

# COMPLEMENTING EASTERN PACIFIC GREEN TURTLE POPULATION MONITORING WITH LOCAL ECOLOGICAL KNOWLEDGE: BASELINE ASSESSMENT OF *CHELONIA MYDAS* SURROUNDING PARQUE NACIONAL ZONA MARINA FROM THE ARCHIPIÉLAGO ESPÍRITU SANTO, BAJA CALIFORNIA SUR, MEXICO

COMPLEMENTANDO EL MONITOREO DE LA POBLACIÓN DE TORTUGA VERDE DEL PACÍFICO ORIENTAL CON EL CONOCIMIENTO ECOLÓGICO LOCAL: EVALUACIÓN DE LÍNEA BASE DE *CHELONIA MYDAS* ALREDEDOR DE PARQUE NACIONAL ZONA MARINA DEL ARCHIPIÉLAGO ESPÍRITU SANTO, BAJA CALIFORNIA SUR, MÉXICO

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**Resumen.**— Para una mejor comprensión del estado actual de la población de tortuga verde del Pacífico oriental, se necesita una evaluación espacial de su presencia y abundancia en sus hábitats frecuentados. Este estudio tiene como objetivo desarrollar un marco a partir del cual se podría realizar un estudio de referencia centrado en las tortugas verdes del Pacífico oriental que rodean las aguas de Parque Nacional Zona Marina del Archipiélago Espíritu Santo. Se utilizaron dos años de datos y una encuesta de investigación enfocada en el Conocimiento Ecológico Local (CEL) de guías de ecoturismo que operan en La Paz, Baja California Sur, México. Debido al protocolo de la Junta de Revisión Institucional (IRB) de la Universidad de California y al pequeño tamaño de la muestra de los participantes de la encuesta, los datos de la encuesta no se pueden usar para extrapolar a la población de operadores de ecoturismo en La Paz. Aunque estudios anteriores han integrado LEK de los pescadores, este es el primer estudio que incluye LEK del sector del ecoturismo para informar los esfuerzos de conservación de la tortuga verde del Pacífico oriental en México. Los resultados de este proyecto contribuirán a un mejor entendimiento y una mayor comprensión de cómo esta especie utiliza esta área.

**Palabras clave.**— Actividad antropogénica, conservación, ecoturismo, Golfo de California, tortuga negra, zonas de alimentación.

**Abstract.**— To improve analysis of the current Eastern Pacific Green (EPG) turtle population status, a spatial assessment is needed on their presence and frequency in their frequented habitats. This study aims to develop a framework from which a baseline study could be undertaken focused on EPG turtles surrounding the waters of Parque Nacional Zona Marina from the Archipiélago Espíritu Santo. Two years of data and a research survey focused on Local Ecological Knowledge (LEK) from ecotourism guides operating out of La Paz, BCS, México were used. Due to the University of California's Institutional Review Board's (IRB) protocol and small sample size of 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 EPG 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.

**Keywords.**— Anthropogenic activity, black turtle, conservation, ecotourism, foraging grounds, Gulf of California.

## INTRODUCTION

Eastern Pacific green (EPG) turtles, *Chelonia mydas*, have a historic population distribution from Baja California Sur (BCS), México to Perú, and the Galapagos Islands (Pacific Sea Turtle Recovery Team et al., 1998). It is estimated that after living in the pelagic for 9-11 years, EPG turtles reside within coastal developmental grounds in which foraging activities occur (Koch et al., 2007). These locations are found in the Gulf of California and the Pacific of the Baja California Peninsula and serve as places of residency for this species due to their high site fidelity (Koch et al., 2007). Migration occurs only to their reproduction sites and nesting beaches and is performed by adult males (reproduction sites) and females (reproduction sites and nesting beaches) (Green Turtle, 2022). However, during their different life stages, they are susceptible to anthropogenic activities and may suffer disease (Reséndiz et al., 2016). Senko et al. (2014) demonstrates that despite Mexican federal protection, current threats to EPG turtles along the Gulf of California and the Pacific of BCS, México are bycatch and harvesting.

To better understand how anthropogenic activities have an effect on long-term population trends, both western science and Local Ecological Knowledge (LEK) can be used. Such an example is a study by Early-Capistrán et al. (2020), in which the ecology of EPG turtles was investigated while integrating LEK. In doing so, a baseline of EPG turtle frequency prior to their exploitation during the 1950s to the 1980s was created (Early-Capistrán et al., 2020). LEK from fishers in Baja California, México, was important and critical in creating a baseline study since they held “place-based empirical knowledge...about their surrounding environments and biota”, not attainable through research (Early-Capistrán et al., 2020).

In an effort to assess the status of this species, EPG turtles have been monitored (Fig. 1) in the Parque Nacional Zona Marina

del Archipiélago Espíritu Santo (PNZMAES), a protected area within the Gulf of California which offers “optimal conditions to carry out different stages of the life cycle” of EPG turtles (Reséndiz et al., 2018). PNZMAES' waters are foraging grounds for highly migratory species such as green turtles (Reséndiz et al., 2019), which can spend decades in the area, feeding and growing until reaching sexual maturity, and also, as adult individuals, 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).

Therefore, it is of importance to create a precursor for a baseline study of them in PNZMAES. This study aims at providing baseline information on EPG turtles' frequency and distribution within the PNZMAES, using spatial analysis, data from scientific monitoring, and surveys from local ecotourism guides.

## MATERIALS AND METHODS

**Study site.** Parque Nacional Zona Marina del Archipiélago de Espíritu Santo is located in BCS, México, between 24°24' and 24°36' north latitude and 110°18' and 110°27' west longitude (Olmos-Martínez et al., 2015) in the Gulf of California off the coast of La Paz. PNZMAES is 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, 2021). This region has great biodiversity and richness, including species that are threatened or under special protection, and offers different environmental services such as the refuge of species for resident and migrant populations,

food production, reservoir of sources of biological material, and ecotourism and research, among others (Olmos-Martínez et al., 2015). La Paz is one of the municipalities in México that attracts tourists, and much of the ecotourism activities take place in PNZMAES such as wildlife viewing, scuba diving, and snorkeling (Olmos-Martínez et al., 2018).

**Sea turtle monitoring.** A total of 39 field trips were carried out from January 2020- January 2022 at PNZMAES at 10 sites that

fit ideal conditions: shallow waters located in bays with sandy floors. Turtle capture was carried out using monofilament gillnets (100 m long by 5 m deep and 60 cm mesh size). The nets were placed in the different turtle transit channels during diurnal periods of six to eight hours and were checked periodically every hour to minimize damage from the organisms. Upon capture, a systematic physical examination of each organism was carried out following methods described by Reséndiz et al. 2021. The standard monitoring protocol was then followed, including



**Figura 1.** Sitios de monitoreo del Parque Nacional Zona Marina del Archipiélago Espíritu Santo (PNZMAES) durante 2020-2022. Los polígonos morados corresponden a las áreas de monitoreo en Parque Nacional Zona Marina del Archipiélago Espíritu Santo (PNZMAES). Las ubicaciones en las que se colocaron las redes se representan con círculos de diferentes colores.

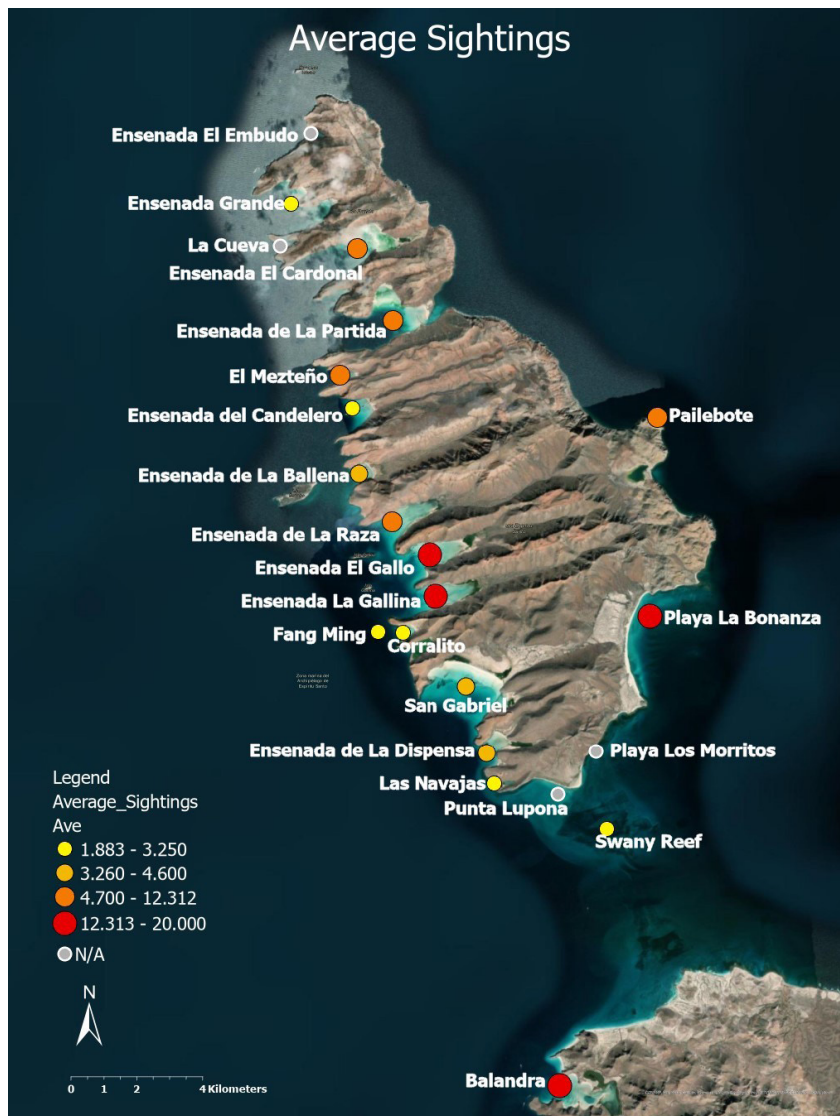
**Figure 1.** Parque Nacional Zona Marina from the Archipiélago Espíritu Santo (PNZMAES) monitoring sites from 2020-2022. Purple polygons correspond to monitoring areas. Locations in which nets were set are depicted by different color circles.

morphometry (Curved Carapace Length, CCL; Straight Carapace Length, LRC), weighing and blood sampling for further analysis of health status. Turtles were tagged on each back flipper using Inconel tags 628 (National Band and Tag Company, Newport, Kentucky) and released unharmed. Catch per unit effort (CPUE) was defined as the number of turtles caught per day per site.

**Local Ecological Knowledge.** We designed semi-structured surveys (Appendix 1) to obtain information from local ecotourism guides on presence and frequency of sightings of EPG turtles and their perceived trends over the past 20 years in the PNZMAES. The survey consisted of 29 open-ended and structured questions focused on demographic information (e.g. age, profession), information and perception on EPG turtle presence and frequency, and tourism activity. The data collected for study included anecdotal observation of EPG turtles during

ecotourism activities, an average number of daily sightings. Participants were given the option of writing their responses or having the researcher write on their behalf. The researcher provided the option of reading the survey questions for the participants.

When discussing EPG turtle sightings, most participants provided locations in which sightings would occur while also providing an average of daily sightings per day, while others did not. Sites were ranked based on their accordance for EPG turtles: low importance, medium importance, high importance, and maximum importance. 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. An average of average daily sightings was calculated to determine EPG turtle active sites (Fig. 2) in order to account for the possibility



**Figura 2.** Avistamientos promedio reportados por guías de ecoturismo. Los sitios de "Importancia máxima" se muestran en rojo oscuro. Las ubicaciones en las que se produjeron avistamientos, pero no se proporcionó ningún valor numérico, se muestran con un círculo gris y N/A.

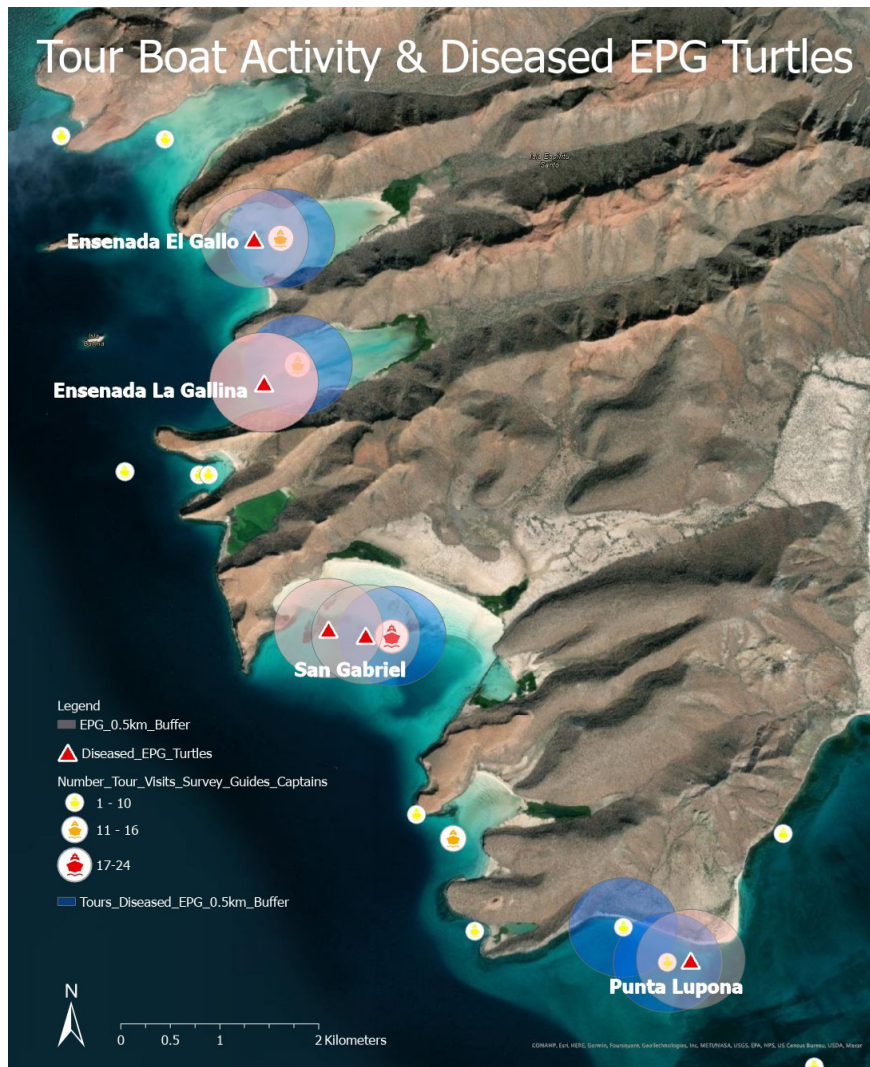
**Figure 2.** Average sightings reported by ecotourism guides. "Maximum importance" sites are displayed in dark red. Locations in which sightings occurred, but no numeric value was provided, are displayed with a gray circle and N/A.

of different sightings of the same turtles. Participants also provided information on the locations they would take tourists and the number of ecotourism trips they make per year. They then marked the locations on paper surveys to specify sites in which they would make stops or pass on route to get to their different destinations. Additional information such as the types of tours, the duration, and months they make ecotour trips was collected.

We estimated that there are approximately 200 guides aged 18 or more in La Paz, our goal was to survey at least 10% of the sample. Participants were contacted using a non-probabilistic sampling as a result of convenience sampling. 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.

**Spatial analysis.** We analyzed data compiled from sea turtle monitoring and turtle sightings using ArcGIS programming software and Excel. The variables used to make an analysis were: EPG monitored sites, average reported sea turtle sightings by site, number of sick monitored sea turtles by site, and number of reported tourism boat activity by site around the PNZMAES.

Data was uploaded in maps generated by ArcGIS Pro Desktop software while using Hybrid Reference Layer and World Imagery Layer as base maps (Version 2.5 of Esri Inc.). Buffer geoprocessing tool conducted an analysis of data pertaining to diseased turtles between January 2020-2022, by creating a 0.5km buffer layer surrounding sick EPG turtles (Fig. 3).



**Figura 3.** Actividad de embarcaciones turísticas y tortugas verdes del Pacífico Oriental enfermas (representadas por triángulos rojos). La zona de amortiguamiento de color rosa alrededor de las tortugas enfermas captura los barcos turísticos dentro de una distancia de 0.5 km. También se aplicó una zona de amortiguamiento azul de 0.5 km a los barcos turísticos en las proximidades de las tortugas enfermas.

**Figure 3.** Tour boat activity and diseased Eastern Pacific green (EPG) turtles (represented by red triangles). The pink color buffer zone around the sick turtles captures the tour boats within a 0.5 km distance. A 0.5 km blue buffer zone was also applied to tour boats in proximity to diseased turtles.

## RESULTS

**In-water sea turtle monitoring.** We conducted scientific monitoring in the southwestern portion of the Espíritu Santo Island in PNZMAES. In total 242 EPG turtles were captured, measured, weighed, sampled, tagged, and released during the study period. EPG turtles ranged from 45.2-109.1 cm in CCL, 42.1-103.5 cm in LRC, and from 8-169 kg in weight.

Overall, the number of EPG turtles caught in specific locations ranged from 1-12, where the site with the highest number of EPG turtles assessed is Ensenada La Gallina (Table 1). Health assessment of the captured turtles resulted in the identification of 14 individuals presenting fibropapillomatosis (Table 1).

**Results from LEK surveys.** Ecotourism guides identified 22 sites within the PNZMAES where EPG turtles are observed (Fig. 2). EPG turtle sightings either fell in specific locations or in areas. Due to the unclarity of the areas mentioned, only specific locations mentioned were taken into account for this study. The average of daily EPG turtle sightings was taken for each specific location reported (Table 1 and Fig. 2).

Based on survey data, sites in which EPG turtles are present and most abundant fall on the southwestern portion of PNZMAES (Fig. 2). They are found 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 in these waters.

Four sites were classified as “maximum importance”, having an average number of sightings of 12.313 or more turtles, five sites

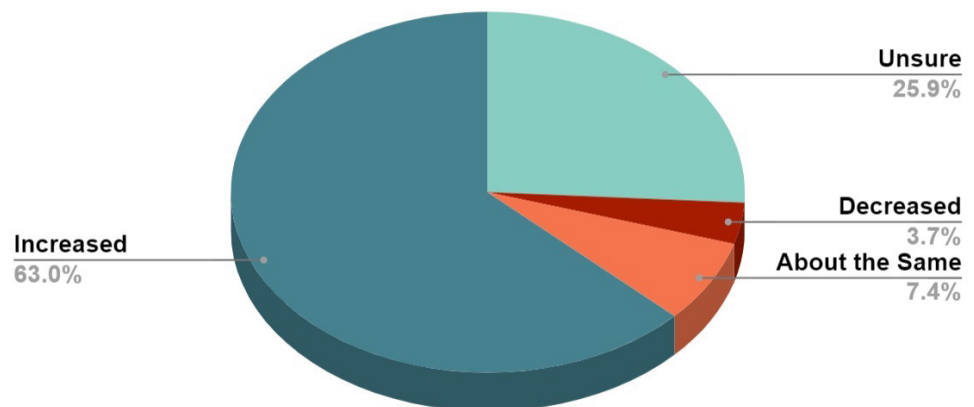
were classified as “high importance” with an average of 4.700-12.312. Additionally, three sites were categorized as “medium importance” and six sites were categorized as “low importance”, with an average number of sightings of 3.260-4.600 and 1.883-3.250, respectively. In nine cases, sites used by our research teams overlapped with sites reported by ecotourism guides. However, 13 more sites were identified by users (Fig. 2).

Figure 3 displays sites in which sick EPG turtles were found and tourism boat activity. The number of tourism boats visiting the different bays was obtained from survey results based on the number of participants reporting making stops in a given site. Tourism boat activity is accounted for and displayed in the map legend: 1-10 boats are represented with a yellow symbology, and 11-16 and 17-24 boats are shown in orange and red, respectively. A 0.5 km buffer was applied around sites in which sick EPG turtles were caught during monitoring PNZMAES and around ecotour boat activity. A color gradient and labeling were applied to demonstrate the amount of boat activity.

Based on answers from the sample size ( $n = 27$ ), 31 sites were frequented during ecotour trips to PNZMAES. Twenty-two (70.9%) ecotour sites fall on the western portion of the island so that tourists can sightsee, visit beaches, snorkel, and dive. Furthermore, based on anecdotal observations, 63% of survey participants shared that PNZMAES’ EPG turtle population has increased (Fig. 4), making them visible to boats either on route to the island or while making tour stops. Additionally, when asked if there was any additional information survey participants wanted to share, 66.7% mentioned that EPG turtles were seen feeding in these areas, making turtles move around and come up to breathe in different places within the bays.

**Figura 4.** Cambio percibido durante los últimos 20 años en la población de tortugas verdes del Pacífico Oriental del Parque Nacional Zona Marina del Archipiélago Espíritu Santo (PNZMAES) basado en observaciones anecdóticas.

**Figure 4.** Perceived change over the last 20 years in Parque Nacional Zona Marina del Archipiélago Espíritu Santo (PNZMAES) of Eastern Pacific green (EPG) turtle population based on anecdotal observations.



**Tabla 1.** Datos del monitoreo de tortugas marinas de este estudio y datos del Conocimiento Ecológico Local (CEL) de guías de ecoturismo de La Paz.**Table 1.** Sea turtle monitoring data from this study and data from Local Ecological Knowledge (LEK) from ecotourism guides of La Paz.

Site	Average CPUE (number of monitoring)	Diseased EPG turtles	Ecotourism guides: average sightings/day	Total number of survey participants
Corralito	1 (1)	0	3.25	3
Ensenada de La Ballena	1 (1)	0	4.6	8
Ensenada de La Dispensa	2.25 (4)	0	4.3	6
Ensenada de La Partida	3 (1)	0	10.25	4
Ensenada El Cardonal	2.667 (3)	0	8.167	4
Ensenada El Gallo	2.4 (5)	1	12.313	18
Ensenada La Gallina	5.192 (26)	9	13.893	16
Punta Lupona	1.5 (4)	1	N/A	2
San Gabriel	2.864 (22)	3	4.429	18
Poza de La Gallina	4 (1)	0	N/A	0

\*Data from turtle monitoring and survey participants was compiled. Monitoring data represent the average number of EPG turtles monitored during a two-year period. An average of sightings/day reported from participants corresponding to monitoring sites is shown. Total number of participants that reported sightings for each site is provided.

\*Se recopilaron datos del monitoreo de tortugas marinas y participantes de la encuesta. Los datos del monitoreo representan el número promedio de tortugas verde del Pacífico oriental monitoreadas durante un período de dos años. Se muestra un promedio de avistamientos/día informados por los participantes correspondientes a los sitios de monitoreo. Se proporciona el número total de participantes que reportaron avistamientos para cada sitio.

## DISCUSSION

Long-term monitoring of endangered species, such as that of EPG turtles, is imperative in creating and maintaining informed conservation assessments (Laloë et al., 2020) that will guide action-driven policy. Since EPG turtles have high site fidelity to their foraging grounds, having a baseline assessment of their population frequency in these waters is of importance in their local conservation scale.

EPG turtles have been observed swimming, feeding, and resting within bays located in the western part of PNZMAES by survey participants. The environmental characteristics of PNZMAES' bays play a role in attracting EPG turtles. Two of these biotic characteristics are the seagrasses and mangroves that grow within these "active" EPG 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) in these foraging grounds.

Additionally, a study done by Acosta-Velázquez et al. (2019) found that San Gabriel is considered of great importance regarding mangrove coverage. The presence of mangrove nursery grounds may influence the presence and frequency of EPG turtles as a result of providing "refuge and habitat" (García, 2014) in addition to food resources. Seminoff et al. (2002) shared that Chelonians may have a diet composed of animals and mangrove matter (Amarocho & Reina, 2007) due to their opportunistic feeding behaviors. Food and shelter in these locations may attract many EPG turtles, which may suggest why they have not been sighted by many survey participants along the eastern portion of PNZMAES and deeper waters on the western side.

Reefs can also be found around PNZMAES, with San Gabriel having the highest number of reef structures. These structures can act as feeding sites and refuge for 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 locations.

Two points that are further off the coast but were also reported to have EPG 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). 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 EPG turtles that can be found near PNZMAES.

Other contributing factors that may influence the presence of EPG turtles are anthropogenic activities such as snorkeling, swimming, fishing, anchoring of large vessels, boats, and harvesting activities (Programa de Manejo del Parque Nacional exclusivamente la Zona Marina del Archipiélago de Espíritu Santo, 2014). Although fishing activities have decreased since PNZMAES 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 bays (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. Despite the high amount of tourism activity in this region, many sightings of EPG turtles were reported by participants.

We would expect to have greater numbers of sightings and monitored EPG 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 (Programa de Manejo del Parque Nacional exclusivamente la Zona Marina del Archipiélago de Espíritu Santo, 2014) may be decreasing the number of EPG 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, there seems to be a higher number of them.

Ecotour sites that are frequented are within a kilometer radius of scientific monitored areas, where researchers assess the health of the population. Special interest is taken when analyzing samples since EPG turtles can have fibropapillomatosis, which is associated with a herpesvirus that may cause tumors (Reséndiz

et al., 2021). Of the 10 monitored areas, 14 diseased EPG 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.

It would be of interest to assess the health of EPG turtles in bays that have a high amount of tourism activities, such as Ensenada Grande and Ensenada del Candelero. 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 bays are feeding grounds for EPG turtles, they may also act as points of high transmission. Based on this, it may be suggested that points of high anthropogenic activity may be associated with the presence of sick EPG turtles. However, more data is needed to investigate this relationship.

## CONCLUSION

Since the harvest of EPG turtles became prohibited in México, there have been more sightings of these endangered species. The waters of PNZMAES serve as essential habitat due to their provision of resources. These organisms have been observed feeding, seeking refuge, and swimming at all times of the year.

LEK from PNZMAES ecotourism guides is essential in aiding conservation efforts for EPG turtles. Based on anecdotal observation, new monitoring sites can be established where researchers may be able to assess the health status of the population of sea turtles surrounding this island. 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 study were made to form a framework so that a baseline spatial assessment of the presence and frequency of EPG turtles can be made. This was completed based on the responses from 27 survey participants and data from scientific monitoring. More research and collaboration between researchers and ecotourism is needed to provide further findings on how the presence, frequency, and health status of the EPG turtle population continues to change around PNZMAES.

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**Ethical Aspects.**— Ethics Approval (Project # 802779) was reviewed by the IRB at UC San Diego (UCSD), and is exempt from IRB requirements under category 45 CFR 46.104(d)(2). The lead investigator can provide the documentation upon request.

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## APPENDIX 1

### **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 Espíritu 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 Espíritu Santo?

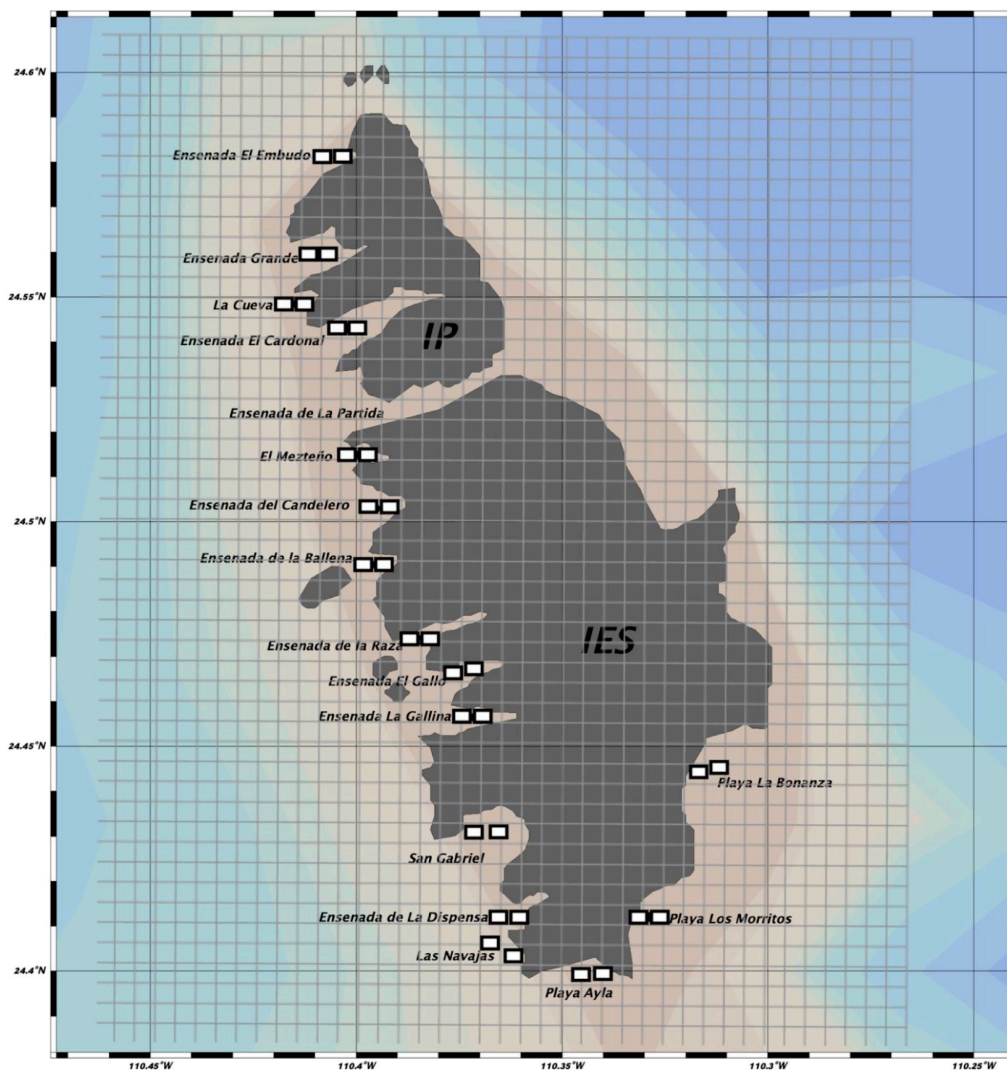
<input type="checkbox"/> January	<input type="checkbox"/> May	<input type="checkbox"/> September
<input type="checkbox"/> February	<input type="checkbox"/> June	<input type="checkbox"/> October
<input type="checkbox"/> March	<input type="checkbox"/> July	<input type="checkbox"/> November
<input type="checkbox"/>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



11. Do these months correspond with specific tours? 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: _____         | <input type="checkbox"/> NA                    | <input type="checkbox"/> 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.



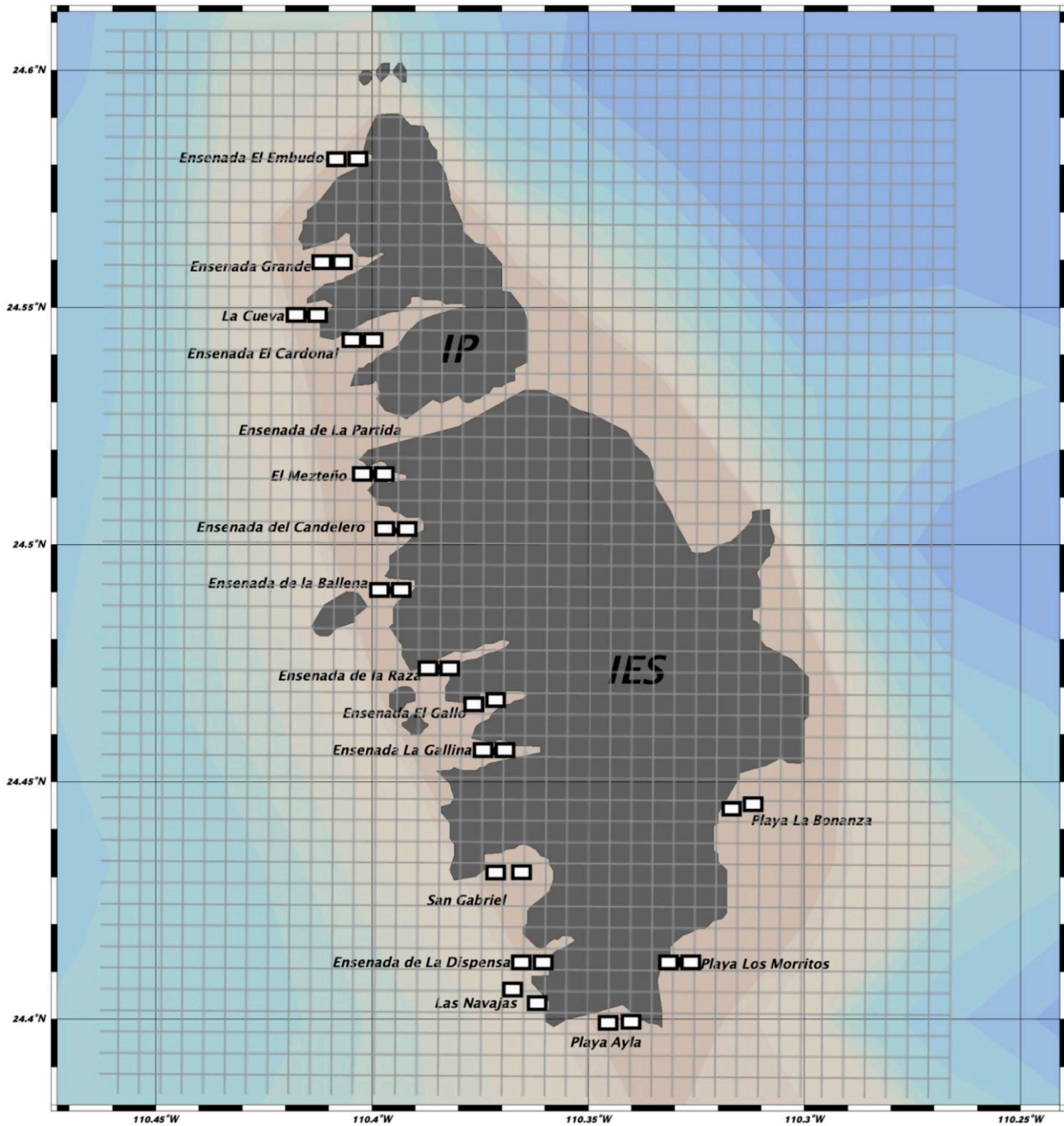
13. How likely are you to encounter a green sea turtle during the tours?

- 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: \_\_\_\_\_,

a. How many green sea turtles do you see? \_\_\_\_\_

b. 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: \_\_\_\_\_,

a. How many green sea turtles do you see? \_\_\_\_\_

b. 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: \_\_\_\_\_,

a. How many green sea turtles do you see? \_\_\_\_\_

b. 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: \_\_\_\_\_,

a. How many green sea turtles do you see? \_\_\_\_\_

b. 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: \_\_\_\_\_,

a. How many green sea turtles do you see? \_\_\_\_\_

b. 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  |



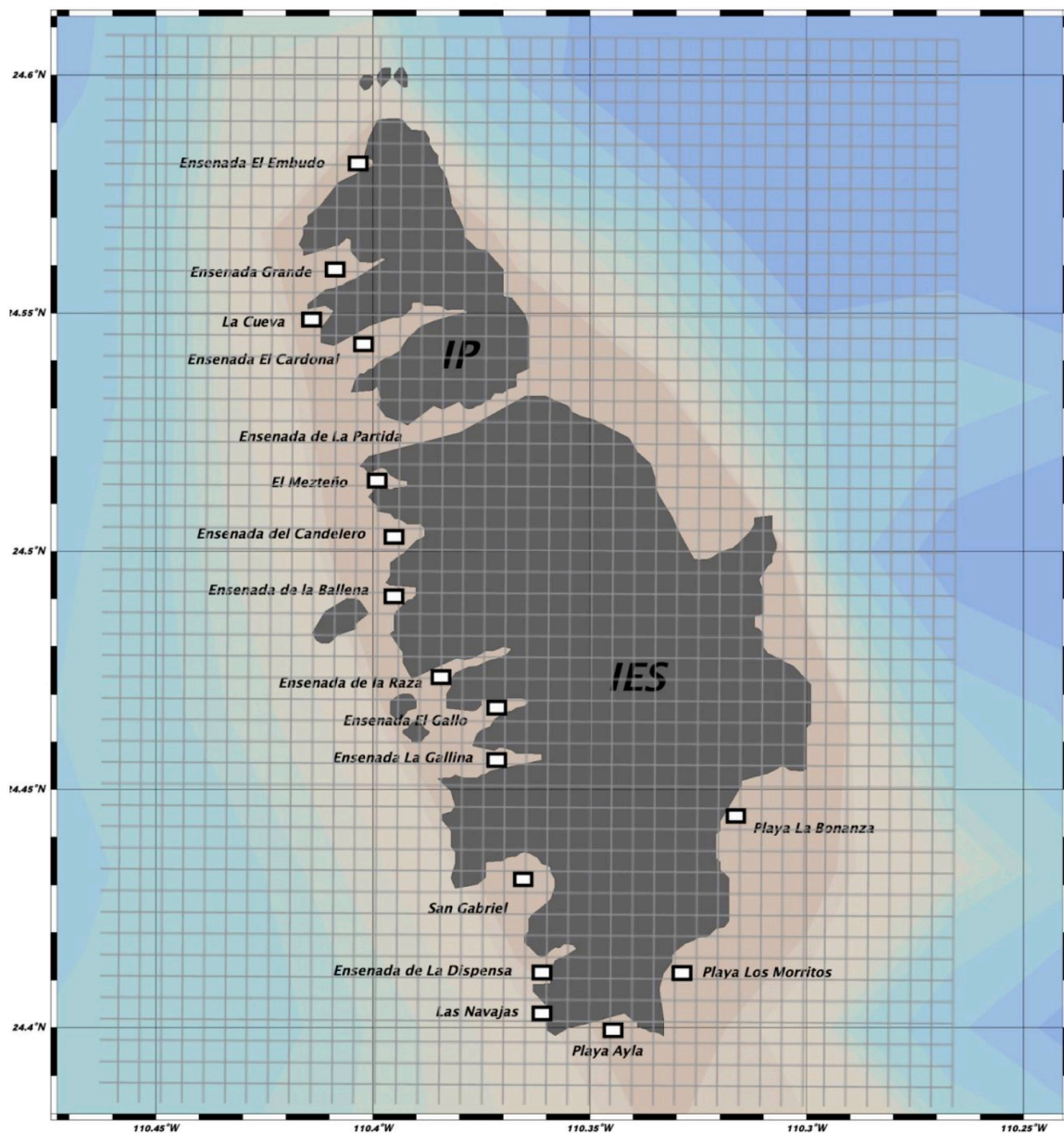
Turtle watching

Diving

Sport fishing

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 Espíritu Santo been staying the same, getting smaller or larger?

- a. Smaller
- b. Staying the same
- c. Larger
- d. I am not sure

25. Is there anything else you would like to share about green sea turtles surrounding Isla Espíritu Santo?

26. What do you do for work? Select all that apply.

- a. Teacher
- b. Fisher
- c. Agriculture
- d. Sales employee
- e. Cook
- f. Boat driver
- g. Eco-tourist guide
- h. Other: \_\_\_\_\_

27. In which municipality do you live?

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

