Marine Turtle Newsletter

Issue Number 130 *November 2011*

Stranded olive ridley sea turtle found on Boavista Island, Cape Verde Archipelago; see pages 25-26 (photo: D. Cejudo).

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Reports

ISSN 0839-7708

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Guest Editorial: Did the BP-Deepwater Horizon-Macondo Oil Spill Change the Age Structure of the Kemp's Ridley Population?

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The BP-Deepwater Horizon-Macondo well blowout on 20 April 2010 and the ensuing oil spill in the northeastern Gulf of Mexico were human and socio-economic tragedies as well as environmental catastrophes for impacted marine and estuarine ecosystems (Crowder & Heppell 2011). Losses to threatened and endangered marine turtle populations could have been substantial (Bjorndal *et al.* 2011).

On 17 March 2010, the Draft Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*) was released for public review and comment (the final plan was released in September 2011: http://www.nmfs.noaa.gov/pr/pdfs/recovery/kempsridley_revision2.pdf). It showed that the outlook for recovery of the Kemp's ridley population was promising, based on demographic model projections made by the recovery team (see Caillouet 2010). However, the oil spill changed that outlook (Crowder & Heppell 2011), even though its actual impacts have not been fully evaluated. Oil spill-related Kemp's ridley strandings occurred, and efforts were made to retrieve them; those that were still alive were cleaned, rehabilitated, and later released (http://www.nmfs.noaa.gov/pr/health/oilspill). Evaluation of impacts of the oil spill and dispersants on the Kemp's ridley population will be ongoing, perhaps for many years. Further demographic modeling (Heppell *et al.* 2005, 2007; Crowder & Heppell 2011) could be essential to this evaluation, but the models, parameter estimates, and data time series must be updated and improved Caillouet (2010). Consideration also must be given to strandings that may have been related to shrimping in the northeastern Gulf of Mexico, prior to the temporary U.S. moratorium imposed on shrimping there in 2010.

Fortunately, four decades of conservation efforts and research laid a strong foundation for comparison of Kemp's ridley population status before and after the oil spill (TEWG 1998, 2000; Heppell *et al.* 2005, 2007; Crowder & Heppell 2011). Recent use of "what if?" demographic modeling suggested long-term detrimental effects on the Kemp's ridley recovery trajectory (Crowder & Heppell 2011).

Reports by Gladys Porter Zoo, Brownsville, Texas (e.g., Peña 2010 and a similar 2009 report presented by Patrick Burchfield, Gladys Porter Zoo) and postings on the National Park Service's Padre Island National Seashore web site (www.nps.gov/pais/naturescience/kridley.htm) showed substantial reductions in annual counts of nests (clutches laid) and hatchlings released in Tamaulipas, Mexico and Texas in 2010 as compared to 2009. For nesting beaches in Tamaulipas, there was a 37% reduction in nests and a 33.6% reduction in hatchlings in 2010 (Table 1). However, average number of hatchlings per nest in 2010 was 54 as compared to 52 in 2009.

Based on time series graphs, annual nests and hatchlings on Texas beaches were lower in 2010 than in 2009 (www.nps.gov/pais/naturescience/kridley.htm). Were these declines in Tamaulipas and Texas caused by impacts of the oil and dispersants, or by other influences? Part of the answer to this question will depend on whether the levels of effort directed toward counting nests, protecting eggs, and producing hatchlings in Tamaulipas and Texas in 2010 were the same, higher, or lower than in 2009. Counts of nests and hatchlings during the 2011 and subsequent nesting seasons in Tamaulipas and Texas will be very important in answering this question.

Assuming that levels of effort directed toward counting nests and hatchlings in Tamaulipas and Texas did not decline from 2009 to 2010, what then caused the substantial drops in nests and hatchlings in 2010? The oil spill occurred in the northeastern Gulf at the onset of the 2010 nesting season in the western Gulf, but nesting beaches in the western Gulf did not appear to be impacted. Therefore, for the oil spill to have reduced nesting in 2010, it would have had to kill large numbers of nesters directly or indirectly (e.g., by killing or tainting their prey), provide barriers preventing them from reaching nesting beaches in the western Gulf, or otherwise interfere with their ability to navigate to nesting beaches (see Putman *et al.* 2010). Alternatively, the decline in 2010 could represent a natural, alternate-year nesting oscillation, unrelated to the oil spill, or differences in environmental variables (e.g., temperature) during the nesting seasons of 2009 and 2010. Perhaps results from the 2011 nesting season will help answer such questions.

The oil spill could have had differential impacts on various life stages of Kemp's ridley, thereby altering the population's age structure and creating a potentially long-lasting and recognizable demographic mark. It might be recognizable in 2011 and in years to come. For example, the drop in hatchlings released in 2010 could make the 2010 cohort recognizable over many years. If this cohort can be followed over the years (e.g. by modeling its location in annual age structure), it could provide useful data for estimating age as sexual maturity, and perhaps other population vital statistics.

Any life stage-specific impacts of the oil spill likely would have been influenced by temporal-spatial distributions of the life stages in relation to temporal-spatial distribution of oil and dispersants (Collard & Ogren 1990; Putman *et al.* 2010). A "before spill-after spill" comparison of size distributions, or age distributions derived by transforming size to age using somatic growth curves, might reveal life stage-specific impacts if they occurred. There are many potential sources of information on sizes of Kemp's ridleys in the population, including the Sea Turtle Stranding and Salvage Network (STSSN), conservation programs on nesting beaches, in-water studies, and by-catch investigations.

	2009	2010	% Reduction
Registered Nests	21,144	13,302	37.1
Hatchlings Released	1,089,452	723,065	33.6

Table 1. Registered nests and hatchlings released on beaches in Tamaulipas in 2009 and 2010 (data from Gladys Porter Zoo annual reports for 2009 and 2010).

If age structure of the population was significantly altered by the oil spill or dispersants, Kemp's ridley recovery could be delayed (Crowder and Heppell 2011), by reducing population momentum and altering reproductive value of the population (Heppell *et al.* 2007; Caillouet 2010). Continued cooperation and collaboration among research groups in universities, government agencies, and non-government organizations in assessing and comparing (pre- and post-spill) annual size distributions and age structure will be essential to evaluating impacts of the oil spill. Investigators should provide public access to collected data, to encourage and facilitate independent assessments.

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Tracking Leatherback (*Dermochelys coriacea*) Hatchlings at Sea Using Radio and Acoustic Tags

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For leatherback turtles relatively little is known about the "lost year(s)" – the time elapsed between a hatchling's first contact with the ocean and the moment it is sighted again as a juvenile in neritic foraging grounds (Carr 1987) – and the factors that might drive the oceanic dispersal during this phase. Although floating particle models have been used to predict dispersal pathways of sea turtle hatchlings (Blumenthal *et al.* 2009), on the near-shore scale, where remotely sensed current data are unavailable, the trajectories taken by hatchlings are more difficult to predict. Frenzied swimming and strong coastal currents may distort the predictions of these "passive drifter" models. This justifies the need to study the actual movements of neonates as well as the near-shore processes that influence them. Tracking hatchlings can be challenging. Due to the animals' small size, the technological options are limited: satellite-based transmitters are (still) too large and heavy so tracking efforts need to be carried out entirely *in-situ* with lighter tags. Neonate sea turtles have been tracked successfully with miniaturized radio transmitters that were either fitted directly onto the hatchlings' carapace (leatherbacks: Liew & Chan 1995) or tethered to a float or "bobber" (green turtles: Okuyama *et al.* 2009). These efforts were limited to tracking a small number of turtles and typically used radio signals as a secondary cue, i.e. as backup in case the tracker(s) would lose sight of the turtle. Thus, the need to keep within visual range of the hatchlings makes it almost impossible to track more than one individual at a time. Interestingly, the use of active acoustic telemetry has been largely dismissed, despite the availability of very small tags (<5 g weight out of water) and the advantage of uninterrupted transmissions (unlike VHF signals that stop when a hatchling is diving). As part of a multi-year effort to study the oceanic dispersal of West-Pacific leatherback hatchlings departing the beaches of Papua's Bird's Head Peninsula (Indonesia, Fig. 1), a pilot study was carried out in July-August 2010 to determine the best tracking methods to use. We tested both acoustic and VHF (radio) tags in the field using stationary buoys and live hatchlings in order to evaluate tag performance and the practicality of each method.

Experiment 1: Overall performance of sonic vs. VHF transmitters. For this experiment, we hung one Sonotronics (www.sonotronics.com) acoustic tag (IBT 96-2-E, w = 4.9 g out of water, transmitting at 68 KHz) from a mooring buoy at a depth $z = 0.8$ m. We attached an ATS (www.atstrack.com) VHF tag (R1655, w = 1.1 g out of water, 149.102 MHz) to the upper (dry) part of the buoy, so that the antenna was at ~20-25 cm above sea surface, the same

Meters from moored buoy		Buoy location	Tag type†	Transmitter frequency	Z (m from sea surface)	Directionality (arc length in degrees)	Max signal strength (1-5 scale)
100	Exp 1	Surface	VHF	149.102 MHz	0.2	50	5
			IBT	68 KHz	-0.8	8	5
	Exp 2	Surface	VHF	149.280 MHz	0.2	50	5*
		Surface	IBT	72 KHz	-1.0	6	5*
		Submerged	IBT	78 KHz	-3.0	7	5
		Submerged	EMT	75 KHz	-3.0	6	5
200	Exp 1	Surface	VHF	149.102 MHz	0.2	70	5
			IBT	68 KHz	-0.8	10	5
	Exp 2	Surface	VHF	149.280 MHz	0.2	65	5
		Surface	IBT	72 KHz	-1.0	10	5
		Submerged	IBT	78 KHz	-3.0	10	5
		Submerged	EMT	75 KHz	-3.0	10	5
500	Exp 1	Surface	VHF	149.102 MHz	0.2	70	3
			IBT	68 KHz	-0.8	10	4
	Exp 2	Surface	VHF	149.280 MHz	0.2	70	4
		Surface	IBT	72 KHz	-1.0	10	4
		Submerged	IBT	78 KHz	-3.0	10	4
		Submerged	EMT	75 KHz	-3.0	10	5
800	Exp 1	Surface	VHF	149.102 MHz	0.2	65	3**
			IBT	68 KHz	-0.8	10	4**
	Exp 2	Surface	VHF	149.280 MHz	0.2	75	2
		Surface	IBT	72 KHz	-1.0	12	2
		Submerged	IBT	78 KHz	-3.0	10	2
		Submerged	EMT	75 KHz	-3.0	10	4
1200	Exp 1	Surface	VHF	149.102 MHz	0.2	Irreg.	2
			IBT	68 KHz	-0.8	10	2
	Exp 2	Surface	VHF	149.280 MHz	0.2	Irreg.	1
		Surface	IBT	72 KHz	-1.0	10	1
		Submerged	IBT	78 KHz	-3.0	10	1
		Submerged	EMT	75 KHz	-3.0	10	3
1500	Exp 1	Surface	VHF	149.102 MHz	0.2	Irreg.	1
			IBT	68 KHz	-0.8	10	1
	Exp 2	Surface	VHF	149.280 MHz	0.2	Irreg.	1
		Surface	IBT	72 KHz	-1.0	10	1
		Submerged	IBT	78 KHz	-3.0	10	1
		Submerged	EMT	75 KHz	-3.0	10	2

Table 1. Results of transmitter range, directionality and optimum depth tests (Experiments 1 and 2). †: IBT = Sonotronics IBT96 acoustic tag, VHF = ATS R1655 radio tag, EMT = Sonotronics EMT01-3 acoustic tag. * In Experiment 2, receivers were set at maximum gain from d = 100-1500m. ** In experiment 1, maximum gain was used for both the acoustic and VHF receivers at $d \geq 800$ m.

height as when affixed to a fishing bobber tethered to a hatchling (following the method of Okuyama *et al*. (2009)). We stopped the boat at distances of 100, 200, 500, 800, 1200 and 1500 m from the buoy to measure the maximum strength and directionality of the signals emitted by both transmitters. We used a 3-element VHF Yagi antenna and scanning receiver (ATS R410) to detect radio signals from the ATS tag, and a directional hydrophone (Sonotronics DH-4) with an ultrasonic receiver (Sonotronics USR-08) to detect "pings" from the sonic tag. We evaluated two parameters. The "maximum signal strength" received at each station and given on a qualitative scale of 1 to 5 (1 being weakest and 5 strongest) with the reference maximum strength (5) measured at 1 m from the transmitter. The second parameter we evaluated at each listening station was the "directionality", defined here as the arc length (in degrees) obtained

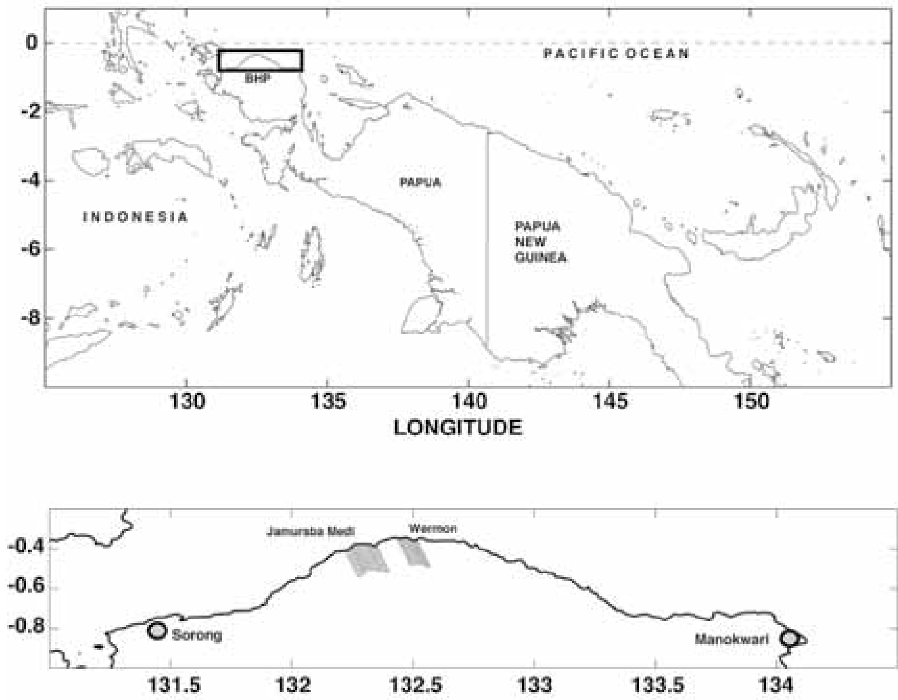

Figure 1. Leatherback nesting sites of Jamursba Medi and Wermon, on West-Papua's Bird's Head Peninsula (BHP).

by rotating the hydrophone or Yagi antenna while receiving signals of maximum strength. We measured the arc length using a digital compass (Garmin Oregon 450t) affixed to either the hydrophone pole or the handle of the Yagi antenna. We carried out this experiment during "calm (glassy)" sea state, following the World Meteorological Organization's Douglas sea scale (http://www.wmo.int/pages/prog/amp/mmop/faq.html).

Experiment 2: Optimum transmitting depth of sonic tag. The aim of the second experiment was to determine the optimal depth of the sonic tag when attached to the fishing bobber. It also provided an opportunity to repeat the radio tracking trial in order to see whether or not the results yielded during Experiment 1 were due to a malfunctioning VHF tag (Table 1). We used two buoys in an area where the water depth was 4 m, one floating at the surface and one consisting in a polystyrene disc floating in the water column at 2 m from the sea bottom. We tethered an IBT 96 tag (transmitting at 72 KHz) to the surface buoy so that it hung 1 m below the water surface (z=1m). We attached a new VHF tag (149.280 MHz) to the buoy as in Experiment 1. We hung an IBT 96 tag (78 KHz) 1m underneath the polystyrene disc (z=3m). We also attached a more powerful Sonotronics acoustic tag (Equipment Marking Transmitter EMT 01-3, transmitting at 75 KHz) to the disc at the same depth to assess the effect of higher transmission power on directionality and tracking range (signal strength). We used the same detection equipment and distances as in Experiment 1 and carried out the tracking during "calm (rippled)" sea conditions, with wavelets in the 0 to 0.1 m range.

Experiment 3: live trials with VHF tag. We tethered the VHF transmitter and bobber unit with a 2.5 m long strand of fishing line (0.13 mm, 2.7 kg strength) attached with a small hook to a pygal scute of a hatchling (Okuyama *et al.* 2009, see Fig. 2). A 1.9 cm plastic bobber (6.49 cm^3, weight out of water: 2.5 g) was tethered at the other end of the line. We glued a VHF tag onto the bobber so its antenna would rise 20 cm (its outstretched length) above the water line (Fig. 2). To contrast the dimensions of the tracking unit with the turtles, the reported average weights of Pacific leatherback hatchlings range from 40.5 g (East-Pacific: Jones *et al.* 2007) to 44.4 g (West-Pacific: Simkiss 1962). We painted the upper half of the bobber with fluorescent orange paint to facilitate spotting. We released a hatchling fitted with the bobber and VHF tag 250 m from shore during "smooth" sea state (wavelets in the 0.1-0.5m range) and tracked as follows: we recorded its initial position using a hand-held GPS unit (Garmin Oregon 450t) and then let it swim away for 10 min. The position of the hatchling was then tracked back using the Yagi antenna. After its new position was recorded we stopped the boat's engine and gave the hatchling a 20 min. head start before attempting to relocate it. Each subsequent lap was 10 min. longer than the previous one. We recorded 3 different laps, with the final one lasting 30 min. We repeated the experiment a second time with another hatchling and transmitter.

Experiment 4: live trials with acoustic tag. For this experiment, we fitted a hatchling with a 2.5 m strand of fishing line and one bobber (following the method employed in Experiment 3) to which we attached an IBT 96 tag (72 KHz) at z=0.8 m. We tethered another IBT 96 tag (78 KHz) to a second hatchling, using the same methods, but adding a bobber 2 m from the hook. We attached the tag to the second (distal) bobber, at 2.5 m from the hook and at z=0.8m (Fig. 3). We used two bobbers in order to facilitate spotting the hatchling, as previous experiments with the VHF tags showed a hatchling easily drags down one 6.49 cm^3 bobber during its frequent dives. The other advantage was that the alignment of the bobbers indicates the heading taken by the hatchling. We tracked both hatchlings simultaneously, in "smooth" sea conditions, and using the lap system of Experiment 3.

Superiority of acoustic tracking. The results given in Table 1 show that up to 200 m from the surface buoys (Experiments 1 & 2) the maximum signal strength of both the acoustic (sonic) and VHF tags was similar for up to 200 m from the surface buoys (Experiments 1 & 2). However, we found that the directionality

Figure 2. Bobber and VHF tag attached to a leatherback hatchling.

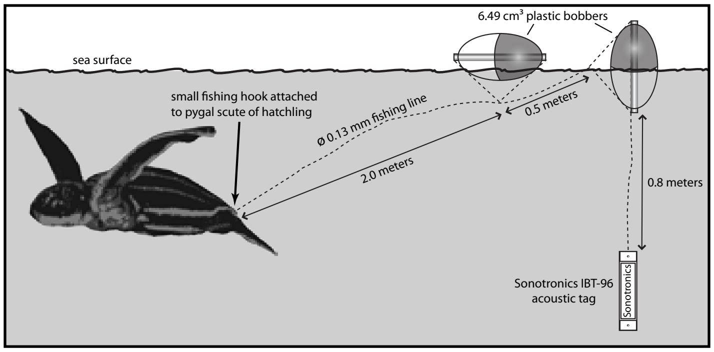

Figure 3. Acoustic tag with two bobbers tethered to a leatherback hatchling.

of the VHF transmitter was 50˚, versus 8˚ for the sonic tag. At subsequent distances we found that the directionality of VHF was never less than 65˚ arc length whereas we picked up the signal of the sonic tags within an arc length of 10-12˚ at all listening stations. At the 1200 m and 1500 m listening stations the directionality of the VHF tag was inconsistent: repeated sweeps with the Yagi antenna would each yield different arc length readings (Fig. 4). Both the IBT and VHF tags had similar signal strength decay throughout the testing range (Fig. 5). By enhancing the gain of the receivers, signals were still audible up to a distance of 1,500 m. There was no apparent difference in directionality and signal strength between IBT tags placed at z=0.8 m (Experiment 1), z=1 m and z=3m (Experiment 2). However, the more powerful EMT transmitter (which weighs 223 g and can by no means be used to track hatchlings) outperformed the smaller IBTs in signal strength, but had the same directionality (Experiment 2). The two live trials with VHF tags both failed within the first hour. The first two tracking laps (10 and 20 min) where successful with hatchlings traveling a total distance of 395 and 420 m. At the end of the third lap (30 min interval) we were unable to relocate the turtles. We interrupted the simultaneous tracking of two hatchlings using Sonotronics IBT tags after 60 min., since we were able to seamlessly relocate the hatchlings at the end of the first 3 laps using on average 3 listening stations.

First tracks of leatherback hatchlings. To validate the acoustic method, 20 hatchlings were tracked in July-August 2010. The main results of this preliminary study (to be published in the near future), were: (1) none of the tracked turtles were predated, (2) the presence of a near-shore tidal current deflecting hatchlings towards the West, (3) all turtles swam North to Northeast, (4) the effect of hydrodynamic drag of the tracking unit on the turtles' swimming behavior was *less* important than a) the effect of this West-flowing surface current, b) the level of fitness of the hatchlings and c) the state of the tide.

Conclusions and future directions. Tracking of VHF radio signals proved difficult even in calm sea conditions. The directionality was insufficient to easily find the correct bearing of the signal's source. A good level of directionality (small arc length) is especially important as the hatchlings' small size make them hard to spot at distances of over 40 m, even when dragging an orange bobber. At the distances of 1200 and

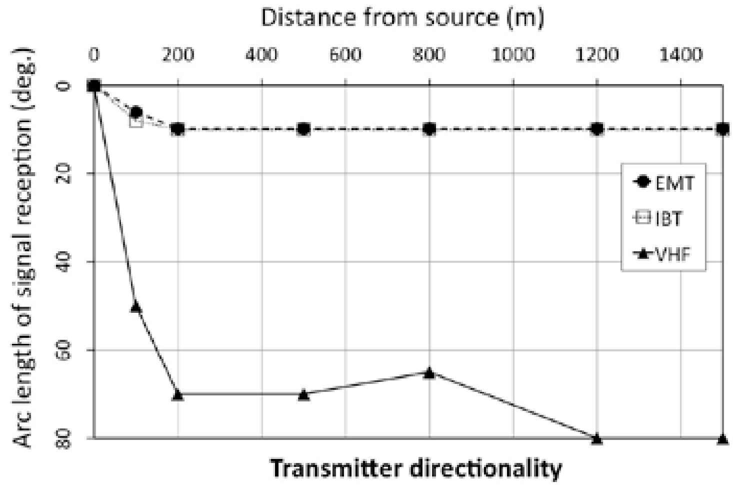

Figure 4. Transmitter directionality (Experiments 1&2). The NaN value represents the inconsistent arc length readings at d=1200 and 1500m.

1500 m, the irregular directionality is likely caused by the signal's range limit. The limitations of VHF tags were further illustrated during the two live trials, which we carried out in slightly rougher sea conditions. Failure to locate the hatchlings was likely the result of the compounded effect of poor directionality, intermittent diving and wave height possibly shielding VHF signals (waves occasionally taller than antenna). The outcomes of Experiments 1-3 show the inadequacy of using VHF signals as primary cue when tracking hatchlings. Conversely, the directionality of the sonic tags remained more than sufficient to move the boat to a closer listening station and consistently obtain a stronger and more spatially accurate signal. During the live trial (simultaneous tracking of 2 hatchlings) we only needed an average of 3 listening stops to move the boat close enough to sight the hatchling and record its exact position. The small arc length of the signal's reception area therefore reduces the chance of the tracker moving out of range of the signal, an important feature when tracking small organisms at sea, and even more so when taller waves make it difficult to spot the hatchling and/

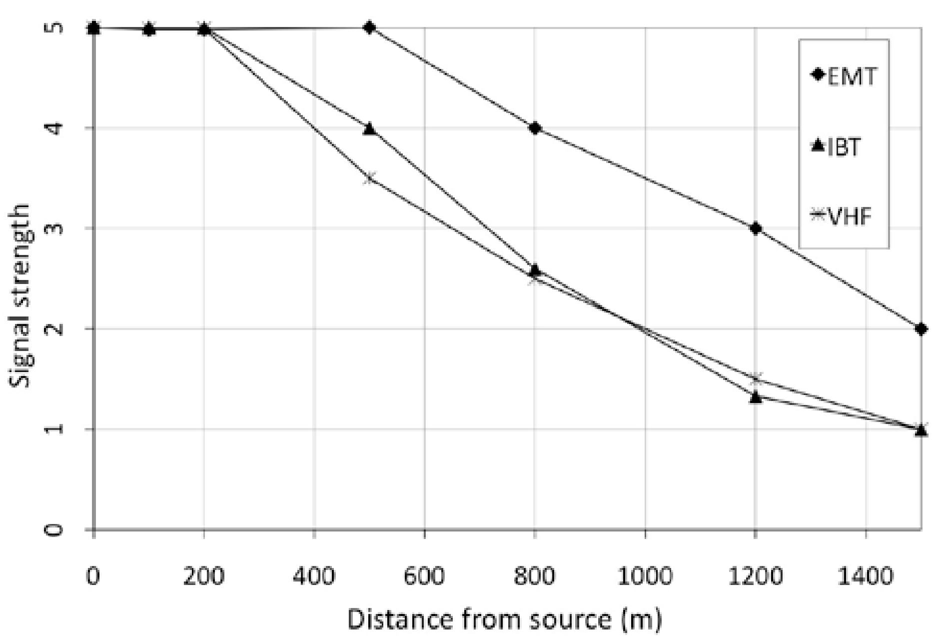

Figure 5. Transmitting range of acoustic and VHF tags (Experiments 1&2).

or the bobber. An additional advantage of acoustic telemetry is that the ultrasonic receiver is tuned to the specific frequency of the tag. The hydrophone picks up a limited amount of background noise, enabling to track without turning off the boat's engine. The more powerful EMT only surpasses the miniature IBTs in transmitting range, further supporting the suitability of the IBTs. The results of the four experiments enabled us to determine the type of tag and the basic setup to track Papuan leatherback hatchlings. Future improvements include reducing drag by using one larger bobber instead of two and fitting a small LED inside the bobber, allowing to track at least two hatchlings simultaneously at night. The first series of live trials using acoustic tags suggests that in the specific case of the Bird's Head Peninsula (Fig.1), predation at sea is limited. The presence of a surface current deflecting hatchlings towards the West shows the importance of resolving the oceanography on the near-shore scale in order to determine how and where hatchlings get entrained in larger scale features such as the New Guinea Coastal Current (NGCC), which reverses its direction seasonally (Ueki et al. 2003). The NGCC might therefore act as a "conveyor belt" distributing hatchlings either into the North or the South Pacific. Future work will focus on connecting the different spatial and temporal scales through a dispersal model that merges in-situ tracking data, Lagrangian drifters and remote-sensing data. This will provide a useful tool to validate existing "passive drift" models for hatchlings such as the one developed by Hamann *et al.* (2011).

Acknowledgments. We thank Dr. Mark V. Erdmann for his unwavering support of GG over the years. Thanks to Pak Ishak, Pak David, all UNIPA and WWF staff and students at Jamursba Medi for their day-to-day assistance during field work, as well as to Barakhiel Heri and Deasy Lontoh for providing hatchlings from Warmamedi. This work was carried out under permit through UNIPA with funding from Conservation International and Scripps Institution Of Oceanography.

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Status of Marine Turtles in Cuthbert Bay, Middle Andaman Islands

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Four of the seven known species of marine turtles are found in Indian waters; the leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), green (*Chelonia mydas*) and olive ridley (*Lepidochelys olivacea*) turtles. Status surveys and studies show that the Andaman and Nicobar Islands have the largest nesting populations of leatherback, hawksbill and green turtles in India (Andrews *et al.* 2006a; Bhaskar 1979a, 1979b, 1993; Kar & Bhaskar 1982). They are also known to have important feeding grounds for hawksbill and green turtles (Andrews *et al.* 2006a; Bhaskar 1993). The leatherback nesting population in the Nicobar Islands is the largest in the south Asian region (Shanker & Andrews 2002). Green turtles are widely distributed throughout the islands (Bhaskar 1979a, 1993, 1995). Hawksbill turtles also nest in small numbers throughout the islands (Bhaskar 1993, 1996).

Olive ridley turtles nest in large numbers on the east coast of India, with mass nesting sites in Orissa. Genetic studies have shown that the population on the east coast of India is the evolutionary source for global olive ridley populations (Shanker *et al.* 2004). In the Andaman Islands, sporadic nesting of olive ridleys occurs at many sites (Andrews *et al.* 2001; Bhaskar 1993), with mini *arribadas* reported from a few beaches (Bhaskar, 1994).

This study was initiated to monitor the nesting of sea turtles in the Andaman and Nicobar Islands. During the study, threats to marine turtles were also documented. In this paper, we compile and analyze nesting data from 2001 to 2006 at Cuthbert Bay nesting beach in the Middle Andaman Islands. We also provide brief comments on the conservation of marine turtles in the Andaman and Nicobar Islands.

Study area. The Andaman and Nicobar Island are a group of islands in the Bay of Bengal. They extend from 6°45′ - 13°41′ N (740 km) to 92°12′ - 93°57′E (190 km). The archipelago consists of >345 islands, islets and outcrops. Cuthbert Bay is located on the northeastern part of Middle Andaman Island (12.7°N, 92.96° E). The beach is relatively long with a gentle slope throughout its length. The northern end is rocky and curves into a small cove edged by large calcified rocks. It is cut at the southern end by a tidal creek flowing to the sea. The creek bifurcates the beach into two segments of ~3.5 km each, though most turtle nesting occurs in the northern half. It is vegetated by shrubs and coastal vegetation, and is dominated by *Hibiscus tiliaeceous* and *Ipomea pescaprae*. The beach is subject to various human uses from minor sand mining to the presence of humans and pet/feral dogs from the adjacent village, though the northern half where most of the nesting occurs is less affected.

Cuthbert Bay nesting beach (Fig. 1) was monitored from 2001 to 2006 during the nesting season, which extends from mid-November to mid-April. Surveys were initiated on January 20, 2001 and continued till March 10, 2006. Continuous ground surveys were carried out and beaches were monitored every night during the nesting season. Turtle nests and tracks were counted. Each identified sea turtle emergence was classified as either a "false crawl" or a "nest". A false crawl was identified as an emergence with only a crawl, or a crawl with one or more typically uncovered nest cavities. Crawls with typical nest area excavations were inferred to indicate successful nesting attempts. Successful nesting crawls were categorized as fresh (crawls with visible flipper marks), and old (those with either only the nest excavation mound and/or faint tracks visible). For turtles that were encountered, the curved carapace length (CCL) and width (CCW) were measured using a measuring tape. Olive ridleys were marked by using a small hacksaw to notch the edge of the carapace. Dead turtles and details of nest predation were also documented.

Nesting trends and seasonality. Olive ridley, leatherback and green turtles were observed to nest at the Cuthbert Bay nesting beach (Table 1) throughout the monitoring period. In 2001, 32 olive ridley nests were counted. Eight green turtles or tracks were observed, of which 2 nested. There were no reports of leatherback nesting activity.

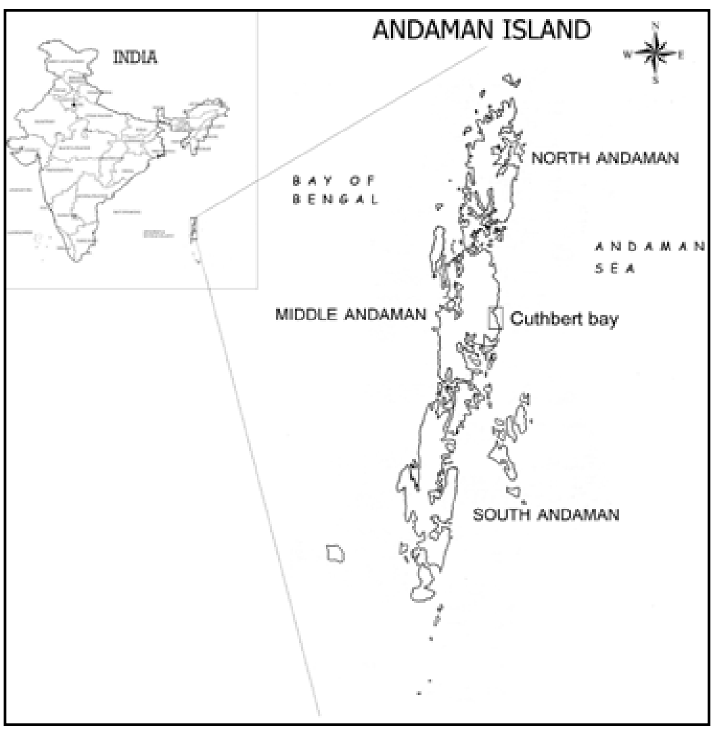

Figure 1. Map of Andaman & Nicobar Island with an outline of Cuthbert Bay nesting beach.

In the 2003- 2004 nesting season, 368 olive ridleys nests were counted, of which 41 were predated by feral dogs. Sixteen olive ridley turtles were found dead, due to either feral dog predation (6) or possible drowning in fishing nets (10). Several had injuries on their flippers or head which may have been caused by dogs, or due to entanglement in fishing nets. During that season, 9 green turtle nests were counted. Eleven green turtles were found dead on the beach. Fifteen leatherback turtle nests were counted during the season.

Turtle nesting was not high during the next season as a tsunami hit the coast on 26 December 2004. Seventy-two olive ridleys nests, four green turtle nests and two leatherback turtles were enumerated. Fourteen olive ridley turtles were found dead on the beach; as in previous years, these may have been caused by dogs or entanglement in fishing nets. The number of nesting turtles dropped in comparison to previous years at Cuthbert Bay.

In the 2005-2006 nesting season, the year after the tsunami hit the coast, 93 olive ridley nests were counted and 14 olive ridleys were found dead on the beach. The nesting numbers remained low with respect to the 2003-2004 season. Six green turtle nests were counted, but no leatherbacks or nests were observed on the beach during this season.

There is a clear peak in nesting from January to March, particularly for olive ridley turtles, as has been documented earlier in the islands (Bhaskar 1993) and on the east coast of India (Shanker *et al.* 2003). Too few leatherback and green turtle nests were documented to infer seasonality, but in general, leatherback turtle nesting peaks from November to March and green turtles nest principally during the monsoon in the Andaman and Nicobar Islands (Andrews *et al.* 2006a, Bhaskar 1993).

Olive ridley nesting patterns. The number of olive ridley nests at Cuthbert Bay is high in comparison to other sea turtles (Table 1). They usually start nesting in the month of November when several false crawls are observed. The number of nesting turtles increases in January, peaks in February and ends by April (Table 2). However, nesting peaked only in March in 2004-2005, believed to be because of disturbance at the nesting site as a result of the December 2004 tsunami. There was no monitoring in 2002.

Previous surveys indicate that a significant number of olive ridley turtles nest at Cuthbert Bay. In the 1988-89 season, 338 nests were reported from this site (Misra 1990), while over 700 nests were reported from the 1990-1991 and 1991-92 seasons, and over 900 nests during the 1993-94 season (Bhaskar 1994). Small arribadas

Year	Survey dates	Olive ridley	Green turtle	Leatherback
2001*	20/1/01-24/4/01	32	2	0
2003-2004	11/11/03-18/4/04	368	9	15
2004-2005	19/11/04-30/4/05	72	4	2
2005-2006	26/10/05-3/10/06	93	6	0

Table1. Number of nests counted at Cuthbert Bay during 2001-2006 monitoring period. * - data from February 20, 2001; no data available for 2002.

Months	*2001	2003-2004	2004 - 2005	2005 - 2006
November	-	11	1	4
December	-	48	10	13
January	-	87	10	42
February	27	114	17	28
March	5	99	25	6
April	0	9	9	0

Table 2. Number of nests of olive ridley turtles (*Lepidochelys olivacea*) at Cuthbert Bay from 2001-2006. * = data from February 20, 2001; no data available for 2002.

have been reported to occur at this site in the past. From 1990 to 1992, 100 to 200 turtles were reported to have nested on each of several nights during the season, constituting 60-70% of the total nesting for the season (Bhaskar 1994). During the survey, 2003-2004 was the best nesting season with 338 nests, and 114 nests in February alone (Table 2). Post tsunami, the number of the olive ridley nests appeared to have declined at this site. This needs to be verified with surveys in the future.

The olive ridley population nesting at Cuthbert Bay shows an annual mean clutch size ranging from 110.2 to 121.6. Mean clutch size was greater in 2005-06 than the other years (Kruskal Wallis $p < 0.05$). Mean clutch size was greater in December and February than other months during 2003-04 (Kruskal Wallis $p < 0.05$), but there was no significant variation in within-season clutch size during the 2004-05 and 2005-06 seasons (Fig. 2).

At Cuthbert Bay, all nesting females were reported to have curved carapace length (CCL) above 62 cm, which is the minimum recorded size for nesting females in the region (Pandav 2000). The annual mean CCL of nesting females ranged from 68.2-70 cm (Table 3). Unlike the population in Orissa which has been showing a decline in adult sizes (Shanker *et al.* 2003), the adult size of olive ridley turtles did not appear to change during this period at Cuthbert Bay.

Threats. Sea turtles are protected under Schedule 1 of the Indian Wild Life Protection Act (1972). Though indigenous aboriginal groups in the Andaman and Nicobar islands are exempt from this law, the level of take is fairly low. However, a variety of other threats to sea turtle populations in the Andaman Islands have been reported by several authors (Andrews *et al*. 2001, 2006b; Bhaskar 1979b; Sivasunder 1996).

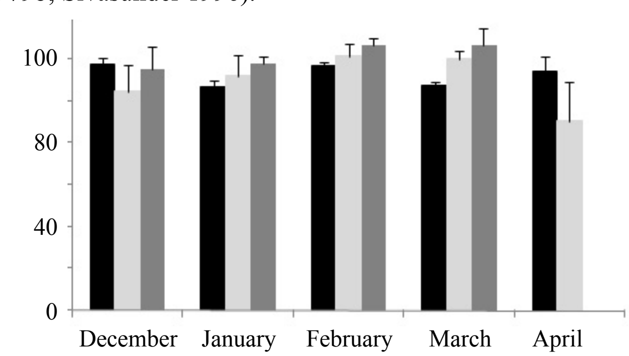

Figure 2. Average clutch size of olive ridley turtles on Cuthbert Bay beach by month and year (black bars represent 2003-04, light grey bars represent 2004-05, dark grey bars represent 2005-06).

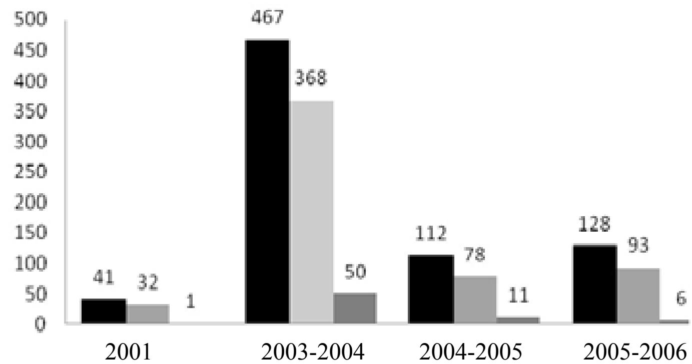

Figure 3. Threats to olive ridley turtles at Cuthbert Bay during 2001-2006 (black bars represent total olive ridley tracks encountered; light grey bars represent total olive ridley nests; dark grey bars represent the total nest predation/dead turtles encountered).

During the study, several turtles were found dead each year on the shore either due to possible drowning in fishing nets, or were attacked by dogs when they come ashore to nest. The major threat to sea turtles in the islands is nest predation; several nests get predated by dogs and pigs (Fig. 3) However, nest predation has been estimated at about 3% at Cuthbert Bay, which is low in comparison to 70% in the rest of the Andaman and Nicobar Islands (Andrews 2001). The low predation levels may be due to the presence of researchers and Forest Department personnel on the beach for monitoring. The other threat to sea turtles at Cuthbert Bay is from local people (non-aboriginal groups who have settled in the islands) who consume both meat and eggs, but again, levels of take are low.

Many nesting beaches in the Andaman and Nicobar Islands were severely affected by the December 2004 tsunami (Andrews *et al*. 2006b). The effect was not as severe at Cuthbert Bay nesting beach as observed at other nesting sites in the Andaman and Nicobar Islands. Olive ridleys and green turtles were observed to have nested here after the tsunami. Surveys carried out in subsequent years (Andrews *et al.* 2006c) show formation of new beaches and the possible recovery of nesting populations at several sites in the islands.

Conservation and Management. Sea turtle conservation and management on the islands comes under the purview of the Andaman and Nicobar Islands Forest Department (ANFD). The Forest Department has management plans and guidelines for the conservation of marine turtles, with a small protection force posted in some of the critical areas and islands. However, the remoteness of most of the areas and islands, logistics, weather conditions and rough seas make it difficult to monitor and patrol beaches in the islands

Year	Sample Size	CCL	CCW
2001	32	70.0 (3.1)	69.0 (6.1)
2003-2004	209	68.2 (3.6)	68.6 (3.2)
2004-2005	65	69.0 (4.7)	69.0 (4.2)
2005-2006	79	69.1 (2.4)	68.6 (2.1)

Table 3. Mean size of female olive ridleys nesting at Cuthbert Bay from 2001-2006 (standard deviation in parentheses)..

Year	Mean	SD	n	Range
2003-2004	112.3	1.15	296	105-118.7
2004-2005	110.2	1.2	47	93-121.7
2005-2006	121.6	1.2	81	115.4-126.8

Table 4. Clutch sizes of olive ridleys at Cuthbert Bay from 2003-2006.

on a regular basis. The lack of adequate staffing, infrastructure and equipment makes their task even more difficult.

Since 1977, the Madras Crocodile Bank Trust (MCBT) has conducted sea turtle surveys and studies on the islands. Over the last decade, the Andaman and Nicobar Island Environmental Team (ANET), a division of MCBT, has been conducting surveys and monitoring sea turtles in the Andaman and Nicobar Islands. ANET works closely with the Andaman and Nicobar Forest Department and conducts long term monitoring, surveys and research. The team has an on-going environmental education programme for school children and teachers. Together with Kalpavriksh, ANET produced a teachers training manual in two languages for the islands that includes sea turtles. Since 2007, ANET has collaborated with the Indian Institute of Science to carry out a research and monitoring programme principally for leatherback turtles on Little Andaman Island, including tagging and satellite telemetry.

Though the islands have several important feeding and nesting populations of sea turtles, the logistic difficulty of establishing and maintaining conservation programmes hampers the formulation of appropriate conservation and management plans. There is a need to work closely with and train local authorities, mainly the Forest Department, towards long term monitoring and protection of these nesting beaches. Periodic surveys across the islands and regular monitoring at index beaches are required. Ongoing research needs to be expanded, especially to in-water studies of green and hawksbill turtles.

Greater awareness needs to be created amongst local settler communities and the administration. There is considerable apprehension amongst environmentalists about plans for tourism and development in the islands. These actions could have severe consequences for sea turtles and in particular, their habitats. Hence, it is imperative that the conservation of marine turtles and their nesting and feeding habitats is incorporated into developmental plans for the islands.

Acknowledgments. We sincerely thank all the people who assisted in the field for data collection, especially the Andaman Nicobar Environmental Team (ANET) and the Madras Crocodile Bank Trust (MCBT). We extend our gratitude to the Andaman and Nicobar Forest Department and to the Ministry of Environment and Forests for providing access to protected areas and permits for monitoring sea turtles. We particularly thank Manish Chandi, Saw Agu and Naveen Ekka from ANET for their help in setting up the field camps. We also acknowledge the work of the late Ambika Tripathy at this site during 2004; Ambika was tragically killed during the 2004 tsunami at the ANET base on Great Nicobar Island along with seven others.

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Green Turtle (*Chelonia mydas*) Mortality in the Galápagos Islands, Ecuador During the 2009 – 2010 Nesting Season

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Four sea turtle species, *Chelonia mydas*, *Dermochelys coriacea*, *Eretmochelys imbricata*, and *Lepidochelys olivacea*, are found in the Galápagos Biological Reserve of Marine Resources (GMR) (Green & Ortiz-Crespo 1981; Hurtado 1984; Pritchard 1971; Seminoff 2004). However, *C. mydas* is the only species that occurs in high numbers and is known to routinely nest in the archipelago, with an estimated 1,800 nesting events from two monitored beaches in 2008 (Zárate 2009a). *Chelonia mydas*, like all species of sea turtles, are susceptible to morbidity and mortality caused by anthropogenic impacts. These impacts include intentional and illegal egg collection and harvesting of adults, accidental fisheries related by-catch, pollution, disease, and coastal development (George 1997; Lutcavage *et al.* 1997; Seminoff 2004).

In the eastern Pacific Ocean, the most important nesting site for *C. mydas* historically was Michoacán, Mexico (Alvarado & Figueroa 1990; Seminoff 2004). However, the exploitation of eggs and adults led to a population decline of 90% of this nesting colony (Alvarado & Figueroa 1990; Seminoff 2004). Today, the Galápagos Islands is one of the most important nesting sites for green turtles in the Eastern Pacific, with the population currently classified as stable over time (National Marine Fisheries Service & U.S. Fish and Wildlife Service 1998; Seminoff 2004).

Regulations on fishery activities and patrolling of marine habitats and nesting beaches ensure protection of sea turtles within the 138,000 km^2 GMR (Heylings *et al*. 2002). However, due to the extensive area involved, it has proven difficult to enforce environmental laws. For example, a pilot study on threats to *C. mydas* in the archipelago demonstrated that the main causes of mortality were due to anthropogenic interactions, including collision with vessels and interactions with fishing gear (Zárate 2009b).

We investigated the causes of mortality in stranded green turtles recovered from three nesting beaches in Galápagos during the 2009-2010 nesting season, and compared causes of mortality between the sites.

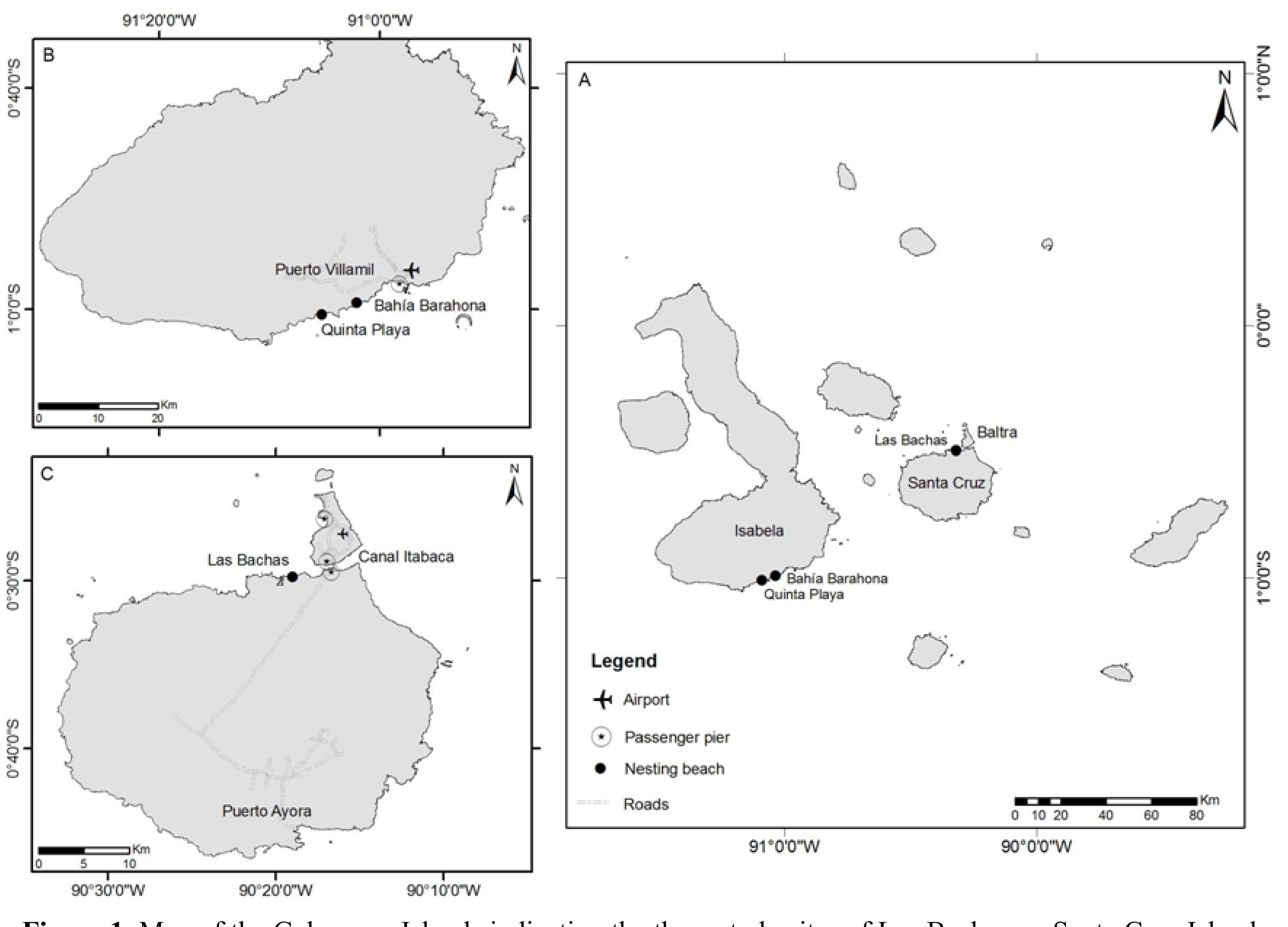

Figure 1. Map of the Galapagos Islands indicating the three study sites of Las Bachas on Santa Cruz Island, and Bahía Barahona and Quinta Playa on Isabela Island.

			Anthropogenic							
Site	Age	Sex	Fisheries Interaction	Boat collision	Human consumption	Debris ingestion	Possible anthropogenic	Natural	Unknown	Total
Quinta Playa	Adult	Male	1	2	none	none	none	1	5	
Quinta Playa	Adult	Femlae	7	3	none	1	1	none	5	
Quinta Playa	Adult	?	6	none	none	none	none	1	8	
Quinta Playa	Juvenile	?	1	1	none	none	none	none	none	
Quinta Playa	?	?	1	none	none	none	none	none	none	44
Bahía Barahona	Adult	Male	none	1	none	none	none	none	1	
Bahía Barahona	Adult	Female	2	none	none	none	none	none	none	
Bahía Barahona	Adult	?	2	none	2	none	none	none	none	
Bahía Barahona	Juvenile	?	none	none	none	none	none	none	none	
Bahía Barahona	?	?	none	none	none	none	none	none	none	8
Las Bachas	Adult	Male	none	none	none	none	none	none	none	
Las Bachas	Adult	Femlae	none	none	none	none	none	none	1	
Las Bachas	Adult	?	none	none	none	none	none	none	none	
Las Bachas	Juvenile	?	none	none	none	none	none	none	none	
Las Bachas	?	?	none	none	none	none	none	none	none	1
All sites	Adult	Male	1	3	none	none	none	1	6	
All sites	Adult	Femlae	9	3	none	1	1	none	6	
All sites	Adult	?	8	none	2	none	none	1	8	
All sites	Juvenile	?	1	1	none	none	none	none	none	
All sites	?	?	1	none	none	none	none	none	none	53
All turtles			20	7	2	1	1	2	20	53

Table 1. Stranded green turtles in Galapagos, Ecuador found during the nesting season of 2009-2010 and classified by location, age, sex, and cause of death.

Figure 2. Sea turtle mortality caused by anthropogenic impacts: (a) evidence of collision with vessel based on carapace longitudinally lesion; (b) clean cut of head and flippers indicative of interaction with fisheries; (c) human consumption based on all soft tissues removed from the turtle with evidence of sharp dissection; (d) marine debris with rope in the esophagus that exited through the oral cavity.

Data were collected from all stranded turtles observed during annual tagging and monitoring of nesting females at three beaches, Quinta Playa and Bahía Barahona on Isabela Island, and Las Bachas on Santa Cruz Island (Fig. 1). Quinta Playa, located in southwest Isabela (1° 0´19.56"S, 91°4´49.36"W) is 2 km in length. This beach is free of obstructions except for rocky areas at the extreme ends, and is largely backed up by a salt lagoon. This is one of the best turtle nesting beaches in the archipelago and located approximately 15 km from Puerto Villamil, a town of 2700 (Emmanuel Cléder, personal communication; Pritchard 1975). People from the town may access the beach by foot (approximately 5 hr), or boat (approximately 30 min). Bahía Barahona, 1.2 km in length and also located in southwest Isabela (0° 59´20.77"S, 91° 01´52.07"W), is the second most important nesting site for green turtles in Galápagos (Hurtado 1984; Pritchard 1975). This beach is located approximated 9 km from Puerto Villamil and can be accessed from town, either by walking 2 hr or by boat. Hunting, surfing, and tourism are especially common at this beach due to its close proximity to Puerto Villamil. Las Bachas, located on northern Santa Cruz (0° 29´39.91"S, 90° 20´32.19"W), is 43 km from Puerto Ayora a town of 21,233 people (Emmanuel Cléder, personal communication) and divided into two nesting beaches of approximately 1 km length. The only access is by boat and can easily be reached from nearby Canal Itabaca, an area with heavy boat activity for local transport and tourism as it is the only access to the main airport in the islands. All three nesting sites are located within the GMR, a management category that covers out to 40 nautical miles to sea and which indicates their use

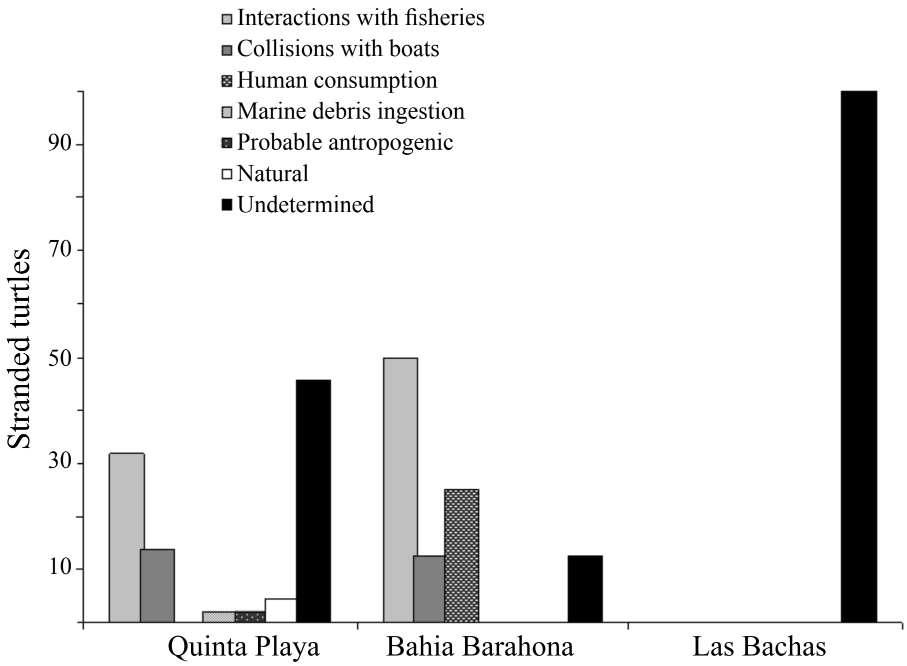

Figure 3. Causes of mortality for stranded green turtles recovered at three sites in the Galapagos Islands during the 2009-2010 nesting season. Quinta Playa (n = 44), Bahía Barahona (n = 8), and Las Bachas (n = 1).

for conservation and extractive (e.g., fishing) and non-extractive uses (Heylings *et al.* 2002). Additionally, Las Bachas is a favorite tourist site, receiving an average of 3 boats and approximately 50 tourists daily (Zárate & Dutton 2002).

For each stranded turtle, we recorded sex based on tail length, morphometrics including curved carapace length (CCL) and width (CCW), and causes of mortality based on gross external lesions, and in nine turtles based on complete necropsies (Work 2000). Photographs were taken of the majority of the turtles and the remains of all individuals were buried in the sand to avoid double counting of turtles.

Causes of mortality were classified into four main categories, including anthropogenic, possible anthropogenic, natural, and undetermined. Anthropogenic impacts were further divided into (1) interaction with fisheries, (2) collision with boats, (3) human consumption, and (4) marine debris ingestion. Lesions supportive of each of these categories were (1) marks consistent with fishing line, sharp dissection of flippers, and / or head and in some cases evidence of drowning based on airway hyperemia, foam and froth in airways, and seawater in the digestive and respiratory systems (Koch 2006; Zárate 2009b; Work & Balazs, 2010), (2) linear fractures in the carapace or head indicative of propeller or hull impact (Phelan & Eckert 2006), (3) carapace and plastron cleaned of all musculature, and (4) marine debris such as plastic, fishing line, hooks, aluminum foil, rubber or tar found within a turtle (Bjorndal *et al.* 1994), respectively.

The second category, possible anthropogenic impact, was based on severe damage to the flippers and / or carapace suggestive of sharp dissection, but due to an advanced state of decomposition cause of death could not be determined with certainty. The third category, natural causes, included those turtles that appeared to have succumbed to hyperthermia and dehydration after having been mis-oriented away from the ocean. Also included in this category were turtles that had evidence of severe parasitism. The fourth category included turtles in which the cause of death could not be determined either due to the advanced state of decomposition or the lack of any gross lesions.

Prevalence was defined as the number of stranded turtles with an attribute (e.g., site, month, cause of stranding) over all stranded turtles and 95% confidence intervals are provided (Thrusfield 2007). Chi-square tests or Fisher's exact tests were used to compare number of stranded turtles by site, category of mortality, and cause of anthropogenic related mortalities. Results were analyzed using a commercial statistical software package (NCSS, Kaysville, Utah; SPSS, version 13.0, Chicago, IL., USA).

Fifty-three stranded green turtles were recorded during the 2009-2010 nesting season and included 44 (83%; 70.8-90.8) on Quinta Playa, 8 (15.1%; 7.9-27.1%) on Bahia Barahona, and 1 (1.9%; 0.3-9.9%) on Las Bachas (Table 1). There were significantly more stranded turtles on Quinta Playa than the other two beaches (chi-square test; $P<0.001$), although we spent 7 and 58 more days monitoring on Quinta Playa then on Bahia Barahona and Las Bachas, respectively. Anthropogenic causes accounted for 56.6%

	Quinta Playa		Bahía Barahona		Las Bachas		
	Start date	End date	Start date	End date	Start date	End date	Source
2002	14-Dec-01	29-Apr-02	10-Dec-01	29-Apr-02	7-Jan-02	28-Apr-02	Zárate 2002
2003	17-Feb-03	17-May-03	18-Feb-03	15-May-03	26-Jan-03	9-May-03	Zárate 2003 a,b
2004	15-Dec-03	14-May-04	15-Dec-03	14-May-03	18-Jan-04	14-May-04	Zárate 2004; Páez & Zárate 2004
2005	14-Dec-04	16-May-05	18-Dec-04	15-May-05	9-Jan-05	16-May-05	Zárate & Chasiluisa 2005; Zárate 2005
2006	15-Dec-05	16-May-06	22-Dec-05	16-May-06	12-Feb-06	19-Feb-05	Zárate 2006 a,b
2007	10-Jan-07	12-Jun-07	17-Jan-07	9-Jun-07	Not monitored in 2007		Zárate *et al.* 2007
2008	9-Feb-08	10-Apr-08	12-Mar-08	31-Mar-08	14-Apr-08	17-Apr-08	Zárate 2009a
2010	6-Dec-09	4-Jun-10	13-Dec-09	5-Jun-10	11-Jan-10	10-May-10	This study

Table 2. Period of green turtle monitoring on Isabela Island (Quinta Playa and Bahía Barahona) and Santa Cruz Island (Las Bachas) in the 2002 to 2010 nesting seasons in Galapagos.

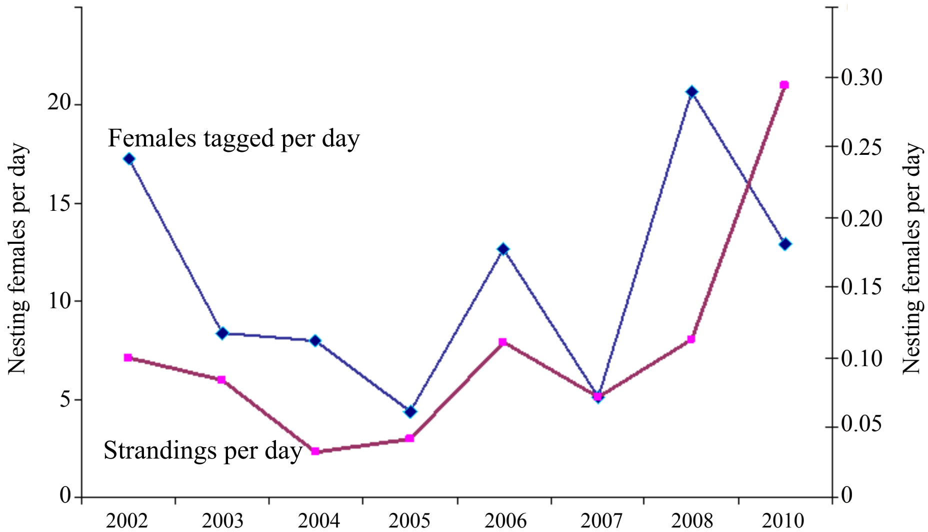

Figure 4. Number of green turtles tagged per day and number of stranded turtles recorded per day at three sites in the Galapagos Islands during the nesting seasons of 2002-2010 (see Table 2 for data sources).

(43.3-69.0%) of all stranded turtles, with the other 47.4% divided into possible anthropogenic causes (1.9%; 0.3-9.9%), natural causes (3.8%; 1.0-12.7%), and unknown causes (37.7%; 25.9-51.2%) (Table 1, Fig. 2 and Fig. 3). Stranded turtles were categorized with an anthropogenic cause of mortality significantly more than the three other causes (chi-square test; $P<0.001$). Further division of the anthropogenic related mortalities demonstrated that interactions with fisheries (66.7%; 48.8-80.8%) were significantly more common than other causes of anthropogenic interactions including collision with boats (23.3%; 11.8-40.9%), human consumption (6.7%; 1.8-21.3%), and ingestion of marine debris (3.3%; 0.6-16.7%) (chi-square test; $P<0.001$). Three of the seven turtles with evidence of fisheries interactions we categorized consistent with drowning based on airway hyperemia, foam and froth in airways, and seawater in the digestive and respiratory systems (Work & Balazs 2010). The two turtles categorized as natural causes of death included one that was found alive but subsequently died and appeared hyperthermic, dehydrated, exhausted and located far from the ocean, and a second turtle that had massive barnacle infestation throughout the entire gastrointestinal tract and a brown discolored liver.

Morphometrics from 21 of the stranded turtles were 81 cm ± 9.4 with range of 58 – 93 cm for CCL and 75 cm ± 8.7 with range 55 – 87 cm for CCW. Based on the previously established CCL values of 60 - 66.7 cm for adult (e.g., the smallest nesting female recorded in Galápagos was 60 cm) and 40-50 cm for juvenile green turtles in Galápagos (Green 1994), we determined that 94% of stranded turtles were adults (n = 50), 4% juvenile (n = 2), and 2% unknown age (e.g., between 50 and 60 cm) (n = 1) (Table 1). For the adults, 38% were females (n = 19), 22% male (n = 11) and 40% undetermined sex (n = 20). Four stranded females were confirmed oviparous at the time of death and three of the females had metal flipper tags, including two from 2009-2010 and one from the 2002-2003 nesting seasons.

A significantly higher number of stranded turtles were recorded in December (49.1%; 36.1-62.1%) than in any of the other months; January (26.4%; 16.4-39.6%), February (13.2%; 6.5-24.8%), March (5.7%; 1.9-15.4%), April (1.9%; 0.3-9.9%), and May (3.8%; 1-12.8%) ($P<0.001$).

The presence of stranded sea turtles is often used as an index of mortality at sea (Murphy & Hopkins – Murphy 1989; Epperly *et al.* 1996) and as a supplementary source for a better understanding of the health status of marine animal populations (Kreuder *et al.* 2003). However, this is believed to be an underestimation of population mortality due to the loss of many turtles at sea (Hillestad *et al.* 1978).

The number of stranded green turtles we report during the 2009-10 season is the highest number recorded when compared to all previous data collected from the monitoring seasons since the program began in 2001 (Zárate 2009b) (Fig. 4). This is of note since although the time spent monitoring on the beaches was longest in this season compared to previous years, the cumulative time was greater for these 7 seasons (Table 2). Additionally, on a per day basis the number of females tagged (and thus nesting) was much higher in 2002 and 2008, than the 2009-2010 season although the numbers that stranded per day were much lower (Zárate 2009b, Fig. 4).

Fifty-three percent of the cases in this study corresponded to mortality caused by anthropogenic impacts with the majority of the stranded turtles discovered on Quinta Playa, an area with the highest human presence among the different nesting beaches monitored. Artisanal fishing and tourism are common in this area with high boat traffic. Additionally, it should be noted that Quinta Playa and Bahia Barahona are located in areas of increased inflow of ocean currents and winds while, Las Bachas is in a calmer region and presumably there is less chance of turtles drifting on to the beach (Banks 2002).

The highest category of mortality was associated with interactions with fisheries, similar to other studies (Parnell *et al.* 2007; Zárate 2009b). Although fishing activities are regulated and methods such as gillnet and shark finning are illegal, evidence exists that these modes of fishing are still commonly practiced in the GMR (Reyes & Murillo 2007).

Boat strikes were the second most common cause of mortality in this study, similar to findings from other regions of the world, and emphasizes the importance of boat traffic on sea turtle morbidity and mortality (Chaloupka *et al.* 2008; Schroeder *et al.* 1987; Sobin & Tucker 2008; Zárate, 2009b). In the Galápagos, there has been an exponential rise in tourists in the last two decades which in turn has led to increased marine traffic (Epler 2007). This increase in tourism has been most evident in the less populated islands such as Isabela which has tripled the number of hotels in Puerto Villamil during the past 15 yr (Epler 2007). Additionally, the recent development of sport fishing and "pesca vivencial" a form of fishing in which tourists use methods of the local fishermen to gain an appreciation of Galápagos culture have increased boat activity and the number of fishermen in the waters of the GMR (Macarena Parra, personal observation). Boat collision is known to be a major cause of sea turtle mortality in developed areas of the worlds, such as Florida and Hawaii, USA (Chaloupka *et al.* 2008; Schroeder *et al.* 1987). With the increase in boat traffic in Galápagos, the number of sea turtles that suffer the same fate may also rise.

Two of the stranded turtles were taken for human consumption. These two turtles were found on Bahia Barahona, the most accessible beach for local people, at just a 2 hr walk from Puerto Villamil. Previously, this site is where other green turtles have been recorded with evidence of human consumption, including signs of being roasted on the beach (Zárate 2009b). One stranded turtle in this study was confirmed with marine debris based on a 4 mm diameter string that passed from the mouth to cloaca (Fig. 2d). Marine debris including items such as plastics, balloons, monofilaments, and oil are a major cause of mortality in sea turtle populations globally (Barreiros & Barcelos 2001; Bjorndal *et al.* 1994; Bugoni 2001; Mascarenhas *et al.* 2004). The turtle in this study is the first confirmed green turtle to die from the ingestion of marine debris in Galápagos waters. Additionally, it is interesting to note that in the 2009-2010 field season we found two live turtles on the beach with nylon wrapped around flippers, and in both cases there was severe muscle damage associated with the nylon tourniquets. One additional turtle was identified with nylon protruding from the cloaca which supports ingestion. The lack of previously diagnosed cases of interaction with marine debris suggests that the waters around the archipelago have until now been relatively marine debris free and that debris appears to be increasing in the region (Sharon L. Deem & Macarena Parra, personal observations).

We recorded the highest number of stranded green turtles in the 2009-2010 turtle nesting season since monitoring began in 2001. The average number of stranded turtles identified during the seven previous years was 11 per year, with 0.08 turtles stranded per day, based on monitoring effort (Zárate 2009b). Therefore, there was a 300% increase in the 2009-2010 season. In previous years, there appears to have been a correlation between number of nesting females and number of stranded turtles (Fig. 4). However, in 2009-2010 there was an increase in the number of stranded turtles, with no corresponding increase in the number of nesting females (Fig. 4), although as discussed previously the monitoring effort was longer for this season (Table 2).

The number of stranded green turtles in Galápagos is lower than other parts of the world, although data currently available is only for 3 of the nesting beaches in the archipelago, even though the population size is believed to be one of the largest. For example, in Magdalena Bay, Mexico, greater than 600 turtles strand each year because of fisheries interactions (Gardner 2001; Koch 2006). However, we must be vigilant to a possible increasing trend in sea turtle mortality in Galápagos, especially as an increase in human population size and tourism in the region continues (Epler 2007). The Galápagos National Park must strive to enforce laws and to penalize offenders that perform illegal activities in the GMR and that threaten sea turtles and other wildlife in this iconic site (Reyes & Murillo 2007). If implemented, a regulation to decrease boat traffic and boat speeds near important foraging and nesting sites during December-February, the peak of the nesting season and the months with the most recorded stranded turtles, may significantly lower the number of stranded green turtles (Sobin & Tucker 2008).

Acknowledgments. The 2009-2010 turtle monitoring season was funded by the Swiss Friends of Galápagos, the Charles Darwin Foundation of Canada, and the bi-institutional program between the Charles Darwin Foundation and the Galápagos National Park Service, which also provided logistical support. We thank Alizon Llerena and the many volunteers of the 2009-2010 season for assistance in data collection, Marina Andrés and Jonathas Barreto for providing photographs, and Volker Koch and Nathalia Tirado for support with the preparation and review of the manuscript.

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Southernmost Records of Hawksbill Turtles Along the East Pacific Coast of South America

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Despite the fact that the hawksbill turtle (*Eretmochelys imbricata*) is widely distributed in tropical waters throughout the central Atlantic and Indo Pacific region, its worldwide population has declined severely during the last several decades (Mortimer & Donnelly 2008). In the East Pacific (EP), the status of the hawksbill is considered precarious, even with new observations of nesting and foraging groups in the region (Gaos *et al*. 2010). In waters of the EP south of Panama, hawksbill turtles appear to be relatively rare, as summarized below.

In Pacific Colombia, during an extensive survey of 41 beaches survey conducted in 2002 by INVEMAR, a few hawksbills sightings were reported in 30 of the beaches (Ceballos-Fonseca *et al*. 2003). In Tumaco (01°49'N, 78°44'W), several juvenile hawksbill turtles were incidentally captured in 2004 (Barreto *et al*. 2008), and small juveniles were observed in some coral reef beaches of Gorgona island (Amorocho & Reina 2007). In addition hawksbills were reported in the national parks of Utria and Gorgona (Amorocho 2009).

In Ecuador, 11 hawksbills were found stranded between 1994 and 1999 (Alava *et al*. 2005). During surveys in 1999, the occurrence of hawksbills were noted in Esmeraldas in the north (Herrera & Coello 2009). Subsequent surveys of 100 beaches and landing points in mainland Ecuador between 1999 and 2000 reported 12 hawksbills (Herrera 2008). In 2002-2003 two adults hawksbills were captured incidentally in Machalilla by artisanal fisheries (Barragan *et al*. 2009), while in 2007 – 2008 two other hawksbill were founded stranded in playa Mar Bravo, Salinas (Vera 2008). In the Galapagos Islands, hawksbills have been observed in the waters but are not considered common (Pritchard 1971; Zarate *et al*. 2008)

In Peru, data regarding hawksbill turtles are scarce. Hays Brown & Brown (1982), reported that only five carapaces were observed in Peru until late 1970s, with the southernmost report from Talara (04°34'S 81°16'W), one of these five carapaces was reported by Carrillo de Espinoza in 1987. Another carapace (37.5 cm curved carapace length or CCL) was found in Lobitos (04°28'S 81°18'W). Other non specified numbers of carapaces were founded in 1983 by Hays in the surrounding areas of the island "Lobos de Tierra" (06° 25'S 80° 51'W). In 1989, also a non-specified number of carapaces were found in the southern coast of Lima and in the Pisco area (13° 42'S 76° 13'W) (Aranda & Chandler 1989). Between 2000–2008, 14 small hawksbills (average CCL = 37.6 cm ±1.6 SD) were observed around artisanal landing sites between Caleta Grau (03˚39'S, 80˚38'W) and Constante (05° 35'S, 80° 50'W) on the northern coast of Peru (Alfaro Shigueto *et al*. in press). Finally, one adult hawksbill (75.5 cm CCL) was reported as stranded in the northern coast of Tumbes in 2008 (Forsberg 2008). To date, the Peruvian records of hawksbills were limited to the northern coast of Peru, without strong evidence of occurrence south of 04° 34'S.

We collected data on the presence of hawksbill turtles in central and southern Peru during two surveys conducted in 1987 and 2010. For 1987, we visited the landing site for the active sea turtle fisheries, in San Andrés (13° 43'S 76° 13'W, Fig 1). Between January and October 1987, we visited the principal turtle landing pier in center of San Andrés, smaller landing sites located up to 1 km north of San Andrés, and the turtle "stockade" where live turtles were stored upside down, in preparation for further distribution and use. For all turtle observed, we verified species and in cases of intact animals, we measured CCL and mass.

From January through November 2010, we conducted informal interviews with local fishermen and local governmental officials in San Andrés, plus twice weekly (minimum) we visited locations where we anticipated finding turtle carapaces: restaurants, homes and even dumps. When we located a hawksbill carapace in homes or businesses, where they were often as decorations, we asked the owner where the carapace came from. All located carapaces were photographed for species confirmation (Fig. 2). Additionally, we occasionally conducted informal interviews and visual surveys in nearby municipalities, including Tambo de Mora, Cerro Azul and Pucusana, the city of Chincha and the beach of Jahuay, all located between 60 and 200 km south of Lima.

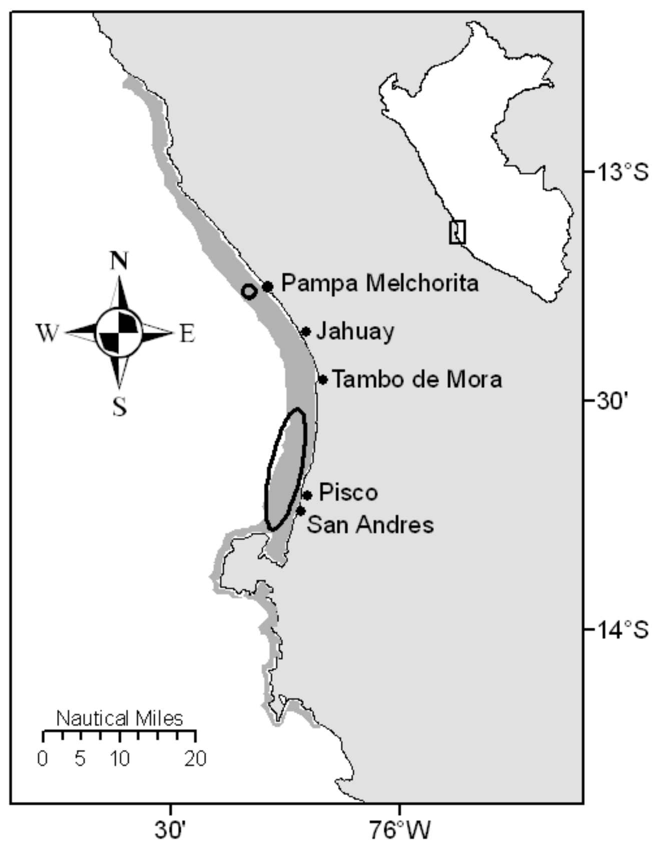

Figure 1. Study area and principal fishing towns in south-central coast of Peru, The principal grounds of the San Andrés turtle fishery during 1987 are shown in dark gray, and black line encircles the places were hawksbills were captured.

Figure 2. Photographs of the hawksbills carapaces found in San Andrés. Each carapace is described below, starting with the first row from left to right and continuing on the bottom row of photographs.

Date recorded	Date captured	Capture Location	Size	Mass	Comments
15-Oct-10	1998	Off San Andrés	43.6	Only carapace	Found in a fisher's house
19-Oct-10	1987	Off San Andrés	45.2	Only carapace	Found in a fisher's house
19-Oct-10	1987	Off San Andrés	45.0	Only carapace	Found in a fisher's house
21-Oct-10	2004	Off Pampa Melchorita	40.4	Preserved animal	Found as decoration in a restaurant in Chincha.
1-Nov-10	unknown	unknown	39.1	Preserved animal	Found in the Natural History Museum at Lima
30-Sep-10	Sep-10	Off San Andrés	51.2	Only carapace	Fresh carapace found in San Andrés beach
17-Jun-87	17-Jun-87	Off San Andrés	45.5	12 kg	Landed at San Andrés pier
18-Jun-87	18-Jun-87	Off San Andrés	46.0	Not weighed	Landed at San Andrés pier

During our 1987 survey, we recorded 1,040 sea turtles total. Of these, 95.9% (N = 998) were black turtles (*Chelonia mydas*), 3.7% (N = 34) were leatherbacks (*Dermochelys coriacea*), 0.3% (N = 3) were olive ridleys (*Lepidochelys olivacea*) and 0.5% (N = 5) were hawksbills. Two hawksbills were measured: 46 and 45.5 cm CCL, one of them weighed 12 kg. All hawksbills were captured by coastal gill nets (1000 – 2000 m long by 6 m high, with 50-65 cm stretched mesh) in the San Andrés area. Anecdotally, in November 2009, we found two shells in a tourist shop in Tumbes, with 23 and 35 cm CCL. The shop owner said that she bought both from a local fisherman who had captured them close to the "Ocean Plant" pier (04º13'S 81º12'W) located between El Ñuro and Cabo Blanco in the northern coast of the country. We found four carapaces in San Andrés, one in Pampa Melchorita, (Fig. 1), and one was observed in the Natural History Museum "Javier Prado" in Lima, measuring 39.1 cm, but the provenance is unknown.

Of these 13 previously unreported carapaces, 10 originated from the San Andrés area, >1300 km south of the previously reported most southern record in the EP. Of these 10 southerly records, seven were captured in 1987 which was characterized by an El Nino (EN) event. Warmer water temperatures in summer months are thought to facilitate the occurrence of this species in southern EP waters (Frazier & Salas 1984), and observations of other hard-shelled turtles in Peruvian waters close to San Andrés were associated with increased water temperatures during EN events (Quiñones *et al*. 2010). In 1987, a maximum anomaly of +4.5 (23-24 °C) was observed in Pisco (Rivera 1988), and likely related to the hawksbill presence in the area. Interestingly, the 1997-98 EN event was even stronger, yet only one hawksbill was reported in the San Andrés area. Likely this was related to reduced fishing effort after stricter controls were implemented by the minister resolution RM-103-95-PE, which banned the capture of all species of marine turtles in Peru (Morales & Vargas 1996). Surprisingly in September 2010 a fresh hawksbill carapace was observed in San Andrés, almost in the middle of the winter time with low temperatures (17.4°-18.4°C), however the natural temperature range for hawksbills range from 15°C to 32°C (Storch *et al*. 2005).

The mean size of the turtles recorded in the San Andrés area was 45.2 cm CCL ±3.2 SD (range 40.4 - 51.2, N = 7), which is below the minimum size of nesting females (53-114 cm SCL) worldwide (Marquez 1990). The closest nesting area to Peru is in "Parque Nacional Machalilla," in Mainland Ecuador, located more than 1600 km northwest of San Andrés, where the mean size of mature females is 94.3 cm CCL, N = 10 (Peña *et al*. 2009). We hypothesize that juveniles and subadults use the San Andrés area as a foraging ground during "warm" years.

The principal of global decline in hawksbills was directed harvest for trade in carapace scutes (Mortimer & Donnelly 2008). Directed harvest of hawksbills in Peru has existed for decades (Hays-Brown & Brown 1982), although all species have been protected by federal law since the 1995. Our observations show that illegal captures of hawksbills (and other species) continue to occur, particularly in the San Andrés region. We recommend that increased monitoring and conservation for sea turtles be conducted in this area in order to protect what appears to be one of the most important aggregations for sea turtles in coastal Peru.

Acknowledgments: We thank the San Andrés fishermen for sharing their information, and allowing us to take photographs of the carapaces, this project was supported by the Instituto del Mar del Perú at Pisco.

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Nesting Sea Turtles at Sonadia Island, Bangladesh

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Five species of sea turtle are reported to occur in the territorial waters of Bangladesh: olive ridley (*Lepidochelys olivacea*), green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*) (Groombridge *et al.* 1989, Rashid & Islam 2005). Illegal harvesting of turtle eggs, bycatch in offshore fisheries, alterations of sand dunes and nesting beaches have been recognized as the main threats to sea turtles in Bangladesh, and since 1980, nesting populations have declined due to severe exploitation of eggs and killing of adult turtles by fishing and other activities (Islam 1999). All sea turtles were listed in the revised Bangladesh Wildlife Preservation (Amendment) Act in 2010, giving them complete legal protection. Nevertheless, sea turtles continue to face severe threats along the coast and offshore areas of Bangladesh and many of the nesting rookeries remain poorly studied. In particular, there are few historical data available for sea turtle nesting in the Sonadia and Kutubdia Islands off the southeastern coast and in the Sundarbans, an extensive mangrove complex on the west coast. This report summarizes information on sea turtle nesting at Sonadia Island from 2005-2010 with some incidental data collected in January 2000.

Sonadia Island (21.49262° x 91.87529°) is located 3.5 km northwest of Cox's Bazar, Najirartek (Figure 1). Prior to 1999, sea turtle data from Sonadia Island were collected opportunistically during the annual waterfowl censuses conducted in 1983, 1987 and 1989, and recorded low levels of nesting of olive ridley and green turtles (Rashid & Islam 2005). In January 2000, MarineLife Alliance conducted a preliminary nesting survey of a five km stretch of beach on the southern end of the island, between Moghchar and Purbapara. Surveys were conducted at every night between 6-9 January. During these surveys seven olive ridley and one green turtle nests were recorded in addition to eight false crawls of olive ridley (Islam 2001).

In 2005, MarineLife Alliance started a monitoring and conservation project. Night patrols of nesting beaches were conducted every night between 01 October and 31 May by 4-6 local people trained in surveying. Night surveys spanned >6 hours starting 3 hours before and ending 3 hours after high tide. Twelve km of beach were surveyed each night to record nesting activity and information on threats. In addition, local volunteers collected information on the turtle egg and

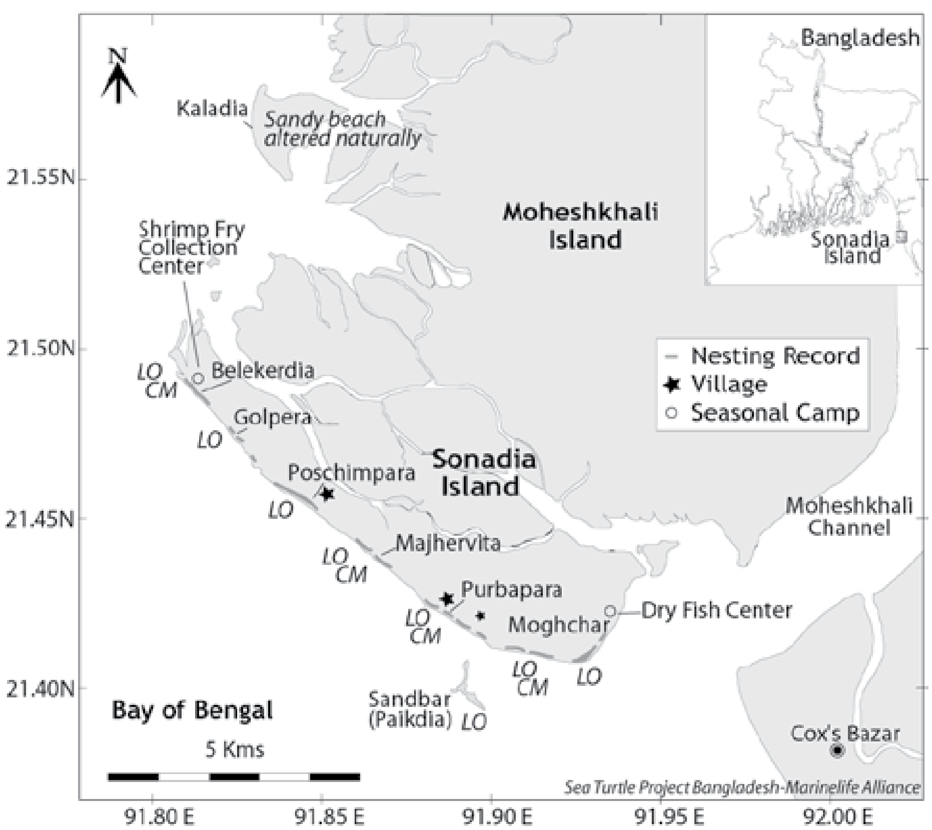

Figure 1. Nesting areas on Sonadia Island, Bangladesh.

Season	Olive ridley nests	Olive ridley false crawls	Green turtle nests	Green turtle false crawls
6-9 Jan 2000	7	8	1	0
2005-06	155	38	0	2
2006-07	142	29	1	5
2007-08	162	27	3	6
2008-09	151	29	3	4
2009-10	158	28	2	4
Total	775	159	10	21

Table 1. Nesting activity of sea turtles on Sonadia Island, during 2005-06 to 2009-10 and a single survey in 6-9 Jan 2000.

meat trade and conducted daytime visits to the beach for further information. Surveyors were trained to identify species, successful nests, false crawls, habitat and egg relocation methods. During the monsoon period (June – September), surveys were continued with limited manpower (3 people) who visited the beach every second day. We also gathered data on nesting activities from poachers opportunistically during *ad-hoc* market surveys at nearby Moheshkhali area.

Both olive ridley and green turtles nested on Sonadia Island (Table 1), although olive ridley nests were more numerous and more widely dispersed across the monitored beaches. Nesting by

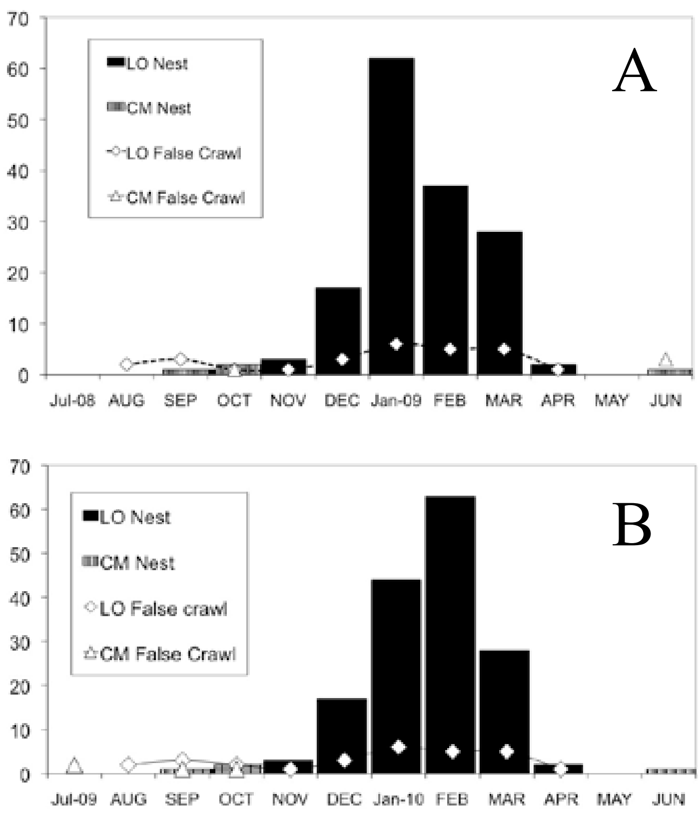

Figure 2. Seasonality of nesting activity of marine turtles in Sonadia Island in 2008-2009 (A) and 2009-2010 (B). LO = olive ridley, CM = green turtle.

Parameters	Mean	SD	n	Range
OLIVE RIDLEY				
Clutch Size	115.0	23.5	449	48 - 204
CCL (cm)	64.8	3.5	71	58.65 - 73.95
CCW (cm)	62.8	3.2	67	57.37 - 73.95
Egg Weight (gm)	27.6	3.7	60	24.0 - 32.8
Egg Diameter (mm)	35.1	3.9	60	32.6 - 38.7
GREEN TURTLE				
Clutch Size	122.0	23.2	5	95 - 154
CCL (cm)	97.5	7.2	7	91.8 - 106
CCW (cm)	85.3	9.2	7	75 - 92
Egg Weight (gm)	42.5	3.7	20	40.3 - 43.5
Egg Diameter (mm)	41.5	3.9	20	40.5 - 42.8

Table 2. Morphometric data of sea turtles, clutches and eggs found on Sonadia Island, Bangladesh.

olive ridley turtles spanned October-April (Fig. 2). Olive ridley nests were recorded from Belekerdia in the north-west to Moghchar in the south-east (Fig. 1). Until 2008, olive ridleys were also recorded nesting at Kaladia beach, but the tidal surges associated with recent cyclones resulted in the loss of nesting habitat in this area. Olive ridley turtles also nested on a small nearshore sand bar off the west of the island known as an important roosting area for gulls and terns. The sand bar is exposed only seasonally and we surveyed during Oct - March in 2009-10. Most of the olive ridley nests were laid on the open beach, although a few were found in patches of groundcover vegetation (*Ipomea pes-caprae, Vitex* spp.). Belekerdia had the highest density of nests observed (42%) and the Majhervita had 33% of nests in recent years. The greatest number of nests laid in a single night was 19 olive ridley nests on 20 February 2006. No daytime nesting was observed. There were gaps in the daily surveys before 2007-08, due to inclement weather and reduced labor, so the nesting totals should be taken as minimum values until then. Green turtle nesting activities were recorded from June - October each year with nests recorded every season since 2006-07 (Table 1, Fig. 2). Green turtle activities were recorded on the south coast near Moghchar during 2000 and during 2005-10, most of the emergences occurred at Belekerdia and Majhervita (Fig. 1). Green turtles had a lower false crawl:nest ratio than olive ridley turtles, with primary disturbances consisting of predatory dogs, beach seine fishing, light disturbances and compacted sand after the monsoon (Table 1). Seven nesting olive ridley turtles with flipper injuries could not dig successfully nesting chambers even after several attempts.

The Island has a small human population, in one small and two medium villages named Purbapara, Paschimpara and Badarkhalipara, totaling 2500 people. The primary occupations of most families are fishing, cultivation and shrimp aquaculture, which have caused the destruction of much of the mangroves between Sonadia and Moheshkhali Island. The seasonal (October to March) Dry Fish Center (DFC) at southern end of the island and Shrimp Fry Collection Center (SFCC) at Belekerdia during monsoon (May - September) are operated by Moheshkhali people (Figure 1). The majority of Sonadian villagers are Muslims and do not traditionally eat sea turtle eggs according to the community, although this does not preclude the collection and selling of eggs. The major inland threats to marine turtles at Sonadia were (a) dog predation, (b) disturbances during shrimp fry collection, (c) beach seine fishing, (d) egg poaching and (e) alteration of the nesting beach by *Casuarina* plantation. Dogs predated five nests immediately after they were laid, three nests that were left on the beach for *in situ* incubation, and six nests relocated to the beach side hatchery. Five nesting olive ridley females have been killed by dogs since 2005 and dogs also attempted to breach the sea turtle egg hatchery that was set up to reduce predation levels. MarineLife Alliance is trying to reduce the dog population but this needs more attention. Most of the nesting beach area remains hazardous to sea turtles during late winter because shrimp fry collectors use kerosene lamps and torches while dragging their nets along the beach during high tide to catch larvae of *Peaneus monodon*. Around 300-400 seine nets are deployed from Purbapara to Belekerdia in clusters parallel to the shore at the intertidal zone, blocking access to the beach by nesting females. On 13 February 2010 a live olive ridley was trapped in a seine net although the fishermen cautiously released the turtle safely, likely a result of attending bycatch reduction training workshops. In nearby waters, gill nets are also used and can incidentally capture reproductively active turtles. More than 2367 dead olive ridley turtles washed ashore during the 2005-10 seasons alone in Cox's Bazar beaches including St. Martin Island, Cox's Bazar - Teknaf Peninsula and Sonadia Island with 549 were recorded at Sonadia alone. Of twelve turtles examined post mortem, five had eggs (MarineLife Alliance 2010).

During 2005-10, 30 olive ridley nests and one green turtle nest were stolen before the nest patrols. Discussions with traders and observations in the local market in Moheshkhali indicate that an additional 23 olive ridley nests were collected for sale and/or consumption. It is presumed that prior to 2005, only 10-20 % of all nests produced hatchlings, and this was only because the eggs were not found by egg collectors. Ongoing efforts by Marinelife Alliance and Department of Environment to raise awareness about the protected status of sea turtles in Sonadia has decreased but not eliminated egg collection in recent years.

The expansion of *Casuarina* plantations on Sonadia in 2008-09 by the Forest Department is a potential threat to the sea turtle nesting habitat from Paschimpara to Belekerdia. In India *Casuarina* has been reported to cause a decline in olive ridley nesting (Mohanty 2002). Additionally, there are chances for developing tourism infrastructure by the Ministry of Aviation & Tourism, which may negatively impact turtle reproduction in future.

Currently, most nests are relocated 5 - 10 m from their original site, primarily to hide the actual location from egg collectors. This short-distance relocation resulted in 92.00% (N = 43; ±5.22 SD) hatching success from olive ridley nests in 2009-10. In areas where dogs frequent the beach, nests are relocated to a fenced hatchery for protection. Ongoing nest protection is needed to ensure hatchling production. Additionally, more efforts are needed to manage beach seine fishing, feral dogs and *Casuarina* plantation to minimize impacts to Sonadia's sea turtles. Year round monitoring and protection of nesting beaches, eggs and turtles is vital. Relocation of nests will remain necessary until current threats are successfully mitigated. An additional proposal is to give special protection status to two km of beach at the north end of Sonadia Island, near Belekerdia, that will benefit not only turtles and their incubating eggs but also roosting waders, gulls & terns. This area is also principal nursery habitat for shrimp and fish, thus its protection will help sustain fisheries.

There is a new threat to sea turtles on Sonadia: the planned development of a port in the northern end of Sonadia, near Belekerdia. The federal government has approved plans for establishing a Deep Sea Port at Sonadia Island that would include 58 jetties totaling 11 km. Initiation of construction is dependent on international investments (US$ 8.6 billion). Anticipated impacts of a large port on sea turtles include loss of habitat, increased boat traffic, water pollution, excessive noise and light pollution Other protected species at Sonadia are at risk from the proposed port development, including spoon billed sandpiper and three other critically endangered wading birds, and many marine species including threatened coastal & marine cetaceans, including the finless porpoise (*Neophocaena phocaenoides*), Irrawaddy dolphin (*Orcaella brevirostris*) and bottlenose dolphin (*Tursiops aduncus*) (Islam 2009). There is concern about a lack of a transparent Environmental Impact Assessment associated with the planned port, that the public is not being properly informed of the port's potential impacts, and that those with financial interests in the port are attempting to downplay Sonadia Island's biodiversity importance, despite the fact that Sonadia has been designated as an Ecologically Critical Area (ECA) by the government under Environmental Conservation Act, 1999 (Islam 2010). We recommend that the current development proposal be subjected to a full and transparent Environmental Impact Assessment before any construction work begins.

Acknowledgements. The authors and MarineLife Alliance are grateful to IOSEA, KNCF, US-FWS, WFN-UK for supporting to conduct sea turtle monitoring and conservation work. The first author also worked for GEF funded Coastal & Wetland Biodiversity Management Project, Department of Environment during 2006-07 and initiated sea turtle activity.

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Marine Turtles Stranded by the Samoa Tsunami

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The Samoa group of islands comprises American Samoa (territory of the United States of America) in the east and the independent State of Samoa (formerly known as Western Samoa) in the west. The Independent State of Samoa consists of two main and seven small islands. The two main islands, Savaii (land area approximately 1,820 km^2) and Upolu (land area approximately 1,115 km^2 and home of the capital city, Apia), and two of the small islands, Manono (land area approximately 5 km^2) and Apolima (land area approximately 2 km^2), are inhabited. All islands are volcanic in origin and lie in the south-west Pacific between latitudes 13°25' S and 14° 05' S, and longitudes 171°23' W and 172° 48' W. The most commonly occurring species of marine turtles in the Samoa Islands are hawksbill and green turtles (Craig 1993; Utzurrum 2002; Witzell 1974).

On 29 September 2009, there was an earthquake and resultant tsunami waves that swept through parts of the Samoa Islands. These waves brought marine life with them, portions of which were stranded on land when the waves subsided, including reef fishes of varying sizes, marine turtles, a few sharks and dolphins. This paper gives an account on the number and fate of marine turtles known to have stranded after the tsunami waves on the island of Upolu (Fig. 1).

Most of the information was obtained from interviews with individuals in villages most affected by the tsunami. Flipper tagging, tissue sampling for DNA, measurements and data recording of turtles that were brought to Apia (capital city) or held by communities were conducted by DEC and SPREP representatives following standard techniques (Balazs *et al.* 1999; Bolten *et al.* 1999).

Date	Species	Location	Turtles	Fate
20-Sep	Green	Falealili?	1	Tagged and released
30-Sep	unknown	Maninoa	>2	Released
30-Sep	Green	Ulutogia	1	Unknown
30-Sep	unknown	Aleipata (village not identified)	1	Unknown
late Sept	unknown	Malaela	1	Released
1-Oct	Green	Aleipata, Malaela	4	Tagged and released
6-Oct	unknown	Malaela	1	Released
6-Oct	unknown	Lotofaga ?	1	Unknown
15-Oct	Green	Aleipata, Malaela	2	Tagged and released
15-Oct	unknown	Malaela	>10	Released
15-Oct	unknown	Malaela/Laulii	7	Escaped into flooded river
17-Oct	unknown	Vaovai	2	Released
29-Oct	Hawksbill	Tafitoala (consumed in Fusi Safata)	1	Consumed
29-Oct	Green	Tafitoala	12	Released
29-Oct	Hawksbill	Tafitoala	1	Released
??	unknown	Lalomanu	4	Released
??	unknown	Salesatele	1	Released
??	unknown	Malaela	<5	Dead and buried

Table 1. Marine turtles reported stranded on land after the Samoa Tsunami, September 2009.

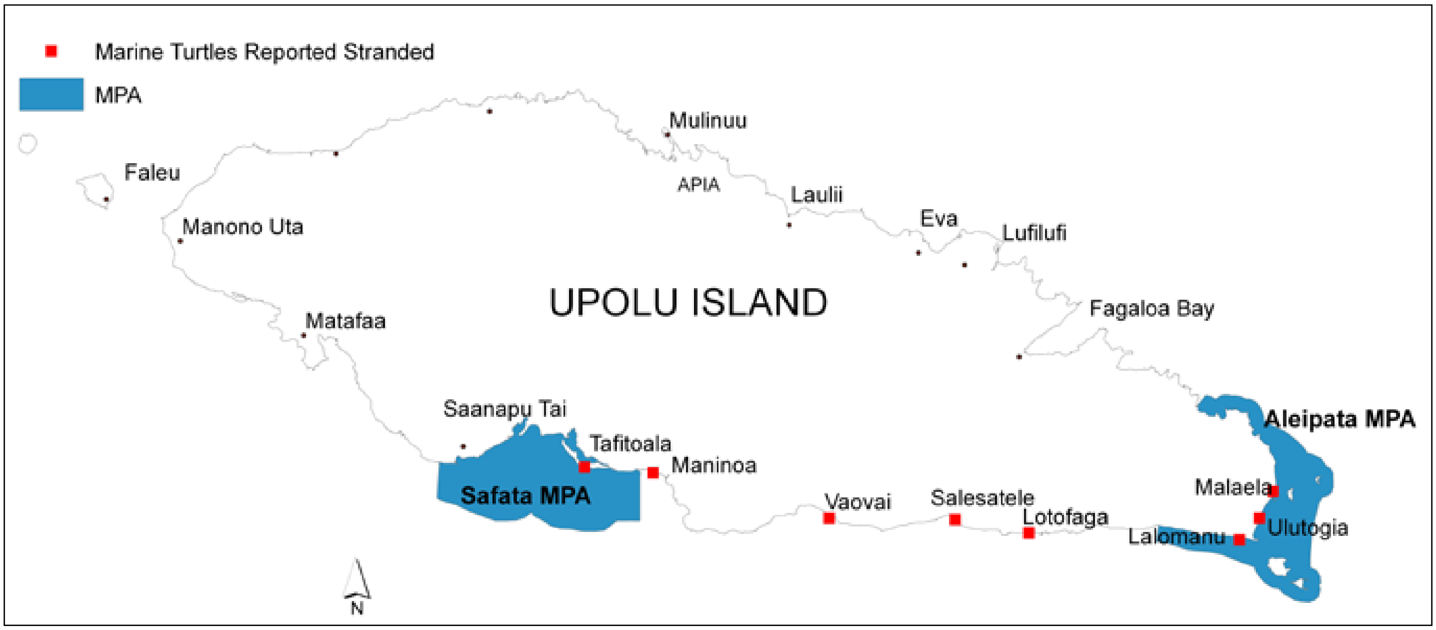

Figure 1. Map of Upolu island in the Independent State of Samoa, with locations of stranded turtles from 2009.

At least 52 marine turtles (Table 1) were reportedly stranded on land. Seven were released by DEC/SPREP, at least forty one (including seven that were taken to another village but escaped to the sea after heavy rain caused flooding at the area where they were kept) were reportedly released by communities, government officials, resorts and individuals where they were found, one hawksbill was consumed (reportedly because its carapace was badly damaged and deemed unlikely to survive) and the fate of three that were reported is unknown. In addition, <5 dead turtles were also reportedly buried at Malaela village.

Of the seven marine turtles released by DEC/SPREP, one was brought in by a construction worker, four were brought from the Police post at Malaela after arrangement by SPREP and DEC, and two were tagged at Malaela after the village found them in the mangrove area and held them in a small pond. All seven turtles tagged and released were green turtles. One of the turtles observed with an unknown fate was also a green. All of the thirteen turtles released at Tafitoala were described as having carapaces of the same colour and "smoothness" as the turtle that was consumed (hawksbill). However further questioning seemed to indicate that they could have been green turtles given they had reddish carapaces with no overlapping scutes, with the exception of one. Thus the vast majority of stranded turtles were green turtles.

Carapace measurements were collected from eight turtles (seven released greens and one consumed hawksbill). Two green turtles, with curved carapace length (CCL) of 91.5 cm and 101.5 cm were adult sized and female (based on short tail length). The other released green turtles were between 50.0 and 90.5 cm CCL. The hawksbill turtle that was consumed was 100.0 cm CCL and female, based on short tail length. One of the turtles (a green) with an unknown fate, stranded at Ulutogia, may have been an adult, based on a photograph (Fig. 2). Of the 13 turtles released at Tafitoala, five were reported to be large while the other eight were sub-adults.

The highest numbers of stranded turtles reported were at Malaela, Aleipata (19+ turtles) followed by Tafitoala (13 turtles plus one consumed). Four stranded turtles were reportedly released in Lalomanu, at least two were released at Coconut Beach Resort at Maninoa, two released at Vaovai, Falealili and one at Salesatele.

Figure 2. Stranded green turtle being carried to the water by villagers in Malaela.

Of the seven turtles tagged and released, one had major cracks on its carapace which may have resulted from handling when the turtle fell on a rock when it was being moved from a mangrove area to a small pond . Another green turtle also had a small crack in the centre of its carapace and abrasions on the tips of its front flippers. There were no signs of damage or trauma on the rest of the turtles observed although most had some mud covering their bodies. No information was obtained on the turtles released by communities or the dead ones that were buried at Malaela.

One of the two green turtles released at Malaela had been tagged previously. Records in the DEC turtle tagging database confirmed that this r turtle had been caught in a fishing net and was tagged and released at Satitoa, Aleipata, in October 2008.

The number of green turtles stranded on land is an indication of the importance of the green turtle foraging area around Aleipata. The stranding of a green turtle that was tagged and released at Satitoa Aleipata in October 2008 further illustrates the value of this foraging area for green turtles and suggests the presence of a foraging green turtle population in the area. The stranding of 13 turtles, including juveniles, in Tafitoala Safata may also indicate a foraging area there.

Although we know of >50 sea turtles that were stranded on the island following the tsunami waves, there may have been more that were pushed on land but were able to swim or crawl back to the sea when the waters receded, particularly in areas where there were no barriers blocking their return.

The successful recovery and release of the stranded turtles was due largely to the action of the communities and the general public at large, and may be a reflection of the success of the campaigns to conserve turtles in Samoa. In particular, the Marine Protected Areas (MPA) work in both districts of Safata and Aleipata on Upolu Island seems to have contributed significantly to the high numbers of stranded turtles being released back to the sea. For example, the first stranded turtle that was tagged and released was brought to the home of the MPA officer near Apia by a construction worker because he knew turtle conservation was part of the officer's tasks. The other four turtles tagged and released were held by Police Officers posted in one of the affected villages and communication with Secretariat of the Pacific Regional Environment Programnme (SPREP) lead to these being brought in for tagging and then releasing. The other two turtles that were tagged and released were kept by a village in the Aleipata District MPA. The release of other turtles for which no information was recorded is believed to be linked to the successful campaign during recent years and positive response of the communities and individuals to conserve marine turtles. The highest numbers of stranded turtles reported were at Malaela, Aleipata (19+ turtles) followed by Tafitoala Safata (13 turtles). Both villages are in the MPA programme and this fact could have contributed to the high reporting at these sites. In addition, the areas in both villages have inland waterways and surrounding vegetation, i.e. mangrove areas. Thus when the waves subsided turtles may have been more susceptible to becoming "trapped" inside the mangrove areas.

Only one turtle, a hawksbill, was reported and confirmed to have been consumed. This was also done because the turtle concerned had serious damages to its sides and considered unlikely to survive if released. Hawksbills in certain locations in the Pacific Islands, including Samoa, are at times known to be toxic (for a review, see Aguirre *et al.* 2006).

The villager who found and released the turtles at Tafitoala was not able to determine whether they were green or hawksbill turtles. Thus points to another need for turtle awareness campaigns, i.e. turtle species identification, especially on differentiating the two most common species in Samoa, greens and hawksbill.

These events have led to prioritizing certain actions related to marine turtle conservation in Samoa, including:

Determine the extent of turtle foraging areas around Aleipata and possibly Safata and the tsunami-related impacts on turtle foraging habitat. If baseline information on this habitat is not available, the survey would be critical in establishing baseline information. This could be the first step towards the identification of major turtle foraging areas in Samoa, which is oneof the three main objectives under the Theme, "Research", in the SPREP regional Marine Turtle Action Plan 2008-2012.

Continued turtle nest monitoring on the major hawksbill nesting beaches, especially around the Aleipata area including the offshore Islands.

Continued turtle conservation awareness campaigns including species identification using simple external characteristics such as shape of the beak and scales on the head.

Possible establishment of a turtle monitoring network in communities involved in MPAs, as part of the turtle conservation programme that is highlighted in the MPA Management Plans.

Acknowledgements. We thank the communities, Government Departments and Corporations and individuals for their efforts and assistance in ensuring that stranded turtles were released back to the sea.

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On the Presence of *Lepidochelys olivacea* (Eschscholtz, 1829) in the Cape Verde Archipelago

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The olive ridley sea turtle (*Lepidochelys olivacea* Eschscholtz, 1829) is known to inhabit the western Atlantic Ocean, between 34° S and 21° N (Fretey 1999a). However, the distribution and nesting locations for this species along the Atlantic African coast are less well known (Fretey 2001). This species nests along the Atlantic coast of the African continent, from Sierra Leona to Angola (Carr & Campbell 1995; Catry *et al.* 2010; Fretey 1999b: Fretey *et al.* 2005; Fretey & Malaussena 1991; Gómez pers. comm.; Pauwels & Fretey 2008; Segniagbeto *et al.* in press), as well as in the Gulf of Guinea islands (Fretey *et al.* 2001; Tomás *et al.* 2001) except Príncipe. The northern limit of the distribution range could be Nouadhibou in Mauritania (Carr 1957), and its presence was recently confirmed in this country by Mint Hama *et al.* (in press).

In the Cape Verde archipelago, López-Jurado (pers. comm. in Fretey 2001) described olive ridley carapaces displayed in gift shops in Sal, and mentioned stranded in Sal and São Nicolãu. Fretey (2001) reported six carapaces or remains of dead turtles in Maio, Santa Luzia, Santiago and Boavista; and also a live entangled individual in Boavista. During the following years several olive ridleys have been observed by fishermen, tourists, and local people. In some of these cases, pictures were taken, so the staff of the NGOs working there (Cabo Verde Natura 2000 and SOS Tartaruga) could identify the species (Table 1).

For the carapaces and remains found into private houses, we cannot be definitive that they were captured or found in Cape Verde. It should be noted that these were immature individuals, which is unusual in the records of western Africa.

When analyzing the records from Fretey (2001) and the new data presented in this paper it is noteworthy that all the individuals found in the nearshore were entangled, in poor health or dead. One turtle captured in Santa Maria, Sal (27 November 2010, Table 1) demonstrated marked deformity. This turtle had a pronounced hump and an atypical layout of the dorsal plates.

These records of the species proves its presence in Cape Verde, but it does not appear to be related with nesting activity. Since 1998 intensive surveys have been conducted on some of the island of Boavista beaches, and no single nesting event of *L. olivacea* has been recorded. We therefore suggest alternative hypotheses –not mutually exclusive– to explain the presence of this species on the archipelago.

Firstly, the beaches on the Bijagos Archipelago, Guinea Bissau (Catry *et al.* 2010), Sierra Leona (Fretey & Malaussena 1991), or Liberia (Stuart & Adams 1990), where olive ridleys breed, are not far away from Cape Verde. It may be that individuals in the neritic of this region would drift to the nearshore of Cape Verde when incapacitated. On the other hand, some individuals

	Date	Location	Island	CCL	CCW	Condition	Source
1	22 August 1999	Praia Gonçal	Maio	47	48	C	Varo-Cruz et al. 1999[a]
2	20 October 1999	Praia do Castelo	Santa Luzia	nd	nd	C	Fretey 2001
3	01 December 1999	Ponta do Sol	Boavista	66	68	D	Fretey 2001
4	02 December 1999	Praia Atalanta	Boavista	nd	nd	A	Fretey 2001
5	08 April 2000	Praia de Galeo	Boavista	60	64	C	Fretey 2001
6	09 April 2000	Baía Pedra Alvim	Boavista	71	71.5	C	Fretey 2001
7	16 April 2000	Praia	Santiago	20	nd	C	Fretey 2001
8	04 November 2004	Praia Atalanta	Boavista	nd	nd	A	this paper
9	26 January 2010	Baía Grande	Boavista	nd	nd	A	this paper
10	27 November 2010	Praia Santa Maria	Sal	nd	nd	A	this paper
11	28 March 2011	Praia Atalanta	Boavista	nd	nd	A	this paper

Table 1. Record list of the individuals or remains of *Lepidochelys olivacea* found in Cape Verde. Top seven rows were compiled by Fretey (2001), others are cited by the first time in this paper. CCL: curve carapace length in cm, CCW: curve carapace width in cm, A: alive, D: dead, C: carapace or remains), nd: no data. [a]Also in Fretey (2001).

may demonstrate oceanic behavior, as previously observed in the Pacific Ocean (Plotkin 2003; 2010) again, reaching nearshore waters of Cape Verde if incapacitated.

Finally, another hypothesis predicts an American origin for *L. olivacea,* where there are important nesting populations (Brazil, Marcovaldi 2001; French Guiana, or Surinam; Kelle *et al.* 2009). We recommend expanding the genetic characterization to all Atlantic nesting population, especially in western Africa. This, together with the implementation of telemetry studies, will enable to know the origin of strandings occurring in Cape Verde and to understand the role of this archipelago for the species.

Acknowledgements. We acknowledge all the people who reported their turtle sightings to the authors, and the information provided, together with the pictures. We are also grateful to Daniel Cejudo and Catalina Monzón-Argüello for their comments and suggestions.

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REPORTS

2nd International Workshop to Mitigate Bycatch of Sea Turtles in Japanese Pound Nets

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To address high rates of bycatch mortality of adult and subadult loggerhead and green turtles in pound nets of the Japanese archipelago (Ishihara 2007), we initiated an international multi-sector program to develop and test bycatch mitigation solutions for these prevalent coastal fisheries. We convened the 2nd International Pound net Escape Device (PED) Workshop and experimental trials at Suma Aqualife Park in Kobe, Japan from September 24 to October 4, 2010 to develop solutions for mitigating bycatch of sea turtles in coastal Japanese pound nets. Twenty-one fishers, plus gear manufacturers and marine conservation scientists from three countries that host the Japanese-nesting loggerhead population - Japan, México and the USA - gathered to test PED designs and to raise public awareness of bycatch solutions. This was the second in a series of three workshops organized by Sea Turtle Association of Japan and the grupo Tortuguero de las Californias with participants from Tokyo University of Marine Science and Technology, National Research Institute of Far Seas Fisheries, and the University of Hawaii.

Pound net fisheries are common worldwide and known to cause high bycatch rates for sea turtle populations, including the North Atlantic (Crouse 1984; Mansfield 2006). In Japan, pound net bycatch results in mortality of many loggerheads and is likely a major threat to the recovery of the North Pacific loggerhead population (Ishihara & Kamezaki 2006; Shiode *et al.* 2006). The pound net consists of a leader set perpendicular to the coast that directs fish into standing nets that entrain fish into an enclosed trap mounted either at the surface or midwater. Fish are retrieved at regular intervals (usually daily) from pound nets, enabling live release of turtles and other bycatch from surface traps. However, pound nets with midwater traps prevent sea turtles from reaching the surface to breathe and thus can result in high mortality rates. Pound nets in Japan often have a midwater trap design and are operated nearshore in depths up to 100 m and range in size to leaders of up to 2km, with traps measuring up to 8,000 m^3, and standing gear costs in excess of US$2m.

Building on preliminary research showing that sea turtles can escape through an integrated hatch in the roof of a modified pound net trap (Abe & Shiode 2009), we are implementing a three phase, multi-sector research and outreach program to a) raise awareness of pound net bycatch solutions, b) develop a system for testing PEDs, and c) develop and test PED designs for turtle escape and fish retention. Applying lessons learned on adoption of mitigation technology in various fisheries (Campbell & Cornwell 2008; Hall *et al.* 2007; Jenkins 2008) and successful mitigation action in Mexican fisheries (Peckham & Maldonado-Diaz in press), fishermen, fisheries managers, marine scientists, and gear manufacturers have been engaged from the outset in all facets of the work in order to increase the efficacy of PED designs and to augment future PED adoption.

In Fall 2009 we conducted Phase I of this project at MinamiChita Beachland Aquarium, in Aichi, Japan. We designed and constructed a scale model of the midwater trap of a pound net with a system of panels in the trap roof that allowed us to compare PED designs in a controlled tank environment. During Phase I, we established a testing protocol using this scale model and tested six PED designs; one appeared promising in terms of turtle escape.

In Fall 2010 we conducted Phase II of the program to further develop and refine PED designs with Japanese and Mexican fishermen, gear manufacturers, and Japanese and U.S. scientists to develop and test PED designs. Based on the 2009 workshop, we assembled a model pound net trap in the central viewing tank of the Suma Aqualife Park. Participants collaborated during the trials to develop several innovative categories of PEDs that allowed turtle escape with high potential for fish retention. Three categories of PED designs of 11 different styles were tested during a total of 34 trials. In the process, we refined our research protocol, gained a better understanding of PED design pitfalls, and identified several promising PED designs. Of the 11 PEDs tested, each allowed turtles to escape, and several showed promise for high fish retention.

Members of the public and press joined workshop participants to observe the trials from within the aquarium (see http://www.youtube.com/watch?v=ZZwA5vdyhTw). The public setting yielded firsthand views of turtles that were struggling to escape from the pound net trap in order reach the surface to breathe. The experiments and the public setting created an excellent venue for media reporters to raise public awareness of the bycatch problem and the efforts to develop solutions. This resulted in extensive press coverage detailing the collaborative process of developing PEDs. Prominent stories appeared in national Japanese newspapers and television, including Shinbum newspapers and NHK TV, reaching tens of millions of viewers and readers. Public and official commentary regarding the workshop focused on solutions development and treated the bycatch problem as a given. Thus the education and public awareness raised throughout this process has been as influential as the PED research itself.

Phase 3 of the program will be conducted at Suma Aqualife Park and will focus on refining PED designs and testing them for fish retention. Media coverage and attention is expected with increased opportunities to inform public policy and to continue to build support for bycatch mitigation in Japan's pound net fisheries.

Although originally scheduled for 1-5 April 2011, Phase 3 was postponed to October 2011 due to the disastrous earthquake and tsunami that struck Japan on 11 March 2011. Detailed meeting reports are available in Japanese and English upon request, and a daily account of the expedition can be found at Peninsula Online: http://peninsulardigital.com/?p=24090

Acknowledgements. We acknowledge the great contributions of workshop participants: Japanese pound net fishermen - Toshiya Kohama, Mitsuharu Kume, Kazuhiko Sasaki, and Suguru Yamashita; Mexican fishermen - Bilde Acosta and Sergio Garcia Tapia; Toshikazu Miyamoto of Global Guardian Trust; and Ryohei Matsuhira of Hokumo Co, Ltd. We thank Dr. Osamu Abe of Japanese National Research Institute of Far Seas Fisheries and Dr. Daisuke Shiode of Tokyo University of Marine Science and Tecnology for their leadership throughout and for sharing their pioneering pound net mitigation research. We also thank Dr. Naoki Kamezaki, director of the Sea Turtle Association of Japan and the Suma Aqualife Park, and Dr. Yonat Swimmer and Irene Kinan Kelly of NOAA Fisheries Service Pacific Islands for their vision, counsel, and expertise. Media outreach was produced by Tatsuya Oshika in Japan and Antonio Diego Fernández in México. The permission for capture and use of sea turtles to the experiment was granted by Kochi Prefecture Marine Fisheries Adjustment Committee. This work was supported by Sea Turtle Association of Japan, Suma Aqualife Park, Grupo Tortuguero de las Californias, AC, Ocean Foundation, NOAA Fisheries and the Marine Turtle Conservation Fund. T.Ishihara was supported with a Research Fellowship for Young Scientists from the Japan Society for the Promotion of Science (JSPS).

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Special Session on Bycatch Solutions at the World Small-Scale Fisheries Congress

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During the World Small-Scale Fisheries Congress (WSFC), held from 18-22 October 2010 in Bangkok, Thailand (http://www.seafdec.or.th/wsfc2010/) the Grupo Tortuguero de las Californias and the Ocean Foundation convened a Special Session, "Assessing and mitigating the incidental capture of highly valuable megafauna in small-scale fisheries." With generous support from the Western Pacific Regional Fisheries Management Council, twelve experts from six countries were invited to present during the Special Session held on 22 October.

Bycatch in small-scale fisheries has been assumed to be low historically because their assessment and management have been generally poor relative to industrial fisheries (Lewison & Crowder 2006). However, recent studies have revealed substantial marine megafauna mortality from globally ubiquitous small-scale fisheries. Where they overlap with coastal megafauna hotspots, small-scale fisheries can generate among the highest bycatch rates documented worldwide (e.g. Peckham *et al.* 2007). As a result, mitigation of bycatch in small-scale fisheries can offer extraordinarily high conservation leverage.

Though advances in bycatch management have been largely limited to industrial-scale operations, assessment and mitigation of small-scale fisheries bycatch is advancing (Gilman *et al.* 2009). Rapid assessment projects have identified areas of particularly high bycatch (e.g. Moore *et al.* 2010). Focused mitigation programs that integrate participatory research, community networking, social marketing, and governance strengthening have been effective in reducing bycatch in certain sites while also augmenting the general sustainability of small-scale fisheries (e.g. Hall *et al.* 2007; Peckham & Maldonado in press).

During the Special Session panelists a) reviewed the importance of small-scale fisheries bycatch (Larry Crowder, Duke University); b) reviewed the methodology and results of rapid bycatch assessments (Rebecca Lewison, San Diego State University; Nick Pilcher Marine Research Foundation; Donna Kwan, UNEP/CMS Dugong MoU Secretariat); c) presented tradeoffs between ocean ecosystem services, in particular extractive vs non-extractive uses of megafauna (Sebastian Troeng, Conservation International); d) reviewed methods for mitigating bycatch in small-scale fisheries (Eric Gilman, Hawaii Pacific University); e) presented case studies of successful bycatch mitigation in small-scale fisheries (Aarón Esliman-Salgado, Grupo Tortuguero de las Californias; Joana Alfaro-Shigueto, ProDelfinus), including market-based solutions (Joaquin Murrieta, Environmental Defense Fund - México); and f) synthesized key components of successful bycatch mitigation strategies (Hoyt Peckham, Grupo Tortuguero de las Californias).

The WSFC united an unusual combination of global fisheries experts ranging from anthropologists to economists to managers, providing the Special Session with an exceptional opportunity to both raise awareness of bycatch issues and to simultaneously tap alternative sources of knowledge and expertise to develop solutions. Several of the panelists contributed to a recent synthesis (Lewison *et al.* 2011), and further syntheses based on this WSFC Special Session are in progress.

***Acknowledgements**:* The panelists thank Ratana Chuengpagdee and all of her excellent team for producing the WSFC, the Western Pacific Regional Fishery Management Council, pursuant to the National Oceanic and Atmospheric Administration Award No. NA10NMF4410219, for supporting panelists' travel expenses, and the Ocean Foundation for administrating that support.

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President's Report from the 31st Annual Symposium on Sea Turtle Biology and Conservation "The Next Generation of Research and Conservation," 10 – 16 April 2011, San Diego, California USA

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For the first time in the 31-year history of the International Sea Turtle Society's Annual Symposium, the meeting was held on the U.S. West Coast, in San Diego. The symposium provided an excellent opportunity to participants from around the world to come to a part of the US that has received relatively little attention regarding its sea turtles. Throughout the week, we highlighted the value of U.S. West Coast, and adjacent waters of the Eastern Pacific for resident sea turtles. This was achieved through numerous oral and poster presentations and educational events that occurred throughout the week.

The theme of the symposium '*The Next Generation of Research and Conservation*' drew attention to the student contributions to our Society. My goal was to highlight how students have advanced research and conservation of sea turtles around the world, and how integral their efforts are to the on goings at the Symposium. We blended many new student-related elements into this year's meeting, headlined by 'Student Day' on April 13th, which had a student-only format for all of the day's oral and poster presentations. Student Day was followed by an evening Student Mixer in the Grand Exhibit Hall, which all Symposium attendees were encouraged to attend. San Diego also marked the launch of the ISTS Student Committee, which now formally integrates student-focused events as a cornerstone of the Symposium.

With nearly 900 participants from 79 countries, the success of the symposium was reflected in the coming together of ideas in research and lessons in conservation from a diverse range of individuals and groups, representing all the species of sea turtles, their diverse habitats around the world, and the myriad of social aspects relating to human-sea turtle interactions. Over 550 abstracts were received and around 450 were presented (~150 oral and ~300 poster format). All submitted abstracts were subjected to a careful review process by the Program Committee, overseen by Program Co-Chairs Bryan Wallace and T. Todd Jones, and the Program Coordinator DuBose Griffin.

The symposium was held at the Town and Country Resort & Convention Center in San Diego. The venue was ideal for hosting main symposium sessions in addition to numerous regional meetings and thematic workshops. For the first time in several years, all the Symposium events were held at one site, including oral and poster presentations, evening social events, vendors. This fostered more interaction among the attendees and promoted numerous impromptu gatherings and discussions among colleagues.

Regional Meetings and Thematic Workshops. Pre-symposium meetings and workshops commenced on the 10th of April and included a large number of regional meetings and thematic workshops. This year's Symposium included the following regional meetings (and organizers): Africa Regional Meeting (Manjula Tiwari, Jacques Fretey, Angela Formia), Indian Ocean & Southeast Asia Regional Meeting (Maggie Muurmans, Rahayu Zulfiki, SMA Rashid, Lalith Ekanayake), The 18th Latin American Regional Meeting (Alan Zavala, Juanpablo Muñoz, Carlos Mario Orrego), Wider Caribbean Regional Meeting (Karen Eckert), IOSEA Marine Turtle Meeting (Douglas Hykle), Mediterranean Regional Meeting (Paolo Casale), Pacific Islands Region and Partners Meeting (Irene Kelly), and East Asia Regional Meeting (Yoshimasa Matsuzawa).

The thematic meetings and workshops (and their organizers) included the: Freshwater Turtle and Tortoise Symposium (Chuck Schaffer), 2nd Workshop on Data Analysis in Marine Turtle Research (Tomo Eguchi), NMFS Scientific Research and Enhancement Permits Workshop (Amy Hapeman), Sea Turtle Medicine Workshop (Heather Harris), 3rd Workshop on Sea Turtle Stable Isotope Research (Karen Arthur, Kim Reich, Bryan Wallace), Marine Turtle Conservation Fund Grant Writing Workshop (Earl Possardt), Pacific Leatherback Turtle Conservation Fund Meeting (Asuka Ishizaki), Public Participation in Turtle Conservation Workshop (Samantha Burgess), Science of Advocacy Meeting (J. Nichols, Todd Steiner), Eastern Pacific Hawksbill Initiative Meeting (Alexander Gaos, Ingrid Yañez), Student Professional Development Workshop (Lisa Komoroske), Marine Turtles, Hooks, and Related Lesions Workshop (Mariluz Parga), and IUCN Marine Turtle Specialist Group Annual General Meeting (Roderic Mast, Nicolas Pilcher).

The San Diego Symposium also hosted two education and outreach workshops for local San Diegans, including the San Diego Schoolchildren Education Workshop and the San Diego Teacher Education Workshop, both organized by Frances Kinney and Barbara Andrews.

Main Symposium Program. The main symposium sessions were held between the 12th and 15th of April, with parallel sessions running throughout all but the keynote presentations and the first special session (*Finding Common Ground in Fisheries Management*). In the afternoon of April 12th there were two additional special sessions entitled *Oil Spills, Cold-Stunning, And Sea Turtles* there and *Next Generation Of Genetics Research*. The traditional session themes included: 1) *Foraging, Physiology, and Movements*; 2) *Breeding Biology*; 3) *Population Assessment*; 4) *Health and Rehabilitation*; 5) *Threats*; and 6) *Conservation Through Social, Economic, Cultural, and Legal Pathways*. The Major Sponsors of these sessions included Western Pacific Regional Fisheries Management Council (Finding Common Ground in Fisheries Management), NOAA-National Marine Fisheries Service (Oil Spills, Cold Stuns and Sea Turtles), The Ocean Foundation (Conservation Through Social, Economic, Cultural, and Legal

Pathways), SeaWorld - San Diego (Health and Rehabilitation), Unified Port of San Diego (Population Assessment), and Telonics, Inc. (Foraging, Physiology, and Movements).

The main symposium sessions commenced early on April 12th with keynote addresses by Dr. Peter Pritchard, who gave a talk entitled *The Eastern Pacific: Where The Turtles Are All Different* and Dr. Karen Bjorndal who spoke on *Planning Our Future: Expanding The Known, Learning The Unknown, And Minimizing The Unknowable*. The main symposium sessions concluded on April 15th with a closing keynote address by Dr. J. Nichols entitled *All Eyes On The Future*.

There was a single poster session that was ongoing for the entire symposium. Located in the expansive Grand Exhibit Hall, there was plenty of space, which enabled poster presentations to be right next to the vendor booths, cash bars, and a 'hi-boy' table area that was site of several social events. Three 'Meet the Authors' sessions were scheduled for the evenings of 12-13 April 12th, giving substantial time for Symposium attendees to interact with the authors.

Media. The event was covered by both local and national level newspapers and television channels. Among the more notable media events was a dedicated show on sea turtles and the symposium on the nationally acclaimed *Treehuggers International* hosted by Tommy Hough. A number of articles in newspapers and online magazines occurred the week of and the week after the Symposium. This coverage helped draw attention to the hot topics in sea turtle research and conservation that were highlighted at the Symposium.

Vendors. This year we did our absolute best to highlight the vendors and exhibitors, all of whom were set up from April 11th to 15th in the Grand Exhibit Hall, along with the poster presentations and cash bars. Vendors and exhibitors at the 31st Annual Symposium included AG-GUA, AHI Enterprises, Bioko Biodiversity Protection Program (Drexel University), Boone's Georgia Jumpers, Boyd Lyon Sea Turtle Fund, CARINAM, Center for Biological Diversity, CLS America, Inc., Chelonian Research Foundation, Conservation International, Desert Star Systems, Earthwatch Institute, Eco, Everlasting Nature of Asia, Instituto de Fomento Pesquero, Inwater Research Group Inc., Karumbe, Lotek, Manta Publications, Marinelife Alliance, Masirah, Mediterranean Association to Save the Sea Turtles, National Marine Fisheries Service, Oceana, Paso Pacifico, Pro Peninsula Fund, San Diego Turtle and Tortoise Society, Sea Turtle Conservancy, Sea Turtle Restoration Project, SeaWorld - San Diego, SEE Turtles, Sirtrack Ltd, Telonics, Inc., The Leatherback Trust, NTV MSNBC, WIDECAST, Western Pacific Fishery Council, Wildlife Computers, Zonk Galleries.

Social Events. With all Symposium activities held at one hotel for the first time in several years, we had an opportunity to organize many evening social activities. Among the new events in San Diego was Speed Chatting with Turtle Experts, a fundraising event that aimed to provide a means for Symposium newcomers and veterans alike to spend time chatting with a stellar collection of turtle enthusiasts and ISTS Symposium veterans. This event was intended to be the 'ice-breaker' for getting to know people you've always wanted to but have never approached.

For the first time in ISTS history, the Nationally acclaimed Wild and Scenic Film Festival was presented during the Symposium. The Festival took place on April 13th at the Symposium hotel, and hosted a selection of environmental and turtle-centric films showing concurrently on two big screens. ISTS-31 attendees attended for free, and there were more than 300 people from San Diego's general public that purchased tickets to attend the Festival.

The farewell banquet was held at the Symposium hotel on night of April 15th, the last day of the main Symposium. The evening commenced with the distribution of the Archie Carr Student Awards and the ISTS Special Awards. The President's farewell speech and vote of thanks was followed by the handing over of the Presidential trowel to the incoming ISTS President Ana Barragan of Mexico. The Closing Ceremony was followed by a set of music by the solo jazz guitar icon Stanley Jordan and capped by a 3-hour set by the locally acclaimed 'Afro-Mexica' group The *B-Side Players*. A definite highlight was when the B-Sides invited Stanley on stage to jam a few tunes. All-star music at its best.

Silent and Live Auction. As is a tradition of the ISTS's fund raising efforts at each year's Symposium, both silent and live auctions were held. A spectacular range of items which included showpieces, artwork, trinkets, items of clothing, etc. were brought by participants from around the world were displayed at the silent auction, which ran bidding all week long.

The live auction was held on the 14th of April. It was lively evening with lots of fun, cheer, and competition! It was kicked off by a set of amazing jazz music by Stanley Jordan, followed by veteran bidders competing with fresh hands and try to outbid each other for all shapes and forms of donated collectibles. This has been the crown jewel of ISTS social events for decades and this year did not disappoint. Proceeds from both auctions contribute to the travel grants for the next symposium. Special thanks are due to Jennifer Homcy, Marina Zucchini and their dedicated team of volunteers for this outstanding effort.

ISTS Awards. A variety of awards were presented at ISTS 31, including career achievement awards (Life-Time Achievement, ISTS Champions, President's, and Volunteerism) and Symposium presentation awards (Archie Carr Student and Grassroots Conservation). The Career Achievement Awards Committee, comprising elected members of the society, and chaired by Karen Arthur, worked very hard to consider deserving individuals and organizations that were nominated for the ISTS Awards this year. The Archie Carr Student Awards Committee was co-chaired by Jeanette Wyneken and Matthew Godfrey, and the Grassroots Conservation Award Committee was chaired by J. Nichols. All did a great job in identifying those presentations deserving of the presentation awards. I must say that I was incredibly proud that San Diego could host such a stellar bunch of award recipients. Congratulations to all.

The ISTS Lifetime Achievement Awards were presented to Sally Murphy, Peter Pritchard, and Karen Bjorndal for their highly significant impact on sea turtle biology and conservation through the course of their careers. All three are true icons of the Symposium, and heroes of sea turtle research and conservation.

The ISTS Champions Awards were presented to Colum Muccio for his leadership in sea turtle conservation in Guatemala, Jepson Prince for his longtime work sea turtle monitoring and education in Antigua, and Sinkey Boone, whose posthumous award was given to celebrate his invention of the turtle excluder device.

The ISTS President's Award was presented at the Welcome Ceremony to Margie Stinson, a true pioneer of sea turtle research in California, and the scientist who put green turtles of San Diego Bay on the map.

A new award, the ISTS Volunteerism Award was given posthumously to Ed Drane, the Society's treasurer for more than two decades, and someone that served as part of the ISTS braintrust throughout. The Society announced at the award ceremony that this annual award would thereafter be known as the ISTS Ed Drane Award for Volunteerism.

The Archie Carr Student Awards were awarded to Morgan Young (Foraging Physiology and Movements Best Poster), Leigh Anne Harden (Threats Best Poster), Vanessa Bezy (Population Assessment Best Poster), Virginie Plot (Health and Rehabilitation Best Poster), Hannah Vander Zanden (Breeding Biology Best Poster), Simona Ceriani (Foraging Physiology and Movements Best Oral), Alexander Gaos (Foraging Physiology and Movements Runner-Up Oral), Qamar Schuyler (Threats Best Oral), Brian Shamblin (Population Assessment Best Oral), Anthony Rafferty (Breeding Biology Best Oral), Jeanne Garner (Breeding Biology Runner-up Oral), and Courtney Shepard (Conservation through Social, Economic, Cultural, and Legal Pathways Best Oral).

The new Grassroots Conservation Award was given to Ingrid Yañez for her work on eastern Pacific hawksbill turtles.

Travel Grants. The ISTS provided $100,000 for travel grant support this year to help 153 travelers attend the meeting. A total of $43,629 was distributed as cash and the remainder as free accommodations at the Symposium hotel for the entire duration of the symposium. The tireless efforts of Alexander Gaos (Travel Chair) and the regional travel chairs made sure that all deserving participants could avail of the travel award. The regional travel committee comprised of Aliki Panagopoulou (Europe), Angela Formia and Manjula Tiwari (Africa), Nicolas Pilcher (Asia/Pacific), Karen Eckert (Caribbean), Alejandro Fallabrino (Latin America), Kartik Shanker (India/South Asia), ALan Rees (Middle East), and Bryan Wallace (USA/Canada).

ISTS Business Meeting. The ISTS Business Meeting held on the afternoon of April 15th was attended by about 150 members. The opening statement by the President was followed by presentations of the Treasurer's Report by Terry Meyer, the Travel Committee Report by Alexander Gaos, the Nomination's Committee Report by Pamela Plotkin, and the Awards Committee Report by Karen Arthur. The Director of Information Technology, Michael Coyne was reappointed by the President to serve another five-year term. The meeting was capped with an introduction to ISTS 32 in Mexico, by President-Elect Ana Barragan.

ISTS Elections. The following candidates were announced as winners of the ISTS elections: Ray Carthy for President Elect, Aliki Panagopoulou and Paolo Casale for the two Board of Directors positions, Terry Meyer for Treasurer, Manjula Tiwari for Secretary, Andres Estrades, Mario Moto, and Frank Paladino for the Nominating Committee, and Kim Maison and Stephen Dunbar for the Awards Committee. Congratulations to all!

ISTS Student Committee. Using the term "student" loosely to include traditional and non-traditional students, this President-appointed committee invited all people interested in advancing their knowledge and professional skills to become involved. Over the course of 2010-2011, the committee networked with students around the world to plan activities for the 2011 ISTS symposium. More than 50 students from over 15 countries became involved, and in this inaugural year the committee focused on four main tasks: (1) presentation feedback, (2) a professional development workshop, (3) a student mixer, and (4) student network development. I gratefully acknowledge Co-Chairs Lisa Komoroske and Alexander Gaos for their vision, enthusiasm, and leadership in launching this new Symposium initiative.

Resolutions. There were two resolutions passed at the 2011 Business Meeting. The first resolution was entitled *Conservation of Leatherback Sea Turtles (Dermochelys coriacea) in the Eastern Tropical Pacific* and was submitted by Rebecca Regnery of Humane Society International, Randall Arauz of Pretoma and Todd Steiner of the Sea Turtle Restoration Network. The second draft resolution was entitled *Conservation of Australian Flatback Turtles (Natator depressus) in Northwestern Australia* and was submitted by Teri Shore, Turtle Island Restoration Network, and Jill St. John of the Wilderness Society of Western Australia. Both resolutions passed with a resounding majority of Society Members in attendance at the Business Meeting. These resolutions have since been sent to the appropriate governments and institutions that we hope will heed these resolutions and enhance their sea turtle conservation efforts.

Sponsors and Donors. The International Sea Turtle Society and the local organizing committee is very grateful to the support provided by our international donors and sponsors, including many of our annual sponsors who supported us despite the economic recession. In particular, we are grateful to the lead sponsors of the 31st Annual Sea Turtle Symposium: *National Oceanic and Atmospheric Administration*, *Western Pacific Regional Fisheries Management Council*, *USFWS Marine Turtle Conservation Fund*, *SeaWorld - San Diego*, *The Ocean Foundation*, and *Disney's Animal Programs*. To all of these organizations, I give a leatherback-sized thank you!!

We've also had amazing support from National Fish and Wildlife Foundation, San Diego Gas and Electric, Unified Port of San Diego, Telonics Inc., Wildlife Computers, International Community Foundation, Earthwatch Institute, Eastern Pacific Hawksbill Initiative (ICAPO), Monterey Bay Aquarium, California Academy of Sciences, Leatherback Trust, San Diego Airport Authority, Sirtrak, Chula Vista Nature Center, CLS America, South Asia Cooperative Environment Programme, Desert Star Systems, Pro Peninsula Fund, and San Diego State University. And for our international travelers, there were several individuals that helped with funding rooms for our travelers, including Syed Abdullah, Dave Allison, Kathryn Craven, Nancy FitzSimmons, Karen Frutchey, Thomas Gray, Janet Hochella, Cindy Lewis, Beth Marcus, Kellie Pendoley, Debbie Sobel, Jessica Thompson, Colette Wabnitz. I would like to thank each of these organizations and individuals for making this San Diego Symposium possible!

I'd also like to again thank the aforementioned major sponsors of the special sessions and traditional sessions: Western Pacific Regional Fisheries Management Council (Finding Common Ground in Fisheries Management), NOAA-National Marine Fisheries Service (Oil Spills, Cold Stuns and Sea Turtles), The Ocean Foundation (Conservation Through Social, Economic, Cultural, and Legal Pathways), SeaWorld - San Diego (Health and Rehabilitation), Unified Port of San Diego (Population Assessment), and Telonics, Inc. (Foraging, Physiology, and Movements). The quality of individual presentations in these sessions is a testament to how well they went at ISTS 31.

Key Members of the Organizing Team. The San Diego Symposium Executive Committee helped develop the vision and theme for this year's meeting, and the 'final product' that the attendees experienced was the result of their vision and the total team effort that followed. I'd like to thank many people, and especially to my Executive Committee, which consisted of many of my closest colleagues: Barbara Andrews, Kama Dean, Stephen Dunbar, Christina Fahy, T. Todd Jones, Robin LeRoux, Rebecca Lewison, Manjula Tiwari, and Bryan Wallace.

Ingrid Yañez and Donna Broadbent in particular were essential to my planning efforts, serving as the On-site and Symposium Coordinators, respectively. Also helping substantially with the planning were Terry Meyer, our ISTS Treasurer, Manjula Tiwari, the ISTS Secretary, Michael Coyne, this year's Registrar, Elena Finkbeiner, our Development Coordinator, Lauren Saez, our Volunteer Coordinator, Rachel Tuck, our Vendor Coordinator, and Jean Beasley and Katie Wedermeyer, our PR team. I'd like to thank Katherine Comer Santos, Cali Turner-Tomaszewicz, Stephen Dunbar, and Christina Fahy for helping with many of the fine details during our planning efforts.

This year we hosted a record number of regional and thematic side meetings, and Kama Dean did a fabulous job coordinating all of these events. Topping that off, the organizers of each of these 23 meetings has had their hands full in recent months, and I'd like to thank each and every person for adding such important elements to this year's Symposium. Working with my Program Co-Chairs Bryan Wallace and T. Todd Jones was incredibly rewarding to me, as they have been close colleagues and even closer friends for more than a decade. I'd also like to thank DuBose Griffin, our ISTS Program Coordinator, and Robin LeRoux and Aliki Panagopoulou, our Poster Session Co-Chairs for helping with oral and poster presentations.

One of the elements of this year's meeting that I am particularly proud of is the involvement of local schoolchildren and teachers, all made possible by the leadership of Frances Kinney and Barbara Andrews. Having school kids integrated with the symposium certainly helped foster the next generation of sea turtle researchers and conservationists!

No meeting would be complete without a healthy portion of evening social and fund-raising events during a Symposium and this year the team has assembled a very special collection of activities. Specifically, I'd like to thank Jennifer Homcy and Marina Zucchini for coordinating the Live and Silent Auctions, Rod Mast for once again being our Live Auctioneer, Giuliana Schroeder and Barbara Andrews for putting together the Wild & Scenic Film Festival, and Emma Harrison and Zoe Meletis for several other social events, including the inaugural 'Speed Chatting with Turtle Experts'.

ACKNOWLEDGEMENTS

Publication of this issue was made possible by donations from the following individuals: Holger Vetter, Ivan Cumpian, Anne Voigt **and organizations:** Conservation International, International Sea Turtle Society, IUCN - Marine Turtle Specialist Group, Sirtrack Ltd., US National Marine Fisheries Service-Office of Protected Resources, Western Pacific Regional Fishery Management Council.

The MTN-Online is produced and managed by Michael Coyne.

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The remit of the *Marine Turtle Newsletter (MTN)* is to provide current information on marine turtle research, biology, conservation and status. A wide range of material will be considered for publication including editorials, articles, notes, letters and announcements. The aim of the *MTN* is to provide a forum for the exchange of ideas with a fast turn around to ensure that urgent matters are promptly brought to the attention of turtle biologists and conservationists world-wide. The *MTN* will be published quarterly in January, April, July, and October of each year. Articles, notes and editorials will be peer-reviewed. Announcements may be edited but will be included in the forthcoming issue if submitted prior to the 15th of February, May, August and November respectively. All submissions should be sent to the editors and not the members of the editorial board. A contact address should be given for all authors together with an e-mail or fax number for correspondence regarding the article.

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To ensure a swift turnaround of articles, we ask that, where possible, all submissions be in electronic format either as an attached file in e-mail or on compact disc in Word for Windows or saved as a text file in another word-processing package. Should these formats not be suitable, authors should contact the editors to seek alternative arrangements. If internet access or compatible computer facilities are not available, hard copies of the article can be sent to the editors by mail or fax.

Scientific names should be italicised and given in full in their first appearance. Citations in the text should be in **alphabetical** order and take the form of: (Carr *et al.* 1974; Hailman & Elowson 1992; Lagueux 1997). **Please keep the number of references to a minimum.**

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References

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For an article in a journal:

HENDRICKSON, J. 1958. The green sea turtle, *Chelonia mydas* (Linn.), in Malaya and Sarawak. Proceedings of the Royal Zoological Society of London 130:455-535.

For a book:

MROSOVSKY, N. 1983. Conserving Sea Turtles. British Herpetological Society, London. 177pp.

For an article in an edited volume;

GELDIAY, R., T. KORAY & S. BALIK. 1982. Status of sea turtle populations (*Caretta caretta* and *Chelonia mydas*) in the northern Mediterranean Sea, Turkey. In: K.A. Bjorndal (Ed.). Biology and Conservation of Sea Turtles. Smithsonian Institute Press, Washington D.C. pp. 425-434.

Where there are multiple authors the initials should precede the last name except in the case of the first author:

BJORNDAL, K.A., A.B. BOLTEN, C.J. LAGUEUX & A. CHAVES. 1996. Probability of tag loss in green turtles nesting at Tortuguero, Costa Rica. Journal of Herpetology 30:567-571.

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