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New foraging grounds for hawksbill (*Eretmochelys imbricata*) and green turtles (*Chelonia mydas*) along the northern Pacific coast of Costa Rica, Central America

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Abstract: Scarce information is available on the foraging grounds of Eastern Pacific sea turtle populations, which hinders the design of efficient national and regional conservation strategies. We surveyed five locations along Costa Rica's North Pacific between 2010-2013 using 45cm mesh turtle tangle nets, with the aim to explore and document new foraging sites (Cabo Blanco, Punta Coyote, Punta Pargos, Punta Argentina, and Bahía Matapalito). We standardized Catch Per Unit Effort (CPUE) as turtles caught per 100m of headrope length per one-hour soak time, which ranged from 0.06 at Punta Pargos to 0.58 in Bahía Matapalito for hawksbill turtles (*Eretmochelys imbricata*), and from 0.01 in Punta Coyote to 0.10 in Cabo Blanco for Eastern Pacific green turtles (*Chelonia mydas*). We found site-specific size ranges for *E. imbricata* with mean \pm Standard Deviation (SD) Curve Carapace Lengths (CCL) of 42.46 ± 17.55 cm in Bahía Matapalito and 61.25 ± 13.08 cm in Cabo Blanco. Only one individual was found at each of the other sites with CCLs from 49.6cm to 60.5cm. Green turtles were found at three of the surveyed locations with mean CCLs of 67.67 ± 19.44 cm at Cabo Blanco and 69.40 ± 9.40 cm at Punta Coyote and only one individual at Bahía Matapalito with a CCL of 56.2cm. The absence of adult size classes for *E. imbricata* and of small juvenile size classes for *C. mydas* at most of these sites stresses the complexity of species-specific distribution during different life stages in the Eastern Pacific and the urgent need to implement long-term monitoring at different coastal sites along the North Pacific to understand habitat connectivity. This study reveals the existence of fragile, non-protected foraging grounds for hawksbill and green turtles in Costa Rica's North Pacific, and serves as a guide for future research initiatives to strengthen national and regional conservation strategies. Rev. Biol. Trop. 62 (Suppl. 4): 109-118. Epub 2014 Diciembre 01.

Key words: Sea turtles, foraging grounds, developmental grounds, *Eretmochelys imbricata*, *Chelonia mydas*, North Pacific, Guanacaste, Costa Rica.

All Pacific Costa Rican sea turtle species are listed under the IUCN Red List of Threatened Species: Olive Ridleys (*Lepidochelys olivacea*) as "vulnerable", Eastern Pacific green turtles (*Chelonia mydas*) as "endangered", and leatherback (*Dermochelys coriacea*) and hawksbill turtles (*Eretmochelys imbricata*) as "critically endangered" (IUCN, 2013). Furthermore, all are included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 2013) and protected under a series of national laws and

decrees, given the persistent trade of sea turtle products in the region (Chacón, 2002). One of the mayor reasons for the decline of sea turtle populations in the eastern Pacific is considered to be the collection of sea turtle eggs and the direct take of adults from nesting beaches and foraging grounds (Seminoff, Alfaro-Shigueto, Amorocho, Arauz, Baquero, Chacón-Chaverri, Gaos, Kélez, Mangel, Urteaga, Wallace, 2012).

Sea turtles show complex life history patterns. Most species follow a general life cycle, in which they undertake large migrations

between geographically distinct habitats (Miller, 1997; Musick & Limpus, 1997; Plotkin, 2003): Hatchlings emerge from their nests and enter the sea, where they drift passively in oceanic gyres until recruiting to juvenile developmental habitats, and later to adult foraging grounds, from which females undergo reproductive migrations every few years back to their natal beach (Lohmann, Witherington, Lohmann, Salmon, 1997). Abundant literature is available on the reproductive biology of most species occurring in Costa Rica, as well as on the conservation and management needs of their particular nesting beaches in the eastern Pacific (for *D. coriacea* see Santidrián-Tormillo, Vélez, Reina, Piedra, Paladino, & Spotila, 2007; Shillinger Palacios, Bailey, Bograd, Swithenbank, Gaspar, Wallace, Spotila, Paladino, Piedra, Eckert, & Block, 2008; for *L. olivacea* see Fonseca, Murillo, Guadamuz, Spínola, & Valverde, 2009; Valverde, Orrego, Tordoir, Gómez, Solís, Hernández, Gómez, Brenes, Baltodano, Fonseca, & Spotila, 2012; for *C. mydas* see Blanco, Morreale, Bailey, Seminoff, Paladino, & Spotila, 2012, Fonseca, Quirós, Villachica, Mora, Heidemeyer, & Valverde, 2013). Nonetheless, scarce information is available on eastern Pacific sea turtle foraging and developmental grounds, which is considered a main threat to the survival of these regional populations (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 1998).

The study of coastal and oceanic realms is important to understand the demography and distribution of sea turtle populations. Pelagic and benthic foraging areas, mating and interesting habitats, as well as migratory corridors, are considered primary research priorities (Bjorndal, 1999) and recent efforts in investigating these marine habitats substantially improved our understanding of the complex natural history of sea turtles (Seminoff, Schroeder, MacPherson, Possards, Bibb, 2007). Long term studies in the Caribbean demonstrated the existence of benthic developmental habitats for juvenile hawksbill and green turtles, described as discrete inshore systems characterized by

the dominance of small size classes, which are geographically distinct from younger juveniles in pelagic stages and from adults in foraging grounds (Carr, Carr, & Meylan, 1978; Meylan, Meylan, Grey, 2011). In fact, ontogenic habitats for juvenile stages and adults are connected and overlapping to different extents, depending on the species and even ocean basin (Meylan et al., 2011). Developmental habitats for juvenile hawksbill turtles in the Caribbean seem to partially overlap with their adult foraging grounds, while adult green turtles seem to use their juvenile habitats as stopovers between their resident foraging and nesting areas (Meylan et al., 2011). In contrast, green turtle foraging and developmental grounds completely overlap in the eastern Pacific (Meylan et al., 2011), where a broad range of size classes are found in the same foraging grounds along the Mexican coast of Baja California (Seminoff, Resendiz, Nichols, 2002; Senko, López-Castro, Koch, Nichols, 2010) and the Galápagos Islands (Green, 1993). In Costa Rica, little is known regarding the characterization and connection of green and hawksbill turtle foraging grounds. Two pioneer studies regarding nesting hawksbill and green turtles in Tortuguero, Costa Rica, revealed the regional connectivity of this nesting beach with their foraging grounds in the Caribbean (Troëng, Dutton, Evans 2005; Troëng, Evans, Harrison, Lageeux, 2005). Satellite tracking of post nesting green turtles along Costa Rica's Northern Pacific coast allowed for the identification of regional adult foraging grounds (Blanco et al. 2012). An important inshore foraging ground for green and hawksbill turtles was recently identified in the Golfo Dulce, located in Costa Rica's south Pacific (Chacón-Chaverri, Martínez-Cascante, Rojas, & Fonseca, 2014a,b), which complements the first description of a foraging ground for resident subadult green and juvenile hawksbill turtles located at Punta Coyote, in the northern Pacific of Costa Rica (Carrión-Cortez, Canales-Cerro, Arauz, & Riosmena-Rodríguez, 2013).

The goal of this study was to identify future national sea turtle research guidelines,

designed to protect all life stages of eastern Pacific sea turtle populations and contribute to integrated regional sea turtle conservation strategies, by exploring new sea turtle foraging grounds along the North Pacific coast of Costa Rica.

MATERIALS AND METHODS

Study sites: Surveys were held at five sites: Bahía Matapalito, on the northern flank of Peninsula Santa Elena, Punta Argentina located in the outer Golfo de Papagayo, Punta Pargos and Punta Coyote occurring gradually south along the Peninsula de Nicoya, and Cabo Blanco on the southernmost tip of the Peninsula de Nicoya (Fig. 1). These sites were chosen after communications were held with key coastal community members (such as fishers), government officers of the National

Park Service, and professionals in the dive industry, all of whom had field experience regarding the frequency of sea turtle sightings along the Northern Pacific coast. Anecdotal information on historic sightings of sea turtles in certain areas was considered as well (including fisheries interactions). Bahía Matapalito ($10^{\circ}56'06''\text{N}$, $85^{\circ}47'42''\text{W}$) consists of a small inlet of less than one kilometer in diameter. In contrast to the bay's sandy bottom with scattered coral patches to the east, to the west the bottom hosts a large coral reef community that is partially exposed during low tide, and which extends into neighboring Santa Elena Bay. The site is subject to high fishing pressure by nearby fishing communities such as Cuajiniquil, Playas del Coco, as well as from Costa Rica's main fishing port Puntarenas, and including illegal fishers from Nicaragua (A. Lara, personal communication, April 21, 2012). Longlines

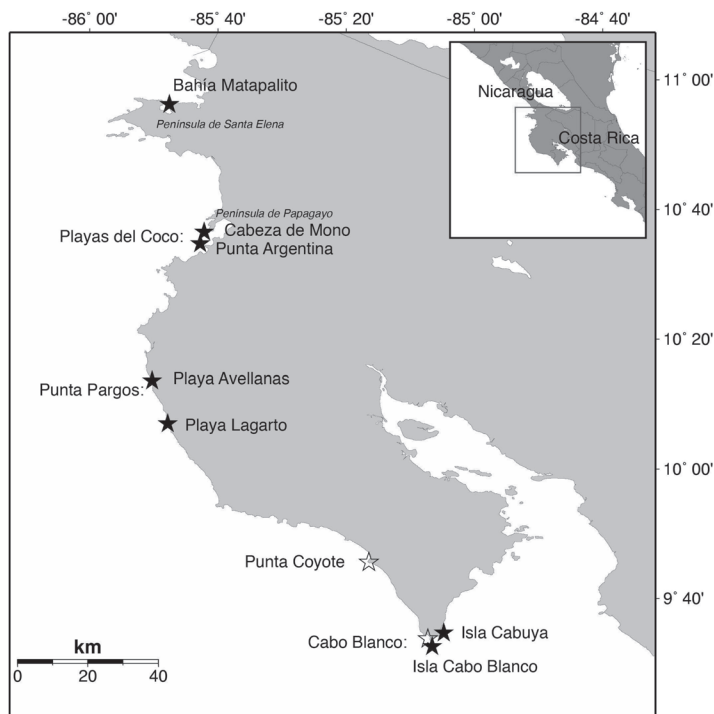


Fig. 1. Locations surveyed along the Nicoya Peninsula in the northern Pacific of Costa Rica during the present exploration (filled stars) and previous research (open stars).

Fig. 1. Ubicación de los sitios de muestreo a lo largo de la Península de Nicoya en el Pacífico Norte de Costa Rica durante la presente exploración (estrella rellena) e investigaciones previas (estrellas vacías).

and gillnets are frequently observed only a few meters from the shore (personal observation). Whilst the terrestrial portion of the Santa Elena Peninsula is included within the boundaries of Santa Rosa National Park, as well as the marine area along its southern flank, the marine area along the northern flank is not protected under any management category whatsoever. According to local dive masters operating out of Playas del Coco (10°34'44"N, 85°42'47"W), a popular dive destination, nearby Punta Argentina (10°34'44"N, 85°42'47"W) and Cabeza de Mono (10°36'32"N, 85°42'11"W) have the highest probability of sighting sea turtles in the surroundings. Playas del Coco and the whole surrounding coastline is highly developed, ranging from small local fisher communities to luxury resorts and hotels, which entails an associated elevated marine traffic with artisanal to semi-industrial fishing vessels, as well as motor boats and yachts of different sizes. Punta Pargos (10°07'05"N, 85°47'42"W) is a rapidly developing fishing community, highly influenced by international residents and tourists. Extensive rocky outcrops that expose large platforms during the low tide border the coastline, with scattered reef patches and a number of small sandy beaches, such as Playa Avellanas and Playa Lagarto. Punta Coyote (09°45'36" N, 085°16'30") also consists of a single rocky outcrop with coralline substrate, the waters along the southern flank of which are included in the the Caletas-Arío National Wildlife Refuge. San Francisco de Coyote, the closest community, consists of artisanal fisher families, who use gillnets and bottom long lines to target spotted rose snappers (*Lutjanus guttatus*) and spiny lobsters *Panulirus interruptus* (Carrión-Cortés et al. 2013). Cabo Blanco (9°32'31"N, 85°06'36"W) is the only study location that enjoys official protection under an Absolute Natural Reserve designation, the strictest management category of Costa Rica's protected area system, and extends over more than 3000Ha, of which 1800Ha are marine. Despite its official protection, marine resources in Cabo Blanco are highly threatened by illegal artisanal and small-scale fisheries, as well as

by sport fishers from the nearby communities of Cabuya, Montezuma and Puntarenas, who are often seen poaching in the protected waters.

Turtle capture, identification and measurements: Data at the five sites were collected irregularly during several field trips from 2010 to 2013. The presence of turtles was assessed by using two especially designed turtle tangle nets, each of 80m in length, 6m in depth and a 45cm stretch mesh size, built with nylon twine. During a single occasion we used a 100x4m shark fishing net with a maximum mesh size of 12cm in Bahía Matapalito, due to unavailability of turtle tangle nets at the moment. Additionally, we used scuba to closer examine study sites at Punta Argentina and Cabo Blanco. The nets were more or less set perpendicular to the beach, depending on current and wind directions, for a duration ranging from 3-6hr, and were checked every hour. Turtles captured were identified by species and brought onboard to record the curved carapace length (CCL), measured from the anterior nuchal scute to the posterior most edge of the carapace with a flexible measuring tape. All turtles captured were tagged on the second scale of each fore flipper with Inconel tags (style 681, National Band and Tag Company, Newport, Kentucky).

Catch per unit effort (CPUE) calculation and CCL comparison: The CPUE was expressed as the number of turtles caught per 100 m of headrope length per soaking hour. At each sampling site, average CCL (mean) and standard deviation (SD) was obtained for each species. Turtles were classified as juveniles or adults according to the published mean nesting size (MNS). Our reference MNS for *E. imbricata* was 80cm (Liles, Jandres, López, Marióna, Hasbún, & Seminoff, 2011) and 85cm for *C. mydas* (Fonseca et al., 2013) estimated from nesting populations along the Pacific coast of Costa Rica. Thus, when CCL<MNS or CCL>MNS, the individuals were respectively ranked as juveniles or adults (Seminoff et al. 2002a). Statistical comparison of variations

between surveyed sites was impossible due to significant data insufficiency and inconsistency.

RESULTS

Turtles captured and CPUE: A total of 28 hawksbill turtles and nine green turtles were caught during a total soak time of 392hr (Table 1). Hawksbill turtles were caught at all sites, whereas green turtles were absent from two (Punta Argentina and Punta Pargos). For practical reasons, Coyote sea turtle soak time is presented as separate data sets for each species. For instance, Carrion et al. 2013 published hawksbill CPUEs after 300 hours of soaking time. In this study, we present green turtle CPUE during that period, including 46 hours of additional soaking time.

Punta Coyote was by far the most surveyed site with 346hr (88.3%), where monitoring was constant from 2009 - 2012. In spite of the greater soaking time, this site is where the lowest CPUE for hawksbill turtles (0.04) (Carrion et al, 2013) and green turtles (0.01) occurred. The highest CPUE for hawksbill turtles (0.58) was recorded in Bahía Matapalito, as well as the second highest green turtle CPUE (0.08), with a soaking time of 12hr (3%). The second highest hawksbill CPUE (0.16) was recorded in Punta Argentina, the site with the lowest soaking time of 4hr (1%) followed by Cabo Blanco (0.07) with a soaking time of 19 hr (4.8%), and Punta Pargos (0.06) with a soaking time of 11hr (2.8%). The highest green turtle CPUE occurred in Cabo Blanco (0.1). No green turtles were caught at Punta Argentina nor Punta Pargos.

Size distribution: Most of the turtles caught (all of the hawksbill turtles and eight of the nine green turtles) were juveniles. Comparisons between sites or size classes were impossible due to insufficient data. The smallest hawksbill recorded was caught in Bahía Matapalito (CCL=31.0cm), the site that also exhibited the smallest CCL average for hawksbills at all foraging sites surveyed (42.46 ± 17.55 , $n=7$). The largest hawksbill turtle found at

TABLE 1
Data summary for *E. imbricata* and *C. mydas* foraging sites obtained during the present study and previous surveys

Study site	Soak time (h)	<i>E. imbricata</i>			<i>C. mydas</i>			Reference
		Turtles captured	CPUE	Mean \pm SD CCL (range) (cm)	Turtles captured	CPUE	Mean \pm SD CCL (range) (cm)	
Bahía Matapalito	12	7	0.58	42.46 ± 17.55 (31.0-52.2)	1	0.08	56.2	This study
Punta Argentina	4	1	0.16	49.6	0	0	-	This study
Punta Pargos	11	1	0.06	60.5	0	0	-	This study
Punta Coyote	300 ^{E.i.} • 346 ^{C.m.}	17	0.04	54.37 ± 12.82 (36.0-76.0)	5	0.01	69.40 ± 9.40 (57.2-80.0)	Carrion-Cortez et al., 2013 ^{E.i.} This study ^{C.m.}
Cabo Blanco	19	2	0.07	61.25 ± 13.08 (52.0-70.5)	3	0.1	67.67 ± 19.44 (50.0-88.5)	This study
Golfo Dulce	7546	62	0.01	56.5 ± 5.3 (34.8-81.1)	253	0.03	79.6 ± 0.9 (33.5-102.2)	(Chacón-Chaverri et al. a.b., 2014).

E.i. = Only accounts for *E. imbricata* data, *C.m.* = Only accounts for *C. mydas* data.

Matapalito was 52.2cm CCL, which represents the minimum size class found in Cabo Blanco (CCL=52.0cm) and the approximate size of individual turtles captured in Punta Argentina and Punta Pargos (CCL of 49.6cm and 60.5cm, respectively). The largest hawksbill was found in Cabo Blanco (CCL=70.5cm). Overall standard deviation was very large due to small sample numbers (range n=1-8), which is why these results are not representative for site-specific size classes. Three green turtles were caught in Cabo Blanco (mean CCL 67.67 ± 19.44), the largest of which was an adult female (CCL=88.5cm). Five green turtles caught in Punta Coyote showed a similar trend with an average CCL of 69.4 ± 9.40 cm, the largest of which was a subadult (CCL=80.0cm). The minimum size of both Cabo Blanco green turtles (CCL=50cm) and Punta Coyote (CCL=57.2 cm) were similar to the only green turtle caught at Matapalito Bay (CCL=56.2cm). This last turtle had a notably distinct morphotype, with a round and indented carapace with light brown-reddish scutes, as well as yellow skin and plastron. All other green turtles captured were gray colored with a heart shaped carapace, the typical morphotype of eastern Pacific green turtles.

DISCUSSION

Most of our study sites are characterized by exposed rocky outcrops and coralline substrates, highly influenced by tidal movements and waves. In the Caribbean, adult hawksbill turtles are typically found in such habitats (Meylan, 1988), as are juveniles in the Eastern Pacific (Carrión-Cortés et al., 2013). Hawksbill turtles recorded in Punta Coyote (Carrión Cortés et al. 2013) included several juvenile males, identified as such by secondary sexual characteristics such as notably elongated tails, and which turned out to be smaller CCLs than the previously reported MNS. The predominance of juvenile and subadult hawksbill turtles was also found at Cabo Blanco and Golfo Dulce (Chacón-Chaverri et al. 2014a, b), a site that has been monitored with similar methods using

turtle tangle nets since 2010 for a total of 7546 hr soaking hr. Interestingly, the foraging habitat at this last site is quite distinct from the rocky coastline of the Northern Pacific, consisting of mangrove swamps and large extensions of sea grass (Chacón-Chaverri et al., 2014a). Furthermore, the Golfo Dulce hawksbill aggregation seems to have a seasonal preference for this site, as significantly more turtles are caught during the dry season (from December to April) than during the rainy season (Chacón-Chaverri et al., 2014a). The contrary was found in Punta Coyote, where no seasonal difference was recorded in hawksbill catch rates. Consumption of food items for hawksbills, such as the sponge *Geodia* sp. and the tunicate *Rhopalaea birkelandi* depended on seasonal availability (Carrión-Cortés et al., 2013). Whether this difference in year-round habitat use at Golfo Dulce and Punta Coyote is due to distinct dietary or seasonal habitat preferences has yet to be studied. Our study sites at Punta Argentina, Punta Pargos and Cabo Blanco resemble the oceanographic and ecosystem characteristics exposed by Carrión-Cortés et al. (2013), which is why we would expect year-round presence of juvenile hawksbill turtles at these sites. Further evidence for this suggestion is given by one juvenile hawksbill turtle tagged with Inconel fore flipper tags at Punta Argentina on July 27 of 2012, which has been re-observed and reported by recreational divers in October, September and December of that year. Foraging ground fidelity was also confirmed at Punta Coyote through tag and recapture data (n=7 of 17 tagged turtles) (Carrión-Cortés et al., 2013) and Golfo Dulce (n=14 of 62 tagged turtles) (Chacón-Chaverri et al., 2014a).

Regarding habitat characteristics and size of captured hawksbill turtles during this study, Bahía Matapalito displays the greatest contrast with the other sites. A sandy bottom and adjacent extensive coral reef formations connect Bahía Matapalito during high tides with Bahía Santa Elena to the West. The seven hawksbill turtles caught at this site presented small CCLs, the largest reaching 50cm. All turtles were covered by different species of

barnacles and algae. During snorkeling, these hawksbills were observed resting underneath corals formations along the outer line that limits the reef from the sandy stretch, exposing the posterior end of their carapace. The high CPUE and small size category of hawksbill turtles in Matapalito Bay, as well as the habitat type, strongly suggest that this area is an important developmental ground. The area provides protection from rough oceanic conditions and larger predators found elsewhere in this region. In the Caribbean, size classes from 20cm to 55cm CCL and high recapture rate led Meylan et al. (2011) to identify Bermuda as a developmental ground for juvenile hawksbill turtles that recruit to benthic areas after their pelagic phase. Due to these distinct oceanographic conditions (Seminoff et al., 2012) and probable adaptive variations in the species' natural history (Gaos, Lewison, Yañez, Wallace, Liles, Nichols, Baquero, Hasbún, Vasquez, Urteaga, Seminoff, 2012a), this bay may well represent a first benthic developmental ground for Eastern Pacific hawksbill juveniles.

Punta Coyote and Cabo Blanco are dominated by large juvenile green turtles, both of which presented at least one individual with a CCL very close to adult size. Thus, these size classes probably reflect a developmental foraging ground dominated by subadults near maturity (Meylan et al., 2011). Such size classes at neritic foraging grounds found in Cabo Blanco and Punta Coyote are consistent with the demographic structure of other foraging sites reported for the region, such as Baja California and the Galapagos Islands (Seminoff, Resendiz, Nichols, Jones, 2002; Green, 2003). The mixed presence of large juvenile and adult green turtles is even more evident in Golfo Dulce, where mean CCL was 79.6 ± 0.9 (Chacón-Chaverri et al., 2014b). The constant overlap of juvenile and adult size classes at neritic green turtle aggregations throughout the Eastern Pacific suggests the overall absence of independent developmental grounds in this region (Meylan et al. 2011). In spite of the greater mean size for green turtles reported in the foraging habitat of in Golfo Dulce, it is at

this same site where the smallest green turtle was found (CCL=33.5cm) (Chacón-Chaverri et al., 2014b). This turtle however, appeared to be the exception of the overall low frequency of individuals under 65cm CCL. Our minimum sizes were higher than those found at Isla Gorgona (CCL=42.7; Amoroch, Abreu-Grobois, Dutton, & Reina, 2013) and Galapagos (CCL=46.2cm; Green, 2003), which suggests that juvenile green turtles foraging in Costa Rica do not recruit from their pelagic phase to the sites here surveyed, but rather originate from other habitats that host earlier development stages, thus highlighting the need of further explorations. Transpacific migrations have been demonstrated to occur in Eastern Pacific green turtles (Omuta, 2005; Nishizawa, Okuyama, Kobayashi, Abe, & Noobuaki, 2010), creating the possibility that at least some development grounds for juveniles born along the Eastern pacific recruit to neritic areas on the other side of the Pacific. One juvenile green turtle (CCL=56.2cm) caught in Bahía Matapalito displayed morphological characteristics similar to those genetically categorized as originating from the Western Pacific (Amoroch et al., 2013), suggesting a local congregation of geographically separated stocks. Nonetheless, further evidence such as genetic information, is required to assign a more precise origin of this turtle. The mixture of Eastern and Western-Pacific nesting stocks has been documented at Isla Gorgona (Amoroch, et al. 2013) and the Galapagos islands (Zárate, 2012) and could possibly occur in the northern Pacific of Costa Rica. Just like Isla Gorgona and Galapagos, Bahía Matapalito also serves as a feeding ground for locally nesting green turtles (Blanco et al., 2012).

In the Golfo Dulce (Chacón-Chaverri et al., 2014b), low recapture rates for green turtles (20 out of 253) may imply that few turtles are resident or that the foraging area is significantly larger than the sampling area. This observation together with the low CPUE at Punta Coyote and Cabo Blanco may indicate that at least in this region, juvenile and subadult green turtles are more mobile in their final developmental

stage. Alternatively, specific home range areas as proposed by Seminoff et al. (2002a), remain to be discovered along the Northern Pacific of Costa Rica, or are simply absent. In any case, our herein presented foraging sites might present habitats where turtles perform “stopovers” along their migrations routes between developmental areas (Broderick, Coyne, Fuller, Glen, Godley, 2007; Meylan et al. 2011).

In contrast, adult green turtles that nest along the Costa Rican Pacific coast, display a high degree of “internesting residency” relatively close to their nesting beaches (Blanco et al., 2012). Post nesting females tracked with satellite tags in Nombre de Jesús, one of the countries’ most important green turtle nesting beaches, revealed different and very large home range areas, concentrated north and south of the Santa Elena Peninsula and adjacent to Nicaraguan waters (Blanco et al., 2012). Consequently, these rather complex patterns may explain why we captured only one adult green turtle along the northern Pacific coast. In fact, this adult female might have been undertaking reproductive migrations, since November to January in Costa Rica is considered to be the peak-nesting season for this species (Fonseca et al. 2013).

Both hawksbill and green turtles use marine corridors close to the coast to move between their nesting and feeding grounds (Blanco et al., 2012; Gaos, Lewison, Wallace, Yañez, Liles, Nichols, Baquero, Hasbún, Vasquez, Urteaga, & Seminoff, 2012b). Thus, our herein presented foraging sites represent important habitats that connect Eastern Pacific sea turtle populations, although the geographical extent and direction must still be investigated. In order to strengthen regional conservation policy and to create national, integral conservation efforts based on information regarding habitat connectivity of different life stages, future research should imply novel and effective methods to determine the origins and possible destinies of sea turtles that forage, nest, and migrate along Costa Rica’s Pacific coast.

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RESUMEN

Existe poca información disponible sobre los sitios de forrajeo de las poblaciones de tortugas marinas del Pacífico Oriental, lo cual dificulta el diseño de estrategias de conservación tanto en el ámbito nacional como internacional. Realizamos observaciones en cinco sitios a lo largo del Pacífico Norte de Costa Rica (Cabo Blanco, Punta Coyote, Punta Pargos, Punta Argentina y Bahía Matapalito) entre el 2010-2013, utilizando redes de enmalle tortugueras con luz de malla de 45 cm, con el objetivo de explorar y documentar nuevos sitios de forrajeo. Estandarizamos la Captura Por Unidad de Esfuerzo (CPUE) como tortugas capturada por 100m de relinga superior por hora de inmersión, el cual varió de 0.06 en Punta Pargos hasta 0.58 en Bahía Matapalito para tortugas Carey (*Eretmochelys imbricata*), y de 0.01 en Punta Coyote hasta 0.10 en Cabo Blanco para tortugas verde del Pacífico (*Chelonia mydas*). Encontramos rangos de tamaño específicos por sitio para *E.imbricata* en Bahía Matapalito y Cabo Blanco, con promedio \pm Desviación Estándar (SD) del Largo Curvo de Caparazón (CCL) de 42.46 ± 17.66 cm y 61.25 ± 13.08 cm respectivamente. Tan solo se encontró un individuo en los demás sitios con CCL de 49.6 cm hasta 60.5 cm. Se capturaron tortugas verde en tres de los sitios observados, con CCL de 67.67 ± 19.44 cm en Cabo Blanco, 69.40 ± 9.40 cm en Punta Coyote, y un único individuo en Bahía Matapalito con un CCL de 56.2 cm. La ausencia de clases de tamaño de adultos para *E.imbricata*, así como de clases de tamaño de juveniles para la tortuga verde del Pacífico, enfatiza la complejidad de la distribución específica por especies durante las distintas fases de vida de las tortugas marinas en el Pacífico Oriental, y la necesidad emergente de implementar monitoreos a

largo plazo en diferentes sitios a lo largo del Pacífico Norte del país para comprender la conectividad entre hábitats. El presente estudio revela la existencia de sitios de forrajeo frágiles desprotegidos para la tortuga Carey y verde en el Pacífico norte de Costa Rica, y sirve de guía para futuras iniciativas de investigación para fortalecer estrategias de conservación en el ámbito nacional e internacional.

Palabras claves: Tortugas marinas, sitio de forrajeo, *Eretmochelys imbricata*, *Chelonia mydas*, Pacífico noreste, Guanacaste, Costa Rica.

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