. Based on anecdotal observation, new monitoring sites can be established and can aid conservation efforts. LEK is

needed to improve these efforts since frequent visitors to the island hold knowledge that cannot be attained through bimonthly monitoring.

The results of this capstone project were made to form a framework so that a baseline spatial assessment of the presence and abundance of Eastern Pacific green sea turtles can be made. This was completed based on the responses from 27 survey participants and data from HASTBCS researchers. More research is needed to provide further findings on how the presence, abundance, and health status of the Eastern Pacific green sea turtle population continues to change around IES.

Methodology

A. Research Survey

For three weeks, a total of 27 individuals (n=27) participated in a research survey: 26 participants fully participated in the survey while one provided a partially completed survey. The research survey consisted of 29 questions (Appendix B) and was administered after this study was exempt from the Institutional Review Board (Appendix A). The research survey was translated by a certified translator and was conducted in Spanish by the researcher. Survey answers were also audio recorded after obtaining consent and were transcribed by the researcher. Participants were given the option of writing their responses or having the researcher write on their behalf after having given oral consent. The researcher also provided the option of reading the survey questions for the participants.

Surveys were conducted in a private setting either in-person or via Zoom to accommodate the participants' preference. The target population was composed of ecotourism guides aged 18 years and above who take tourists to the island. The estimated population reported working in the ecotourism sector in La Paz during 2022 are 200 individuals (Survey Participant 6, personal communication, March 2022). Of the 200 individuals, only 13.5 percent participated in this study. The intention of the research survey was to gather information regarding sightings of Eastern Pacific green sea turtles and assess the presence and abundance of these organisms over the past 20 years in IES.

When providing information regarding Eastern Pacific green sea turtle sightings, most participants provided an average of sightings per day while others did not. They then ranked the locations according to the amount of green sea turtle sightings. Participants also provided anecdotal observations related to sightings. Average sightings per day with a non-numeric value were assigned a No Answer (N/A) and were not used to calculate total average sightings per site. A sum of their individual responses was made to determine Eastern Pacific green sea turtle active sites (Fig. 2).

The data collected for this capstone project is focused on anecdotal observations, which may provide some insight into ecotourism activities around IES, and an average number of daily sightings of Eastern Pacific green sea turtles. No statistical inferences can be drawn from this study, and findings cannot be extrapolated to other ecotourism guides and boat captains operating out of La Paz.

Survey Responses

A total of six categories of active sites (points) and four categories of active regions (polygons) were generated based on individuals' daily green sea turtle sightings (Appendix C, Figs 10-14). In some cases, participants answered that they would see the same amount of green sea turtles in different locations around IES. When this occurred, answers would be grouped in the same category of "active site" leading to more than one response per participant within the same category.

Using ArcGIS Pro (Version 2.5), a hatched color gradient was applied to polygon regions and a solid color gradient was applied to point locations to aid in visualization; with yellow being the lowest and red being the highest number of sightings per day (Appendix C, Figs 10-14).

Graduated symbology was also applied to point locations: large circles represent a high number of sightings, while small circles represent the lower number of sightings. Each point location displays the various sightings which were reported by survey participants. Locations in which participants had sighted Eastern Pacific green sea turtles but did not provide an average value were left as N/A and were assigned a gray color.

Active Regions and Sites

“Active sites” are categorized based on the presence of Eastern Pacific green sea turtle sightings, with “most active site” being the category with most green sea turtles sighted or assessed by HASTBCS.

Sum of Total Sightings per Day (Figure 2)

To standardize the “active sites” reported by participants, a sum of their total sightings per day was taken for each point location.

To see each survey participants’ response displayed on a map, refer to Appendix C, Figures 10-14. Additionally, the following active sites made were based on individuals’ survey response and ranking.

Most Active

Based on individuals’ survey responses, the “first active regions” (Appendix C, Fig.3) are concentrated between Ensenada de La Ballena and Ensenada La Gallina with a range of 1-50 sightings per day.

Survey participants chose three specific locations within this region: Ensenada de La Raza (four participants), Ensenada El Gallo (12 participants), and Ensenada La Gallina (12 participants) as “first active sites” of turtle sightings. Four sites located south were also mentioned: Fang Ming and Corralito each had two participants, three participants selected San Gabriel, and one person mentioned Ensenada de La Dispensa.

Second Active

Appendix C, Figure 4 displays “second active” locations in which green sea turtle sightings take place. These sightings occurred more spread out along the western coast of IES and off the coast of La Paz.

Thirteen individual locations were considered by guides as “second active sites” of green sea turtles. Some locations that were previously mentioned as “most active” were also considered in this category due to guides having different experiences and number of green sea turtle sightings per IES site/region. Responses ranged from 1-20 sightings per day in point locations. Whereas in polygon regions four participants answered having between 1- 17 sightings per day in Canal San Lorenzo, between Ensenada de La Ballena and Ensenada La Gallina, Bahía de La Paz, and between Playa Ayla and Playa Los Morritos. Sightings in Canal San Lorenzo and Bahía de La Paz occurred on the route from La Paz to IES.

One point location that is not part of IES but was mentioned as having multiple sea turtle sightings is Balandra beach which is about 8-9km from IES. This site was selected by two participants.

Third Active

In the “third active” category, only one region is mentioned, and 16 individual sites are selected (Appendix C, Fig. 5). Of these 16 sites, half of them do not have an average of green sea turtle sightings per day and therefore display a gray coloration. N/A begins to appear more within survey responses.

Despite these locations being considered third in terms of the amount of green sea turtle sightings, many turtles were still being observed in Ensenada de La Ballena and San Gabriel. Sightings within Ensenada El Gallo and La Gallina are no longer mentioned.

Canal San Lorenzo was chosen as a third active region with an average of two sightings per day which occurs mostly when the tour boats are traveling from the Muelle Fiscal in La Paz to IES.

Fourth Active

Canal San Lorenzo was marked as a fourth active region by one guide (Appendix C, Fig.6). The polygon has a gray color due to the guide not being able to provide a specific number of sightings per day. In addition, another participant also drew a polygon further north, between IES and Isla Partida, where they sighted an average of one green sea turtle per day.

Fifth and Sixth Active

Due to the low number of responses assigned to this category, “fifth and sixth active sites” were placed in the same map (Appendix C, Fig.7).

B. HASTBCS Data

Bimonthly IES sea turtle monitoring data during the years 2020, 2021, and 2022 were provided by HASTBCS researchers working under permits: Oficio No. SGPA/DGVS/01431/20; Oficio No. SGPA/DGVS/0600/21; Oficio No. SGPA/DGVS/03552/22. This data consisted of information regarding 242 Eastern Pacific green sea turtles’ morphometric data, health status, dates and sites in which capture took place. The data was analyzed using ArcGIS programming software, Excel, and RStudio.

C. ArcGIS Pro 2.9 and ArcGIS Story Map

Data compiled from survey results and HASTBCS data was uploaded to ArcGIS Pro Desktop software to conduct a spatial analysis of Eastern Pacific green sea turtles. Hybrid Reference Layer and World Imagery Layer were used as base maps (Version 2.5 of Esri Inc.). Coordinate points were taken using GPS Waypoints phone application during bimonthly monitoring efforts at IES.

A Story Map was created incorporating many map products, including an interactive tour map using the ESRI web application for Story maps. Data layers compiled from bimonthly IES monitoring and survey responses can be viewed using maps generated using ArcGIS Pro. Link to the Story Map can be accessed: <https://arcg.is/0W0KKC>.

a. HASTBCS Data

Coordinates were taken in different locations where 100-meter gill nets were set during monitoring efforts. In some locations, there were two coordinates that correspond to different locations in which nets have been set. Google Maps was used to obtain coordinates to generate polygons of monitored areas. RStudio facilitated the analysis through data frame usage.

b. Survey Data

Using the monitored areas' polygons, the centroid points of these sites were calculated and assigned to ecotourism activity using ArcGIS. Additional coordinates were obtained after having gone on a tour to IES and by using coordinate points that coincided with where participants made marking on the survey map.

Polygons and points of “active” turtle regions were provided by survey participants and were included in map imagery. Geoprocessing and data management tools were used to conduct an analysis of data.

Table 4: Geoprocessing Tools

Geoprocessing Tool	Purpose
Calculate Geometry	Generated centroid points for tour sites.
Buffer	Created a 0.5 kilometer buffer layer surrounding sick green sea turtles and ecotourism boats.
Spatial Join	Provided tour sites according to the number of sick turtles surrounding them.
Intersect	Generates a new feature layer displaying intersecting sites for sea turtle sightings and monitoring efforts. This was applied to different levels of “active sites”.

Table 5: Data Management Tools

Data Management Tools	Purpose
Select Layer by Location	Used to provide a number of HASTBCS monitored turtles by location. Selected data points not intersecting with regions consisting of sea turtle sightings. These data sets were then exported to create a new feature class.
Feature Class to Feature Class	Converted export feature class generated by “Select Layer by Location” into a feature class displayed on map.

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Appendix A

Kuali UCSD Institutional Review Board

#802779 - Baseline assessment of presence and abundance of Eastern Pacific green sea turtles, *Chelonia mydas*, surrounding Isla Espiritu Santo, Baja California Sur, México

Protocol Information

Review Type: Exempt

Status: Exempt

Approval Date: Mar 15, 2022

Continuing Review Date --

Expiration Date --

Initial Approval Date: Mar 15, 2022

Initial Review Type: Exempt

Feedback

Approval Comment

The above referenced project is EXEMPT from Institutional Review Board requirements under category 45 CFR 46.104(d)(2): Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) as the following criteria is met: (i) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects.

This determination does not expire. Submit amendments to our office only for those changes that could affect exempt status.

The PI should ensure that the research activities are conducted in compliance with applicable UCSD policies and ethical standards as well as local, state, and federal regulations.

Exemption from IRB review does not exempt the PI and study team from their responsibilities under UC San Diego PPM 100-5 (Responsibilities section, item d) or from any other approvals or permissions required by applicable laws or university policies.

The protocol listed the following funding (or potential funding) information: The Master of Advanced Studies Program in Marine Biodiversity and Conservation

Appendix B

Research Survey: English Version

Research Survey

Participant ID: _____

Baseline assessment of presence and abundance of Eastern Pacific green sea turtles, *Chelonia mydas*, surrounding Isla Espíritu Santo, Baja California Sur, México

Thank you for your participation in this research!

Your responses will be essential in determining how green sea turtles utilize the waters surrounding Isla Espíritu Santo and will inform conservation efforts. Your responses will be kept confidential and will not be used for any other reasons than this study.

Questions:

1. How has ecotourism in La Paz changed over the past 20 years?
2. How has your work impacted your awareness of the environment?
3. On average, how many hours do you work in ecotourism per day?
4. What factors influenced your decision to work in ecotourism?
5. Is working in the ecotourism industry your primary source of income?
 - a. Yes
 - b. No

6. Which of the following tours are you a part of? Check all that apply.

- | | | |
|---|--|---|
| <input type="checkbox"/> Whale watching | <input type="checkbox"/> Goat watching | <input type="checkbox"/> Manta ray watching |
| <input type="checkbox"/> Whale shark watching | <input type="checkbox"/> Marine birds watching | <input type="checkbox"/> Sea lion watching |
| <input type="checkbox"/> Turtle watching | <input type="checkbox"/> Diving | <input type="checkbox"/> Sport fishing |
| <input type="checkbox"/> Other: _____ | | |

7. How many years have you been working in ecotourism?

8. How satisfied are you with your profession?

Very unsatisfied Unsatisfied Neutral Satisfied Very satisfied

9. On average, how many monthly tourism trips do you participate around Isla Espiritu Santo?

a. _____ times

b. I do not take tourists to this area (go to Q16)

10. What month(s) do you make the most tours around Isla Espiritu Santo?

January

May

September

February

June

October

March

July

November

April

August

December

11. Do these months correspond with specific tours? Mark all that apply.

Whale watching

Goat watching

Manta ray watching

Whale shark watching

Marine birds watching

Sea lion watching

Turtle watching

Diving

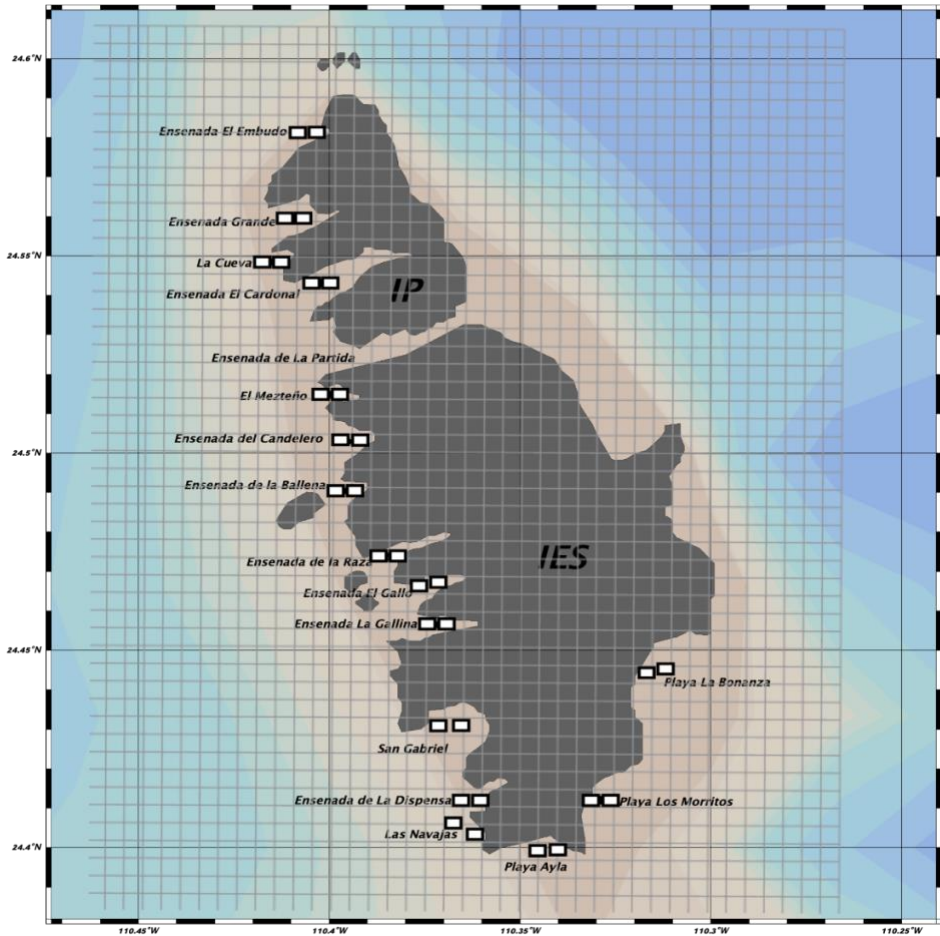
Sport fishing

Other: _____

NA

I am not sure

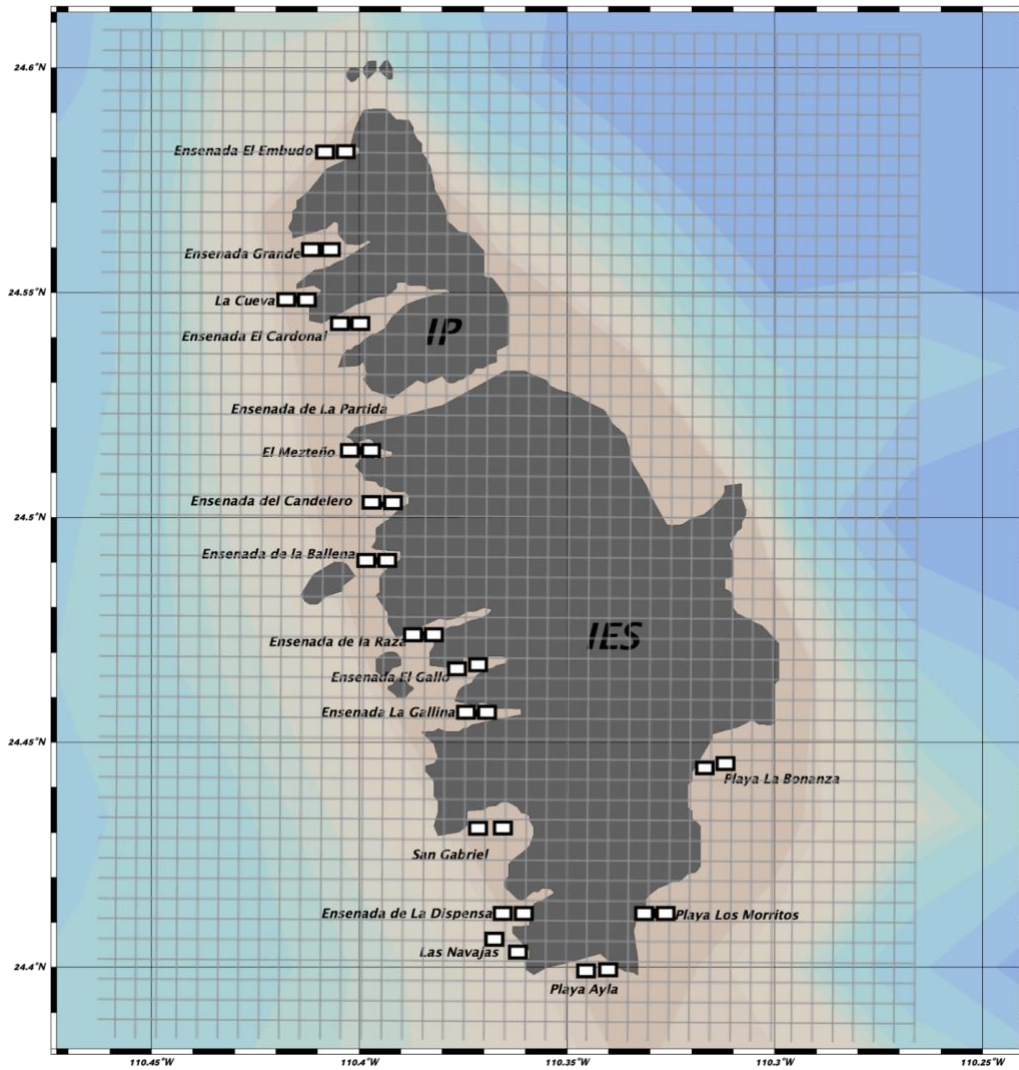
12. Which places do you visit during the ecotours at Isla Espíritu Santo? Mark the square(s) on the map with a red color to indicate this.



13. How likely are you to encounter a green sea turtle during the tours?
 Never Not likely Somewhat likely Very likely

14. In a typical month how many times would you encounter a green sea turtle? (skip if answered "Never" in Q13)

15. Mark the squares next to the site(s) you encounter green sea turtles with a green color.



16. For the most active site: _____,

- i. How many green sea turtles do you see? _____
- ii. What month(s) do you see them?: Mark all that apply

- | | | |
|-----------------------------------|---------------------------------|------------------------------------|
| <input type="checkbox"/> January | <input type="checkbox"/> May | <input type="checkbox"/> September |
| <input type="checkbox"/> February | <input type="checkbox"/> June | <input type="checkbox"/> October |
| <input type="checkbox"/> March | <input type="checkbox"/> July | <input type="checkbox"/> November |
| <input type="checkbox"/> April | <input type="checkbox"/> August | <input type="checkbox"/> December |

17. Second most active site: _____,

- i. How many green sea turtles do you see? _____
ii. What month(s) do you see them?: Mark all that apply

- | | | |
|-----------------------------------|---------------------------------|------------------------------------|
| <input type="checkbox"/> January | <input type="checkbox"/> May | <input type="checkbox"/> September |
| <input type="checkbox"/> February | <input type="checkbox"/> June | <input type="checkbox"/> October |
| <input type="checkbox"/> March | <input type="checkbox"/> July | <input type="checkbox"/> November |
| <input type="checkbox"/> April | <input type="checkbox"/> August | <input type="checkbox"/> December |

18. Third most active site: _____,

- i. How many green sea turtles do you see? _____
ii. What month(s) do you see them?: Mark all that apply

- | | | |
|-----------------------------------|---------------------------------|------------------------------------|
| <input type="checkbox"/> January | <input type="checkbox"/> May | <input type="checkbox"/> September |
| <input type="checkbox"/> February | <input type="checkbox"/> June | <input type="checkbox"/> October |
| <input type="checkbox"/> March | <input type="checkbox"/> July | <input type="checkbox"/> November |
| <input type="checkbox"/> April | <input type="checkbox"/> August | <input type="checkbox"/> December |

19. Fourth most active site: _____,

- i. How many green sea turtles do you see? _____
ii. What month(s) do you see them?: Mark all that apply

- | | | |
|-----------------------------------|---------------------------------|------------------------------------|
| <input type="checkbox"/> January | <input type="checkbox"/> May | <input type="checkbox"/> September |
| <input type="checkbox"/> February | <input type="checkbox"/> June | <input type="checkbox"/> October |
| <input type="checkbox"/> March | <input type="checkbox"/> July | <input type="checkbox"/> November |
| <input type="checkbox"/> April | <input type="checkbox"/> August | <input type="checkbox"/> December |

20. Fifth most active site: _____,

- i. How many green sea turtles do you see? _____
ii. What month(s) do you see them?: Mark all that apply

- | | | |
|-----------------------------------|---------------------------------|------------------------------------|
| <input type="checkbox"/> January | <input type="checkbox"/> May | <input type="checkbox"/> September |
| <input type="checkbox"/> February | <input type="checkbox"/> June | <input type="checkbox"/> October |
| <input type="checkbox"/> March | <input type="checkbox"/> July | <input type="checkbox"/> November |
| <input type="checkbox"/> April | <input type="checkbox"/> August | <input type="checkbox"/> December |

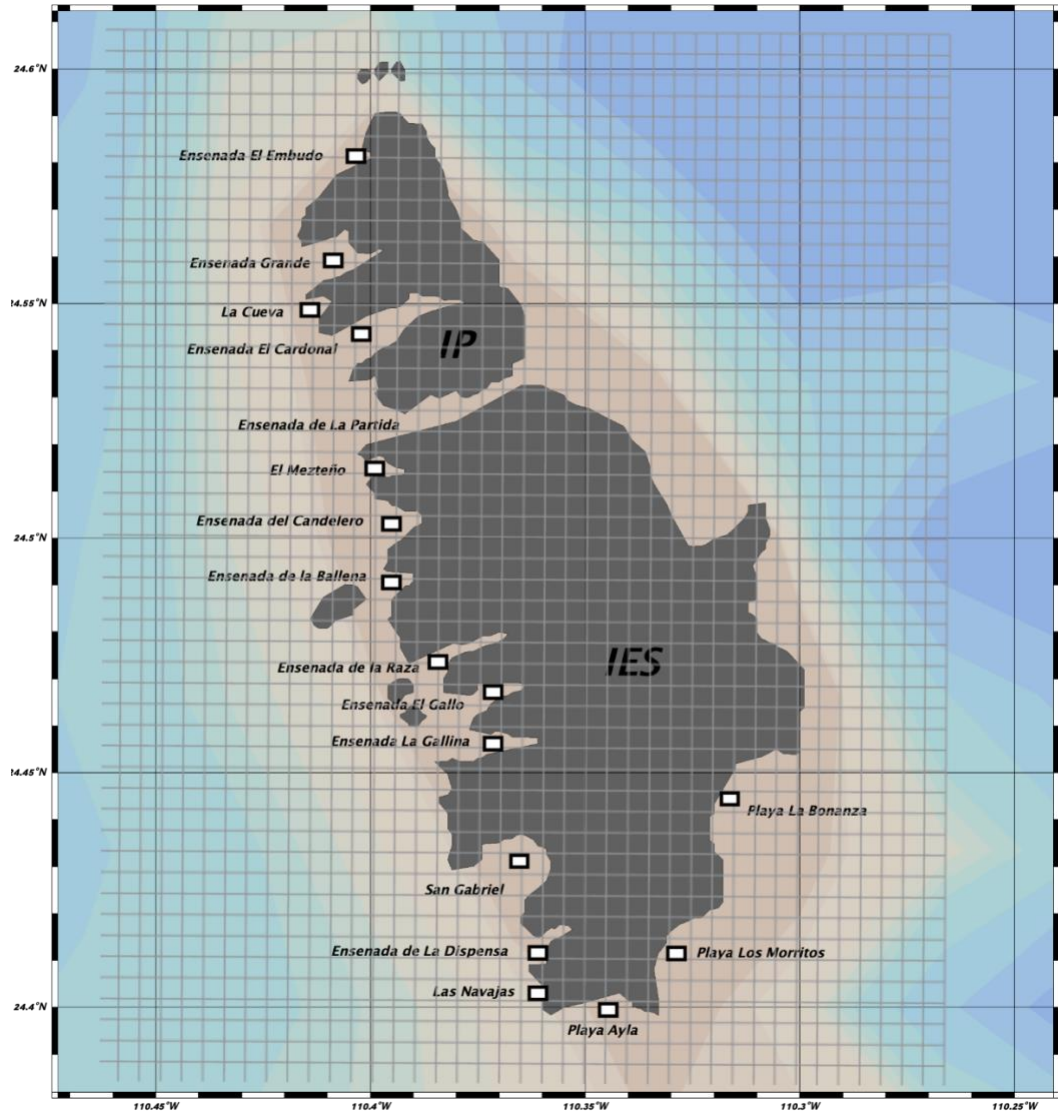
21. What is the average number of green sea turtles you see per month?

- | | | |
|---------------|-------------|----------------|
| ____ January | ____ May | ____ September |
| ____ February | ____ June | ____ October |
| ____ March | ____ July | ____ November |
| ____ April | ____ August | ____ December |

22. During which tour(s) do you see the most green sea turtles? Mark all that apply

- | | | |
|---|--|---|
| <input type="checkbox"/> Whale watching | <input type="checkbox"/> Goat watching | <input type="checkbox"/> Manta ray watching |
| <input type="checkbox"/> Whale shark watching | <input type="checkbox"/> Marine birds watching | <input type="checkbox"/> Sea lion watching |
| <input type="checkbox"/> Turtle watching | <input type="checkbox"/> Diving | <input type="checkbox"/> Sport fishing |
| <input type="checkbox"/> Other: _____ | | |

23. Are there sites where you never see green sea turtles? If yes, please identify on map.



- 24.** For the past 20 years, has the green sea turtle population surrounding Isla Espiritu Santo been staying the same, getting smaller or larger?
- Smaller
 - Staying the same
 - Larger
 - I am not sure
- 25.** Is there anything else you would like to share about green sea turtles surrounding Isla Espiritu Santo?
- 26.** What do you do for work? Select all that apply.
- Teacher
 - Fisher
 - Agriculture
 - Sales employee
 - Cook
 - Boat driver
 - Eco-tourist guide
 - Other: _____
- 27.** In which municipality do you live?
- Comondú
 - Mulegé
 - La Paz
 - Loreto
 - Los Cabos
- 28.** For how long have you been living in this municipality ?
- 29.** What year were you born?

Thank you for your time! Your participation is greatly appreciated.

Research Survey: Spanish Version

Encuesta de investigación

Identificación del participante: _____

Evaluación de base (Baseline) de presencia y abundancia de tortugas marinas verdes del Pacífico Oriental, *Chelonia mydas*, en los alrededores de la Isla Espíritu Santo, Baja California Sur, México

¡Gracias por su participación en esta investigación!

Sus respuestas serán esenciales para determinar cómo las tortugas marinas verdes utilizan las aguas que rodean la Isla Espíritu Santo y servirán de base para los esfuerzos de conservación de las mismas. Sus respuestas se mantendrán confidenciales y no se utilizarán para ningún otro motivo que no sea este estudio.

Preguntas:

1. ¿Cómo ha cambiado el ecoturismo en La Paz en los últimos 20 años?
2. ¿Cómo ha impactado su trabajo en ecoturismo en tu conciencia sobre el medio ambiente?
3. En promedio, ¿cuántas horas al día trabaja en ecoturismo?
4. ¿Qué factores influyeron en su decisión de trabajar en ecoturismo?
5. ¿Trabajar en la industria del ecoturismo es su principal fuente de ingresos?
 - a. Si
 - b. No
6. ¿De cuál de los siguientes tours es usted parte? Marque todo lo que corresponda.

<input type="checkbox"/> Observación de ballenas	<input type="checkbox"/> Observación de cabras	<input type="checkbox"/> Obs. de mantarrayas
<input type="checkbox"/> Avistamiento de tiburones ballena	<input type="checkbox"/> Avistamiento de aves marinas	<input type="checkbox"/> Avistamiento de tortugas
<input type="checkbox"/> Avistamiento de leones marinos	<input type="checkbox"/> Buceo	<input type="checkbox"/> Pesca deportiva
<input type="checkbox"/> Otro: _____	<input type="checkbox"/> NA	<input type="checkbox"/> No estoy seguro
7. ¿Cuántos años lleva trabajando en el ecoturismo? _____.
8. ¿Qué tan satisfecho está con su profesión?

Muy insatisfecho	Insatisfecho	Neutral Satisfecho	Muy satisfecho
------------------	--------------	--------------------	----------------

9. En promedio, ¿cuántos viajes de turismo mensuales realiza alrededor de la Isla Espiritu Santo?

a. _____ veces

b. No llevo turistas a esta zona (pase a la pregunta 16)

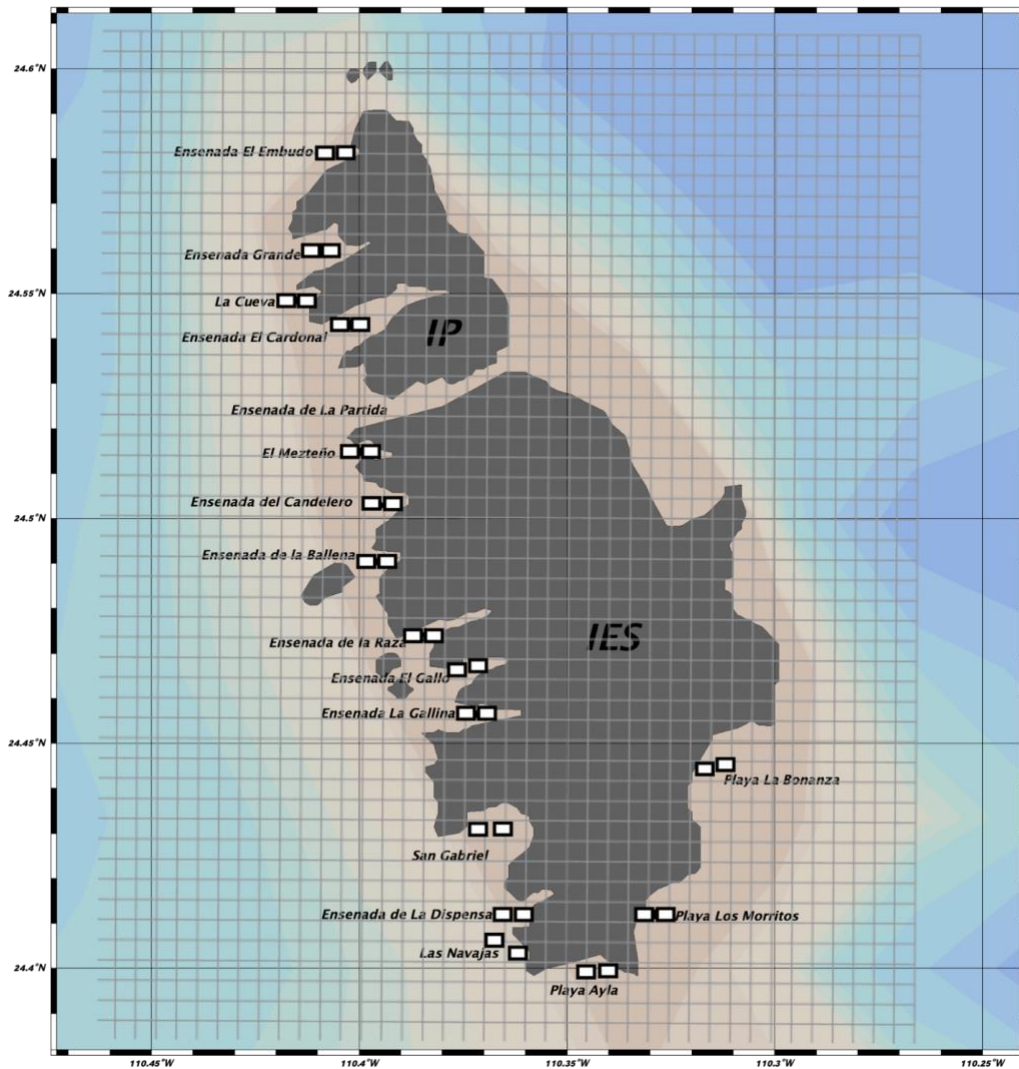
10. ¿En qué mes o meses usted realiza la mayor cantidad de recorridos por la Isla Espiritu Santo?

- | | | |
|----------------------------------|---------------------------------|-------------------------------------|
| <input type="checkbox"/> enero | <input type="checkbox"/> mayo | <input type="checkbox"/> septiembre |
| <input type="checkbox"/> febrero | <input type="checkbox"/> junio | <input type="checkbox"/> octubre |
| <input type="checkbox"/> marzo | <input type="checkbox"/> julio | <input type="checkbox"/> noviembre |
| <input type="checkbox"/> abril | <input type="checkbox"/> agosto | <input type="checkbox"/> diciembre |

11. ¿Estos meses corresponden con estos recorridos específicos? Marque todo lo que corresponda.

- | | | |
|--|---|---|
| <input type="checkbox"/> Observación de ballenas | <input type="checkbox"/> Observación de cabras | <input type="checkbox"/> Obs. de mantarrayas |
| <input type="checkbox"/> Avistamiento de tiburones ballena | <input type="checkbox"/> Avistamiento de aves marinas | <input type="checkbox"/> Avistamiento de tortugas |
| <input type="checkbox"/> Avistamiento de leones marinos | <input type="checkbox"/> Buceo | <input type="checkbox"/> Pesca deportiva |
| <input type="checkbox"/> Otro: _____ | <input type="checkbox"/> NA | <input type="checkbox"/> No estoy seguro |

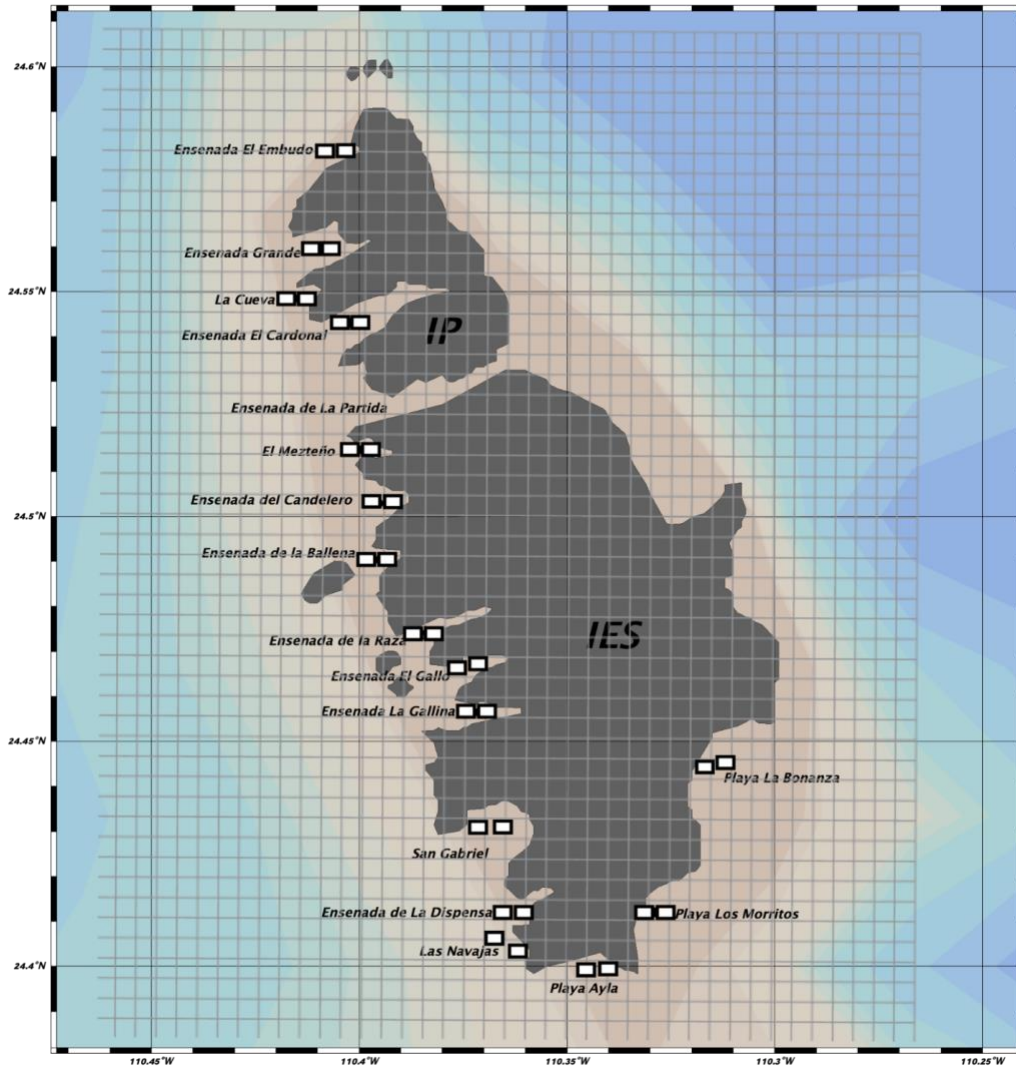
12. ¿Qué lugares visita durante los eco tours en Isla Espíritu Santo? Marque los cuadrados en el mapa con un color rojo para indicar esto.



13. ¿Qué tan probable es que usted encuentre una tortuga marina verde durante los recorridos? Nunca Poco probable Algo probable Muy probable

14. En un mes típico, ¿cuántas veces se encontraría con una tortuga marina verde? (omita si respondió "Nunca" en la pregunta 13)_____.

15. Marque los cuadrados junto a los sitios donde encuentre tortugas marinas verdes con un color verde.



16. Para el sitio más activo: _____,

i. ¿Cuántas tortugas marinas verdes usted ve? _____

ii. ¿En qué mes o meses las ve? Marque todo lo que corresponda

- | | | |
|----------------------------------|---------------------------------|-------------------------------------|
| <input type="checkbox"/> enero | <input type="checkbox"/> mayo | <input type="checkbox"/> septiembre |
| <input type="checkbox"/> febrero | <input type="checkbox"/> junio | <input type="checkbox"/> octubre |
| <input type="checkbox"/> marzo | <input type="checkbox"/> julio | <input type="checkbox"/> noviembre |
| <input type="checkbox"/> abril | <input type="checkbox"/> agosto | <input type="checkbox"/> diciembre |

17. Para el segundo sitio más activo: _____,
i. ¿Cuántas tortugas marinas verdes usted ve? _____
ii. ¿En qué mes o meses las ve? Marque todo lo que corresponda
- | | | |
|----------------------------------|---------------------------------|-------------------------------------|
| <input type="checkbox"/> enero | <input type="checkbox"/> mayo | <input type="checkbox"/> septiembre |
| <input type="checkbox"/> febrero | <input type="checkbox"/> junio | <input type="checkbox"/> octubre |
| <input type="checkbox"/> marzo | <input type="checkbox"/> julio | <input type="checkbox"/> noviembre |
| <input type="checkbox"/> abril | <input type="checkbox"/> agosto | <input type="checkbox"/> diciembre |

18. Para el tercer sitio más activo: _____,
i. ¿Cuántas tortugas marinas verdes usted ve? _____
ii. ¿En qué mes o meses las ve? Marque todo lo que corresponda
- | | | |
|----------------------------------|---------------------------------|-------------------------------------|
| <input type="checkbox"/> enero | <input type="checkbox"/> mayo | <input type="checkbox"/> septiembre |
| <input type="checkbox"/> febrero | <input type="checkbox"/> junio | <input type="checkbox"/> octubre |
| <input type="checkbox"/> marzo | <input type="checkbox"/> julio | <input type="checkbox"/> noviembre |
| <input type="checkbox"/> abril | <input type="checkbox"/> agosto | <input type="checkbox"/> diciembre |

19. Para el cuarto sitio más activo: _____,
i. ¿Cuántas tortugas marinas verdes usted ve? _____
ii. ¿En qué mes o meses las ve? Marque todo lo que corresponda
- | | | |
|----------------------------------|---------------------------------|-------------------------------------|
| <input type="checkbox"/> enero | <input type="checkbox"/> mayo | <input type="checkbox"/> septiembre |
| <input type="checkbox"/> febrero | <input type="checkbox"/> junio | <input type="checkbox"/> octubre |
| <input type="checkbox"/> marzo | <input type="checkbox"/> julio | <input type="checkbox"/> noviembre |
| <input type="checkbox"/> abril | <input type="checkbox"/> agosto | <input type="checkbox"/> diciembre |

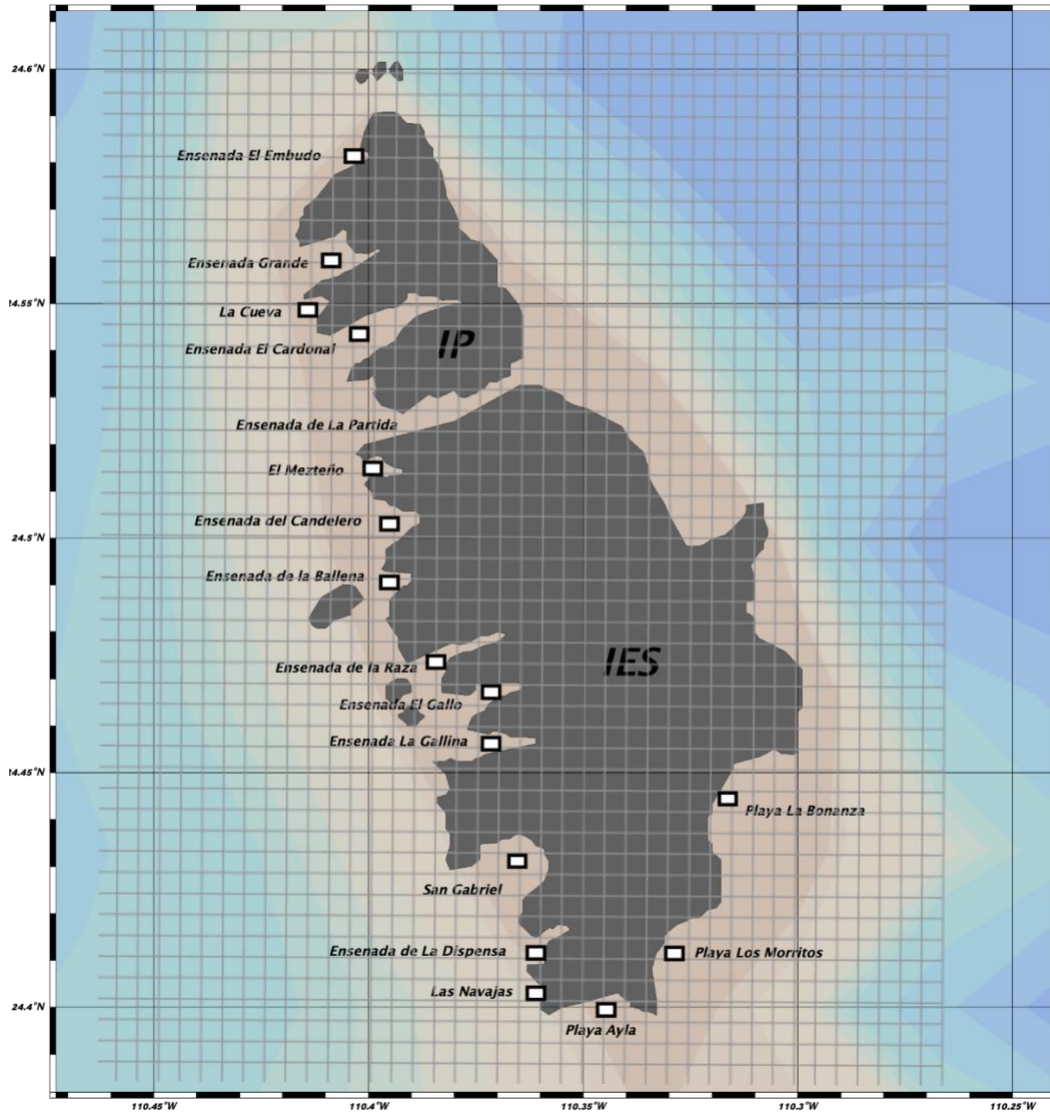
20. Para el quinto sitio más activo: _____,
i. ¿Cuántas tortugas marinas verdes usted ve? _____
ii. ¿En qué mes o meses las ve? Marque todo lo que corresponda
- | | | |
|----------------------------------|---------------------------------|-------------------------------------|
| <input type="checkbox"/> enero | <input type="checkbox"/> mayo | <input type="checkbox"/> septiembre |
| <input type="checkbox"/> febrero | <input type="checkbox"/> junio | <input type="checkbox"/> octubre |
| <input type="checkbox"/> marzo | <input type="checkbox"/> julio | <input type="checkbox"/> noviembre |
| <input type="checkbox"/> abril | <input type="checkbox"/> agosto | <input type="checkbox"/> diciembre |

21. ¿Cuál es el número promedio de tortugas marinas verdes que ve usted por mes?
- | | | |
|---------------|--------------|------------------|
| _____ enero | _____ mayo | _____ septiembre |
| _____ febrero | _____ junio | _____ octubre |
| _____ marzo | _____ julio | _____ noviembre |
| _____ abril | _____ agosto | _____ diciembre |

22. ¿Durante qué recorrido(s) ve la mayor cantidad de tortugas marinas verdes? Marque todo lo que corresponda

- | | | |
|--|---|---|
| <input type="checkbox"/> Observación de ballenas | <input type="checkbox"/> Observación de cabras | <input type="checkbox"/> Obs. de mantarrayas |
| <input type="checkbox"/> Avistamiento de tiburones ballena | <input type="checkbox"/> Avistamiento de aves marinas | <input type="checkbox"/> Avistamiento de tortugas |
| <input type="checkbox"/> Avistamiento de leones marinos | <input type="checkbox"/> Buceo | <input type="checkbox"/> Pesca deportiva |
| <input type="checkbox"/> Otro: _____ | | |

23. ¿Hay sitios donde usted nunca ha visto tortugas marinas verdes? En caso afirmativo, identifique en el mapa.



24. Durante los últimos 20 años, ¿La población de tortugas marinas verdes que rodea a la Isla Espíritu Santo se ha mantenido igual, o se ha hecho más pequeña o más grande?

- a. Menor
- b. Permanece igual
- c. Ha crecido/más grande
- d. no estoy seguro

25. ¿Hay algo más que le gustaría compartir sobre las tortugas marinas verdes que rodean la Isla Espíritu Santo?

26. ¿En qué trabaja usted? Seleccione todo lo que corresponda:

- a. Soy profesor
- b. Soy pescador
- c. Me dedico a la agricultura
- d. Soy empleado de ventas
- e. Soy cocinero
- f. Soy conductor de barco
- g. Soy guía eco turístico
- h. Otro: _____

27. ¿En qué municipio vive usted?

- a. Comondú
- b. Mulegé
- c. La Paz
- d. Loreto
- e. Los Cabos

28. ¿Hace cuánto tiempo vive usted en este municipio? _____.

29. ¿En qué año nació usted? _____.

¡Gracias por su tiempo! Su participación es altamente apreciada.

Appendix C

Maps Based on Individuals Responses

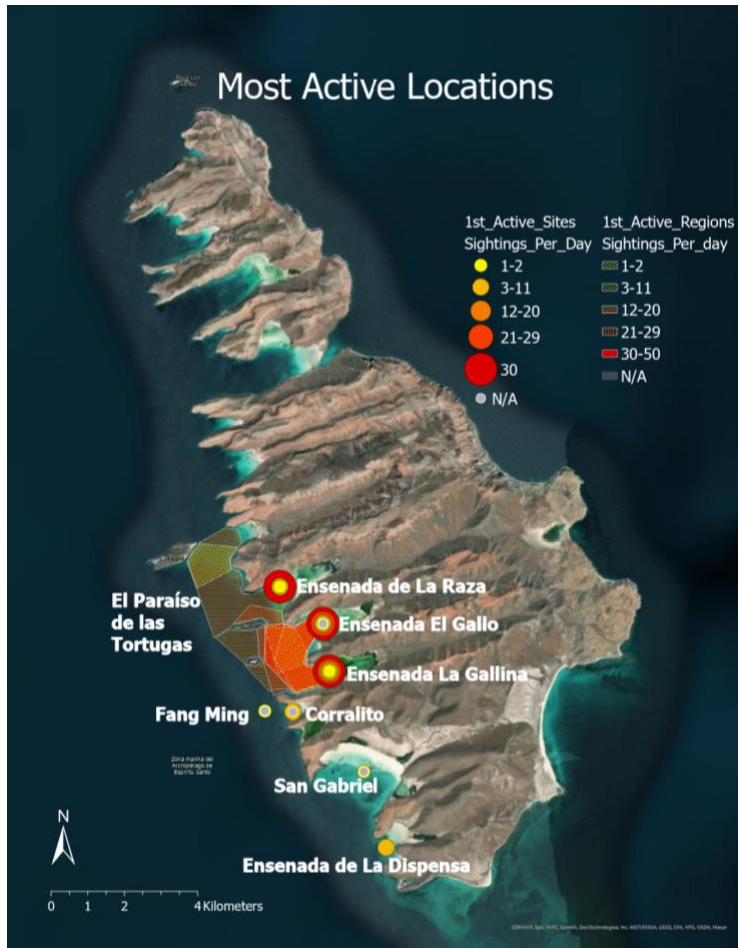


Figure 10: First Active Regions and Sites of green sea turtle sightings. Specific point locations are labeled. The active regions correspond to *El Paraíso de las Tortugas*.

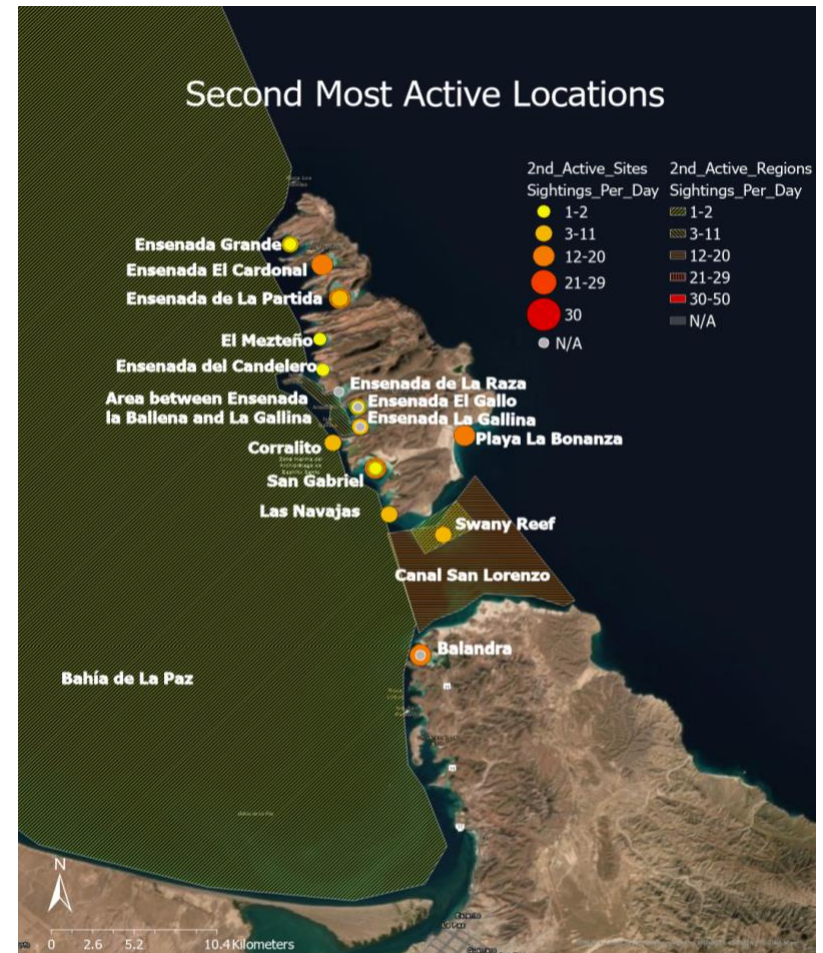


Figure 11: Second Active Regions and Sites of green sea turtle sightings. There is an average of 1-20 and 1-17 sightings per day for point locations and polygon regions, respectively.

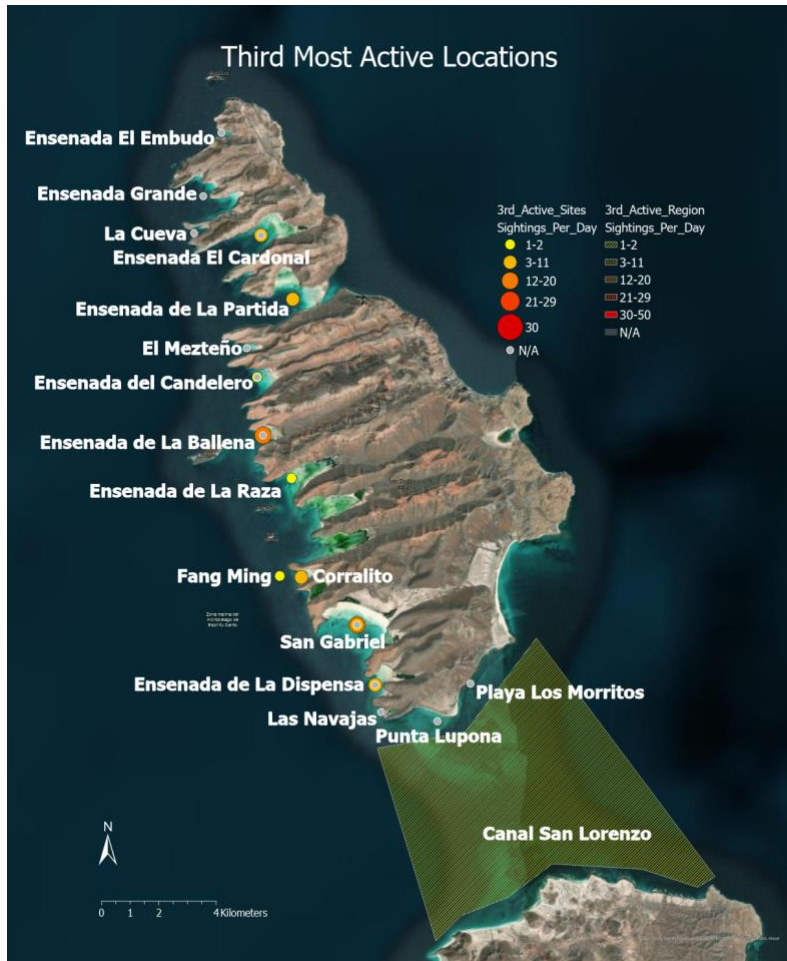


Figure 12: Third Active Regions and Sites. Consist of an average of 1-15 and 1-2 sightings per day for point and polygon regions, respectively.

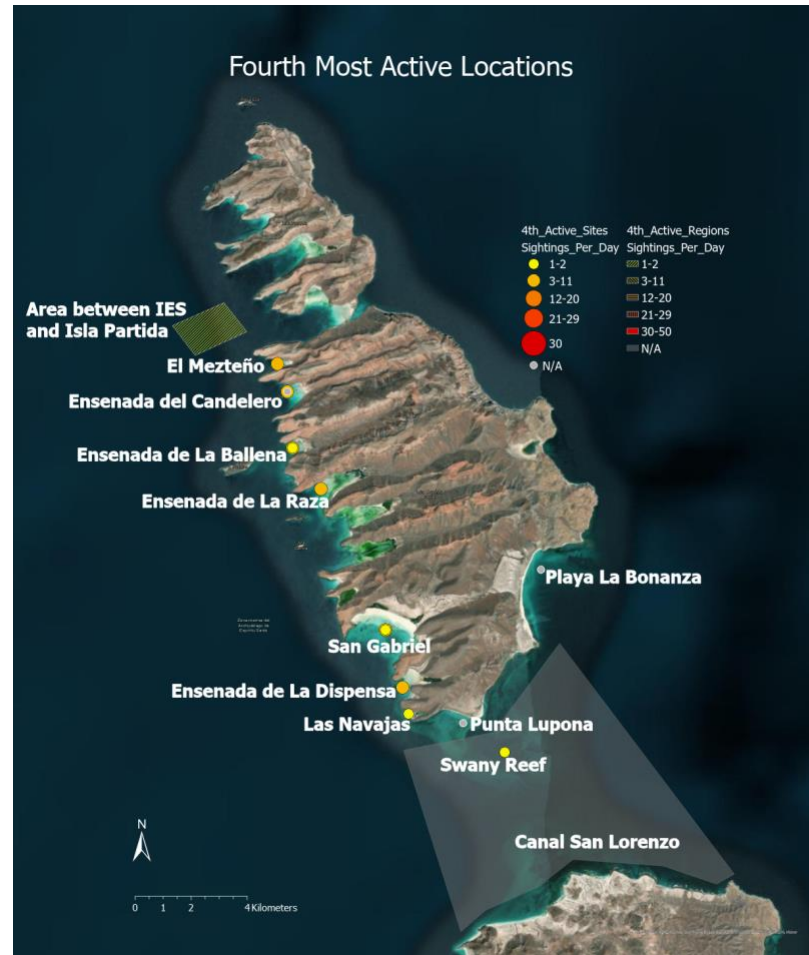


Figure 13: Fourth Active Regions and Sites. An average of 1-10 sightings per day occurred in specific locations and one sighting per day occurred in the region between IES and Isla Partida.

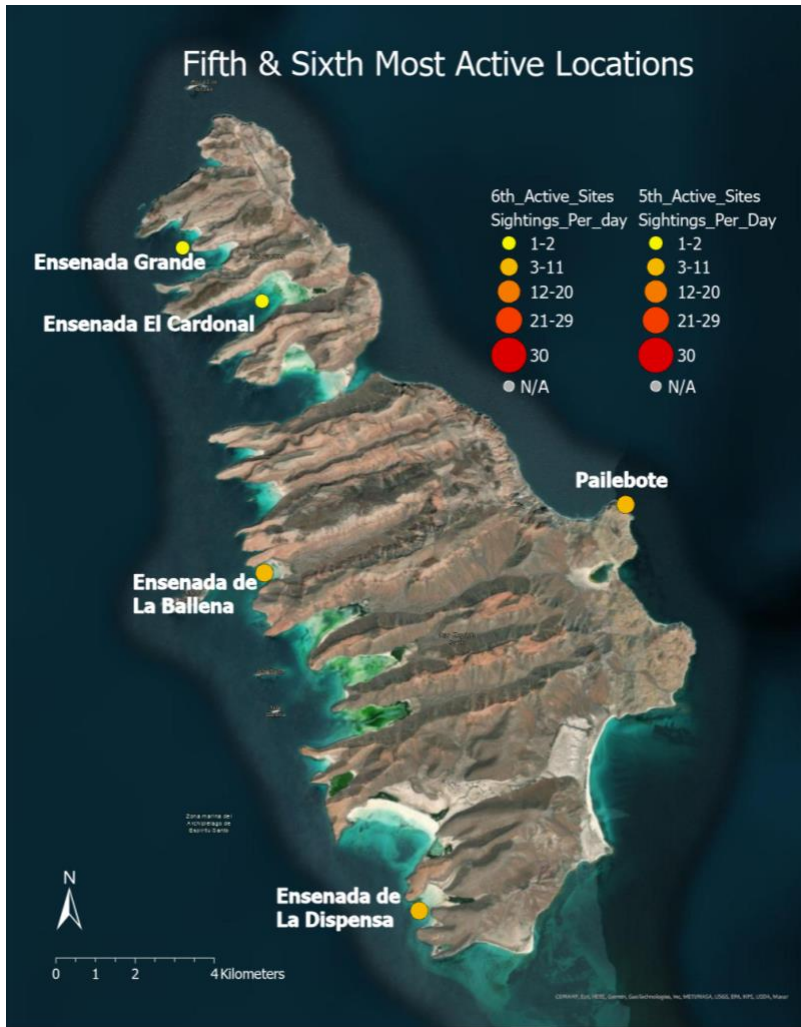


Figure 14: Fifth and Sixth Active Regions and Sites. An average of 1-7 green sea turtle sightings per day were reported by survey participants.