

# **Long-term monitoring of sea turtle populations along the Baja California peninsula**

## **Results of first and second year**

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### **Background:**

Five of the world's seven species of endangered and threatened sea turtles inhabit the waters of Mexico's Baja peninsula. These are the East Pacific green turtle (*Chelonia mydas*), the loggerhead turtle (*Caretta caretta*), the hawksbill turtle (*Eretmochelys imbricata*), the olive ridley turtle (*Lepidochelys olivacea*) and the leatherback turtle (*Dermochelys coriacea*).

Historically, the peninsula was home to one of the most diverse abundances of sea turtles in the world (Cliffon et al. 1982). But exploitation in the 1900's, with collection of both animals and eggs peaking between 1960 and 1970, led to a drastic decline in numbers of all species (Cliffon et al. 1982). By the mid 1980's, many traditionally rich lagoons and bays were almost entirely depleted of sea turtles (Seminoff 2000, Nichols et al. 2002a). Since then, international and national laws, including a presidential decree in 1990 (Aridjis 1990), have been implemented with the intention of protecting sea turtles. But mortality continues and it is estimated that as many as 35,000 sea turtles die in the region each year (Nichols, unpublished data; Gardner and Nichols 2001). This mortality is compounded by the drowning deaths of turtles in fishing nets along the peninsula, adding approximately 2,000 turtle deaths to the yearly total. Because sea turtles remain easy to capture, their numbers appear abundant, reinforcing the misconception among coastal residents that sea turtles are not in danger of extinction.

In 1999, the Grupo Tortuguero de las Californias was formed, and a multi-year monitoring project was initiated at six sites along the peninsula. The sites were chosen because they are poaching hotspots. The project is led and carried out by community members in partnership with local non-profit organizations, and coordinated by WiLDCOAST.

### **Project Goals:**

There are several goals of the project: to acquire the first standardized sampling data on population abundance trends in the region; to perform informal anti-poaching patrols; and to support and encourage local efforts to conserve endangered species. The data collected in this effort will help us determine if our other conservation efforts, including creative "don't eat the sea turtles" media campaigns, classroom education programs, and community outreach projects, are successfully restoring sea turtle populations in the region. At the end of five years, we hope our data will show that turtle populations are recovering.

### **Monitoring Sites:**

Sites were chosen based on local knowledge of traditional sea turtle hunting sites and experienced fishermen were consulted in choosing the sites. In the first year, the Gulf of California locations included Bahía de los

Angeles and Loreto, and the Pacific coast sites included Laguna Ojo de Liebre, Laguna San Ignacio, Punta Abreojos and Bahía Magdalena. In the second year, Cabo Pulmo was added as the seventh monitoring site.

Bahía de los Angeles (28°58' N, 113° 33' W) is located on the east coast of the state of Baja California. It encompasses an area of roughly 60 km<sup>2</sup> and is separated from the larger Gulf of California by an archipelago of seventeen islands. Maximum depth in the bay occurs between 40 and 50 m and tides range 4 m. Water temperature ranges from 14°C to 31 °C and air temperatures range from 12°C to 31°C (Resendiz 2002). Bottom substrate is soft and sandy with marine algae pastures occurring on the western and southern margins (Seminoff 2000).

Laguna Ojo de Liebre (27°35' - 27°55' N and 113°50' -114°20' W), also known as Scammon's Lagoon, is an evaporative lagoon located in the El Vizcaino Biosphere Reserve (De La Cruz-Aguero et al. 1996). The 36.6 km<sup>2</sup> lagoon is characterized by sediment consisting of sand, silt and clay (Phleger and Ewing 1962), with sea grass and algae pastures throughout (Aguila-Ramirez 1998). Channels of over 20 m in depth cut through the generally shallow basin, and tides of up to 2.5 knots result in a tidal range of 1 to 3 m (Phleger and Ewing 1962). Average salinity ranges from 35‰ to 39‰ (with a high salinity of 47‰ reported) and average water temperatures range from 18°C to 25.5°C (Acevedo 1997). Salt flats are located at the head of the lagoon, and this area is recognized as an important breeding habitat for both sea birds and grey whales.

The monitoring site at Punta Abreojos is located in Estero Coyote (26° 48'N, 113° 27' W), a small uninhabited coastal lagoon. The area is biologically similar to Laguna San Ignacio, hosting sea grass and algae beds. Little boat or human traffic disturbs the area, making it relatively pristine and unexploited.

Laguna San Ignacio (26°43' – 26°58' N and 113°08' – 113°16' W) is also located in the El Vizcaino Biosphere Reserve on the Pacific coast of Baja California Sur. It encompasses an area of 17.5 km<sup>2</sup> and is characterized by wide channels ranging from 6 to 14 m deep. Algae and sea grass beds are abundant (Nuñez-Lopez et al. 1998) and mangroves line much of the shore. Average tidal range is 1.6 m. and salinity ranges from 36‰ at the entrance of the lagoon to 41‰ at the innermost boundary (Centro de Investigaciones 1994).

The monitoring site in Loreto is located in the Parque Nacional Bahía de Loreto in the Gulf of California, Baja California Sur. This park, created by presidential decree in 1996, encompasses an area of 2,062 km<sup>2</sup> and includes five islands within the boundaries. Habitat within the park ranges from rocky island and sandy coastlines to submerged reefs. The monitoring site (25°51' N, 111°19' W) is located in a near-shore, semi-protected sandy environment close to Playa Notri. Depth ranges from 5 to 12 m.

The Bahía Magdalena-Almejas complex is one of the largest Pacific coastal lagoon systems in Mexico, and encompasses an area of over 1000 km<sup>2</sup> (Funes-Rodriguez et al. 2001). The monitoring site, in Estero Banderitas (24°50' – 25°00' N and 112°05' – 112°08' W), is located in the northern zone of Bahía Magdalena. This estero is the largest in the complex, and is heavily influenced by tidal currents, with salinity and temperature increasing towards the head of the basin (Brooks et al. 2001). Average salinity at the mouth of Estero Banderitas has been measured at between 36.9‰ and 38.7‰ (Alvarez-Borrego et al. 1975). Average water temperatures range from 18°C to 31 °C and depth ranges from 1 to 7 m. A sand-mud substrate covers most of the benthos, with patchy algae and sea grass beds found throughout.

The monitoring site in Cabo Pulmo is located in the Parque Nacional Cabo Pulmo in the Gulf of California, Baja California Sur. This marine park was established by presidential decree in 1995 to protect the only living coral reef system in the Sea of Cortez and includes a 7,111 hectare area. Habitat within the park ranges from rocky and sandy coastlines to submerged coral and rocky reefs. The Cabo Pulmo monitoring sites (23° 415' N and 109° 415' W) are both near-shore, semi-protected rocky and coral reef formations at the North and South borders of Pulmo Bay, the largest bay in the park. Depth ranges from very shallow to 30 m.

## **Capture methods and data collection:**

At each of the sites, excluding Cabo Pulmo, two 100 m-long entanglement nets (20 cm mesh) are used to capture sea turtles at previously determined locations at each study site. A “unit effort” is considered one 100 m net soaking for one hour. Unit effort per capture (UEPC) was calculated for all sites. Nets are monitored continuously for 24 hours during a neap tide of each month throughout the year. Captured turtles are removed from the net, brought to a holding area for morphological measurements, tagged, and released within hours. All netting procedures followed protocol described by Ehrhart and Ogren (1999).

Standard morphological data were recorded for each turtle. Measurements included standard length (straight carapace length (SCL), measured notch to tip and width, curved length and width, and weight. Turtles are assessed for overall health, and special consideration is given to examination of eyes for traces of disease or virus. Turtles are tagged on each rear flipper with metal Iconel tags (National Band and Tag Company, Newport, Kentucky) and subsequently released at location of capture.

Because the Cabo Pulmo monitoring site lies within a protected area (the Cabo Pulmo National Park), nets of any kind are banned from use. The Cabo Pulmo team instead monitors turtles by: viewing turtles underwater while scuba diving, manually capturing individual turtles by hand, and monitoring nesting turtles on beaches. Cabo Pulmo is also the newest team and monitored turtles in the eight-month period from February 2003 – September 2003. During eleven dives over this time period, 3 sea turtles (hawksbill and green) were visually identified during 1,660 minutes of effort time (average = 553.33 minutes to view one turtle). Six turtles were captured by hand, including olive ridleys, green turtles, and hawksbills. A pilot nest protection and tagging program was initiated during the summer nesting season.

## **Results:**

Year One: A total of 268 turtles were captured at six sites. Of these, 266 were green turtles. Two hawksbill turtles were captured at the Bahía Magdalena site. Loggerhead turtles were encountered infrequently near net sites, and two were captured in Laguna Ojo de Liebre. SCL for all sites ranged from 36.2 cm to 90.2 cm with a mean of 57.7 cm ( $\pm$  10.8 SD). Turtles were captured in all months and at all sites. Mean unit effort per catch (UEPC) for all sites was 10 h/turtle and ranged from 2 to 120 h/turtle. The overall health of turtles was found to be positive.

Year Two: In the second year of monitoring, a total of 377 turtles were captured, including 51 recaptures. This year, it took an average of 10.49 hours per turtle captured (range 0.74 hours to 40 hours). The mean straight carapace length for all turtles was 56.2 centimeters. Turtles were captured in all months and at all sites. The average weight of captured turtles was 54.4 pounds. All of the turtles captured were east Pacific green turtles (*Chelonia mydas*).

Summary of captures is given by site:

### ***Bahía de los Angeles***

Year One: A total of five turtles were captured at Bahía de los Angeles, representing the lowest number of captures per site. Mean SCL was 76.1 cm. Turtles were captured in November, May, June and July. A total of 600 effort hours resulted in a UEPC of 120 h/turtle.

Year Two: A total of 21 turtles were captured, with nine recaptures. The mean SCL was 83.3 cm. A total of 186.6 hours resulted in a UEPC of 8.89 h/turtle.

### **Laguna Ojo de Liebre**

Year One: A total of 36 turtles were captured at Laguna Ojo de Liebre, with one individual captured at a later date. Both loggerhead turtles captured in the study were found at this site. Mean SCL was 57.2 cm. Turtles were captured in all months but January. A total of 288 effort hours resulted in a UEPC of 8 h/turtle.

Year Two: A total of 58 turtles were captured in the second year, with 13 recaptures. The mean SCL was 59.06 cm. Total effort hours of 216 resulted in a UEPC of 3.72 h/turtle.

### **Punta Abreojos**

Year One: A total of 164 captures occurred in Punta Abreojos, including 5 recaptures. This represented the highest density site in the network. Mean SCL was 57.8 cm. Turtles were captured in all months. A total of 315 effort hours resulted in a UEPC of 2 h/turtle.

Year Two: A total of 163 turtles were caught in the second year of the project, with 22 recaptures. The mean SCL was 56.5 cm. A total of 137.5 hours resulted in a UEPC of 0.84 h/turtle.

### **Laguna San Ignacio**

Year One: A total of eleven turtles were captured at Laguna San Ignacio. Mean SCL was 48.2 cm. Turtles were captured in August, November, June and July. A total of 528 effort hours resulted in a UEPC of 48 h/turtle.

Year Two: A total of 96 captures occurred in the second year, with 7 turtles being recaptured. The mean SCL was 51.1 cm. A total of 234.3 effort hours resulted in a UEPC of 2.44 h/turtle.

### **Loreto**

Year One: A total of seven turtles were captured in Loreto. Mean SCL was 62.7 cm. A 90.2 cm SCL green turtle represents the largest turtle captured in the first year's effort. Turtles were captured in August, September, October, February and March. A total of 432 effort hours resulted in a UEPC of 62 h/turtle.

Year Two: In the second year, only 3 turtles were captured, with none being recaptures. The average SCL was 59.0 cm. A total of 120 effort hours resulted in a UEPC of 40 h/turtle.

### **Bahía Magdalena**

Year One: A total of 44 captures occurred at Bahía Magdalena, including 4 recaptures from previous netting efforts in the same year. Mean SCL was 57.6 cm. Two hawksbill turtles were captured at this site, representing the only hawksbill turtles captured for all sites. Turtles were captured in all months. A total of 508 effort hours resulted in a UEPC of 12 h/turtle.

Year Two: A total of 36 turtles were captured in the second year, with 9 recaptures. The mean SCL was 58.0 cm. A total 258 effort hours resulted in a UEPC of 7.17 h/turtle.

### **Discussion:**

Data indicate a predominantly juvenile, year-round population at all sites, with Pacific coast sites possessing a higher abundance than Gulf of California sites. East Pacific green turtles made up the great majority of the total captured turtles, suggesting that green turtles are currently the most abundant species found in near-shore coastal waters, or in evaporative lagoons. Recent mortality data supports this information. Green turtle carapaces made up more than 50% of those recovered in the greater Bahía Magdalena region from 1999 – 2000 (Gardner and

Nichols 2001). This suggests that not only are green turtles the most abundant species, but they are also the most heavily exploited in direct or indirect take fisheries.

Two hawksbill turtles were caught in Bahía Magdalena, a relic of past abundance. Clifton et al. (1982) note that hawksbill turtles were once abundant, even common as recent as the 1960's. Little is known about their status at the present, but it is generally accepted that hawksbill turtles are nearly extirpated from the peninsula's waters. Their presence in Bahía Magdalena underscores the importance of protection in this area.

Mean SCL for all sites indicates that the populations are made up predominantly of immature individuals. Punta Abreojos had the highest density of sea turtles captured during both years of the monitoring project. The overall health of turtles captured was qualitatively assessed to be positive.

Netting effort per turtle (UEPC), an accurate measure of sea turtle density, did differ markedly between sites. More turtles were caught at Punta Abreojos than at any other site, in both years of the project. The UEPC of 2 h/turtle in the first year and 0.84 h/turtles in the second year represented the lowest at any site. Results at Laguna Ojo de Liebre and Bahía Magdalena appeared to characterize a similar population in terms of both density and size. The two highest UEPC were from the Gulf of California sites. Sea turtle populations appear to be most dense at Pacific sites, and less dense at Gulf of California sites.

It is clear that sea turtle populations face several serious threats in northwestern Mexico. Mortality is reported for as many as 35,000 turtles per year based on carapace counts from refuse piles, direct observation and interviews. An additional 2,000 turtles are documented as drowning in fishing nets and washing up on Baja's beaches each year. Direct take by poachers and bycatch, which causes death by drowning in nets, continue to cause the most impact on turtle populations. A number of the sites occur in federally protected areas. The Loreto site is part of the Loreto Bay National Marine Park, and the Vizcaino Biosphere Reserve encompasses both the Laguna Ojo de Liebre and Laguna San Ignacio sites. The Cabo Pulmo site lies within the Parque Nacional de Cabo Pulmo. Bahía de los Angeles has been proposed for National Marine Park status.

Data indicate that there is no apparent difference between the size and density of populations within or outside of an official protected area. Higher densities of turtles instead appear to exist in those areas that are being protected and monitored by communities, whether as part of a government effort or not.

### **Anticipated progress:**

In the upcoming months, we expect the new site at Mulegé to receive training and support in the live-capture and data recording methods. Three local fishermen will make up the new monitoring participants. The Cabo Pulmo team will be building and formalizing its nest protection program which complements the in-water turtle surveys.

Rodrigo Rangel, the Grupo Tortuguero coordinator, will be traveling to the sites regularly to provide support, equipment, and technical advice. Rodrigo is also working on an educational program in La Paz, which will be coordinated with the non-profit organization Pronatura. He is expected to deliver sea turtle talks at schools and events, as well as continue in the tradition of Javier Villavicencio, who served as a passionate media spokesperson for saving the world's sea turtles.

The Punta Abreojos team has received so much interest from community kids and their families that they have initiated a project that will focus on involving children. Groups of kids will be invited and transported to the monitoring sites each month. They will learn about the endangered status of sea turtles and how their community is working to save them, and they will be able to participate in naming the turtles as they are being tagged and measured, prior to release.

## Conclusion:

This monitoring project is carrying out several vital roles: empowering local citizens to become involved in positive environmental projects, helping create a new tradition of sea turtle conservation to replace the former tradition of exploitation and consumption, collecting the first standardized data for Baja turtle populations, and preparing to assess the longer-term impacts of region-wide conservation efforts. We look forward to supporting the project's participants and helping in the continued growth of the movement.

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