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Spatio-temporal patterns in occurrence and niche partitioning of marine turtles along the coast of Togo (West Africa)
(Testudines: Cheloniidae, Dermochelyidae)

Muster im räumlich-zeitlichen Auftreten und in der Nischenaufteilung bei Meeresschildkröten entlang der Küsten von Togo (Westafrika)
(Testudines: Cheloniidae, Dermochelyidae)

GABRIEL HOINSOUDE SEGNIAGBETO & DEDE OKANGNY & KOMLAN AFIADEMAGNO & KOMLAN KPOTOR & DANIELE DENDI & JACQUES FRETEY & LUCA LUISELLI

KURZFASSUNG

Die Küste von Togo (Westafrika) wurde täglich über ein Jahr hin von Wächtern (eco-guards) begangen, die Daten zur Phänologie der Meeresschildkröten sammelten. Drei Arten wurden an den Stränden festgestellt, Oliv-Bastardschildkröten, *Lepidochelys olivacea* (ESCHSCHOLTZ, 1829), Suppenschildkröten *Chelonia mydas* (LINNAEUS, 1758) und Lederschildkröten *Dermochelys coriacea* (VANDELLI, 1761). Zur Datenbeurteilung wurde die Küste gedanklich in fünf Abschnitte mit verschiedenen Merkmalsausprägungen unterteilt.

Insgesamt überwogen *L. olivacea* and *C. mydas* zahlenmäßig deutlich. Bei allen Arten war das Geschlechterverhältnis klar zugunsten der Weibchen verschoben. Nur im *C. mydas* Material waren Jungtiere und Halbwüchsige zahlreich. Zur Eiablage bevorzugten die Schildkröten sandige aber auch von Felsen durchsetzte Strände. Nistende Weibchen mieden stark beleuchtete Strandabschnitte deutlich, auch wenn sie zur Eiablage aufgrund ihrer sonstigen Merkmale geeignet erschienen. Monatlich betrachtet, waren die erhobenen Individuenzahlen bei *L. olivacea* and *C. mydas* über das Jahr untereinander ähnlich und wiesen Häufungen im November und Juli auf, während *D. coriacea* eigentlich nur zwischen November und Februar auftrat. Bei *L. olivacea* and *C. mydas* waren die Häufigkeiten von lebend im Meer und tot auf dem Strand gezählten Individuen ziemlich gleichmäßig über die Abschnitte verteilt, mit Häufungen für im Meer gefangenen *C. mydas* in Abschnitt IV und für gestrandete Kadaver von *L. olivacea* in Abschnitt II. Die Untersuchungsergebnisse werden im Hinblick auf Schutzkonsequenzen diskutiert.

ABSTRACT

Using a network of eco-guards, the coast of Togo (West Africa) was surveyed on a daily basis during a 12-month period, to obtain data on several aspects of the phenology of marine turtles. Three species of turtles were observed on the beaches, viz., Olive Ridleys *Lepidochelys olivacea* (ESCHSCHOLTZ, 1829), Green Turtles *Chelonia mydas* (LINNAEUS, 1758) and Leatherbacks *Dermochelys coriacea* (VANDELLI, 1761). For data assessment, the coast was theoretically divided into five sites each with different beach conditions.

Lepidochelys olivacea and *C. mydas* dominated the samples, and adult sex-ratio was clearly skewed towards females in all species. Only the *C. mydas* sample comprised a significant number of juveniles and subadults. The turtles exhibited a preference for sandy beaches, but also beaches interspersed with rocks as egg-laying areas. There occurred clear avoidance by nesting females of intensely lighted beaches, even though beach characteristics were apparently good for oviposition. Counts of specimens per month were similar across the year in *L. olivacea* and *C. mydas*, with peaks in November and July, and with *D. coriacea* occurring between November and February. For *L. olivacea* and *C. mydas*, the frequency of specimens captured in the sea and of stranded corpses was rather homogeneous across sites, with a peak for *C. mydas* captured in the sea at site IV, and a peak for stranded corpses of *L. olivacea* at site II. Conservation implications of the results are discussed.

KEY WORDS

Reptilia: Testudines: Cheloniidae, Dermochelyidae: *Lepidochelys olivacea*, *Chelonia mydas*, *Dermochelys coriacea*, nesting, activity patterns, reproduction, mortality, behavior, ecology, conservation, Togo, West Africa

INTRODUCTION

Marine turtles are the least diverse chelonian group in number of species, but exhibit a worldwide distribution across the tropical and temperate seas (BJORNDAL 1987, 1997; ERNST & BARBOUR 1989; PRITCHARD 1997; FRAZIER 1999; MEYLAN et al. 1999; Bjorndal & Jackson 2003). Marine turtles are studied across the world as for conservation biology aspects, as most of the extant species are adversely affected by human activities at all life stages (Wallace et al. 2011), with severe negative impacts at the local level, that produce deleterious effects on population viability at the global scale (Groombridge 1990; Fazier 1999; Huxley 1999; Lescure 2003; Wallace et al. 2011; Mortimer & von Brandis 2013). However, the sea turtles' spatial and temporal use of the available resources, including aspects of community ecology, remain poorly studied, whereas terrestrial and freshwater reptiles represent popular model organisms for community ecologists (e.g., Luiselli 2006, 2008a, 2008b).

There are wide regions in the tropical seas where species of marine turtles can be found in sympatry (e.g., Fretey 2001), providing ideal conditions for the study of their community ecology and resource partitioning patterns (Meylan et al. 1999; Hamann et al. 2010). The coastal area of Togo in the Gulf of Guinea (West Africa), which is characterized by a rich marine turtle fauna, a sandy barrier beach and water deeper than in the surrounding countries, therefore is well suited for study (Fretey, 2001; Segniagbeto 2004; Segniagbeto et al. 2013, 2014). In this paper, the authors analyze the spatial and temporal patterns of occurrence (phenology) and niche partitioning of sympatric marine turtle species along the coast of Togo, with the specific aims:

- to determine the relative frequency of occurrence of marine turtle species;
- to evaluate whether or not the adult sex-ratio is even (e.g., Wibbels et al. 1991; Casale et al. 2005);
- to evaluate whether or not subadults occur within the Togolese coasts;
- to explore whether or not marine turtles exhibit site-specific preferences for egg-laying and other routine activities along the Togolese coast;
- to analyze the monthly activity patterns of the various species; and
- to assess the potential adverse impact of human activities on marine turtles, and conservation implications.

MATERIALS AND METHODS

This paper is based on field data collected from October 2012 to September 2013, in cooperation with AGBO-ZEGUE NGO (Togolese Society for the Conservation of Nature). This study was conducted with the help of specifically instructed ecoguards, who monitored the Togolese coast from Kodjoviakopé (western outskirts of Lomé) to the municipality of Agbodrafo (Djéké) (42 km east of the former location) to collect data on the niche partitioning patterns and phenology of marine turtles. For the study of spatial niche partitioning by marine turtles, the monitored coast (42 km in total) was subdivided into five contiguous sections (termed 'sites' in the following text; see Fig. 1):

Site I – from the border of Ghana (Kodjoviakopé) to the level of the roundabout at Hotel de la Paix (Peace Hotel). This site comprises six km of sandy shore where sea turtle nesting was previously documented (Segniagbeto 2004). The coast is currently disturbed by the presence of ships emitting light at night. Ship lights, coastal lampposts and buildings can be disorienting to females entering the beach for egg-laying.

Site II – from the roundabout at Hotel de la Paix (Peace Hotel) to the main pier of the port (Port de pêche) of Lomé. This site comprises five km of sandy shore where sea turtle nesting was previously documented (Segniagbeto 2004). This section corresponds to the site of construction for a container terminal and thus is very busy and highly disturbed.

Site III – from Gbétsogbé to Kpogan. This section comprises ten km of rocky shore. The rocky features of this site were thought to discourage marine turtles from oviposition (Segniagbeto 2004).

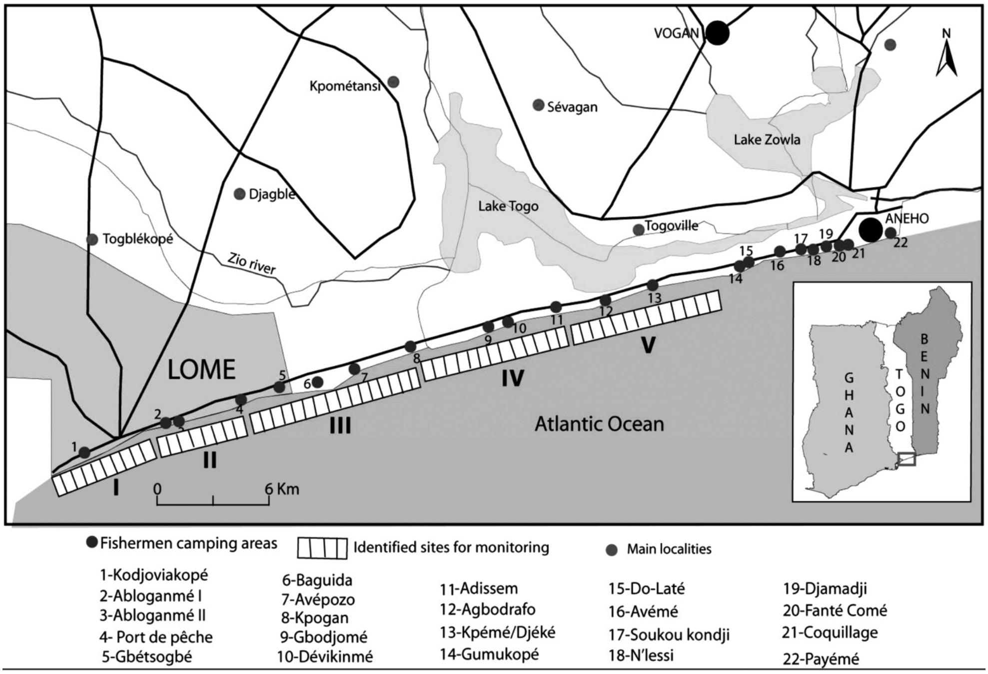

Fig. 1: The position of five sections (sites I to V) defined along the Togolese coast for the present sea turtle study.

Abb. 1: Die Lage der fünf Abschnitte (I – V), die zur vorliegenden Untersuchung der Meeresschildkrötenvorkommen an der Küste von Togo festgelegt wurden.

Site IV – from Kpogan to Adissem. This site comprises 11 km of mainly sandy shore, with scattered rocky spots, where sea turtle nesting was previously documented (SEGNIAGBETO et al. 2004, 2014).

Site V – from Adissem to the mineral port of Kpémé. This section comprises ten km of sandy shore where sea turtle nesting was previously documented (SEGNIAGBETO 2004; SEGNIAGBETO et al. 2013).

Two eco-guards specifically educated for this study patrolled the sections on a daily basis collecting data. Eco-guards monitored the beaches for ovipositing or stranded turtles and recorded specimens brought by fishermen. Eco-guard patrolling activity occurred both by day (11:00 am to 04:00 pm) and night (4:00 to 6:00 am). Each turtle was identified to species and sex, and its carapace was measured with a tape (BOLTEN 1999) [results of measurements not reported in the present paper]. The field effort was about 420 person hours per month and section.

Randomness versus nonrandomness of niche partitioning patterns were determined, after 30,000 Monte Carlo simulations, using the RA2 and RA3 algorithms, by EcoSim Professional version 1.2 software for null model analysis in community ecology (ENTSMINGER 2014; see LUISELLI 2006, for a more detailed description of the statistical procedure).

All statistical analyses were performed using PAST version 3.0 software package (HAMMER et al. 2001), with alpha set at 0.05. Observed versus expected χ^2 tests were used to analyze (i) sex-ratios of the observed species and (ii) the frequency of observations by site. Monthly activity patterns were analyzed by Kruskal-Wallis test, as the observed samples were not normally distributed.

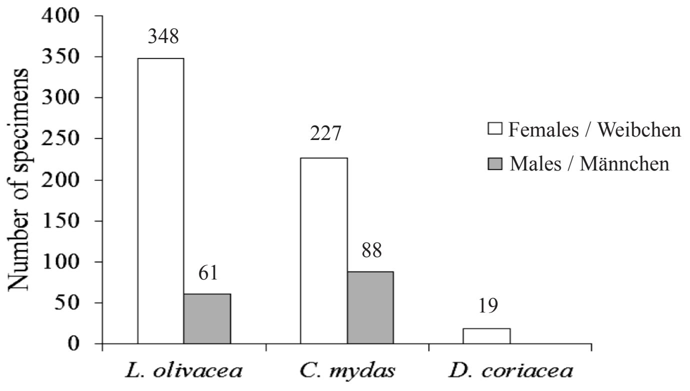

Fig. 2: Sex-ratio of the observed marine turtle species in Togo.
Abb 2: Das bei den Meeresschildkröten von Togo beobachtete Geschlechterverhältnis.

RESULTS

Overall, 743 individuals were recorded during the present study, with a large number of animals found dead on the beaches or in fishermen's nets (26 %). These individuals belonged to three species: Olive Ridley, *Lepidochelys olivacea* (ESCHSCHOLTZ, 1829) [N = 409], Green Turtle, *Chelonia mydas* (LINNAEUS, 1758) [N = 315] and Leatherback Turtle, *Dermochelys coriacea* (VANDELLI, 1761) [N = 19].

Sex ratio of the observed samples was uneven in *L. olivacea* ($\chi^2 = 114.8$, $df = 1$, $P < 0.0001$), *C. mydas* ($\chi^2 = 32.2$, $df = 1$, $P < 0.0001$) and *D. coriacea* ($\chi^2 = 12.7$, $df = 1$, $P < 0.0001$), and in all cases skewed towards females (Fig. 2). For *L. olivacea*, males were regularly present (Fig. 2) whereas juveniles were absent. Concerning *C. mydas*, the regular presence of individuals of different age groups was observed, including adult males (Fig. 2) and juveniles (these latter constituted 58 % of the *C. mydas* sample of N = 315). Regarding *D. coriacea*, all individuals were gravid females laying eggs on the beaches.

Spatial niche partitioning.- Marine turtles (numbers of individuals in parentheses) were recorded mainly in sites number II (166), III (175) and IV (187). With the exception of site IV, *L. olivacea* dominated all the sites (Fig. 3). *Lepidochelys olivacea* were found more frequently in sites II and III than in the other sites ($\chi^2 = 20.6$, $df = 4$, $P < 0.0003$).

Inter-specific spatial niche overlap (O) was high (mean O = 0.857 ± 0.002): it was higher between *D. coriacea* and *C. mydas* (O = 0.905) than between *L. olivacea* and *C. mydas* (O = 0.831) or *L. olivacea* and *D. coriacea* (O = 0.836). The observed mean overlap index was not significantly different from the mean of simulated indices (O_{sim} = 0.828 ± 0.0021) either at RA3 (P = 0.767) or at RA2 (P = 0.790). The marine turtles partitioned the various available resources (sections) randomly.

Monthly activity patterns.- In general, two major peaks of monthly activity (counts of specimens) were noticed, a first peak occurring in November, and another in July (Fig. 4). The relative peak observed in January was caused substantially by *L. olivacea*. Frequency of records was very low in April, September and October. Overall, the three species differed significantly in terms of monthly activity patterns ($H = 23.71$, $P < 0.0001$), and Bonferroni corrected pairwise comparisons revealed that *L. olivacea* were similar to *C. mydas* (P = 0.496), whereas each of these species significantly differed from *D. coriacea* (P < 0.0002 and P < 0.0001, respectively).

Clutches.- Fifty clutches were recorded, 46 of *L. olivacea* and four of *D.*

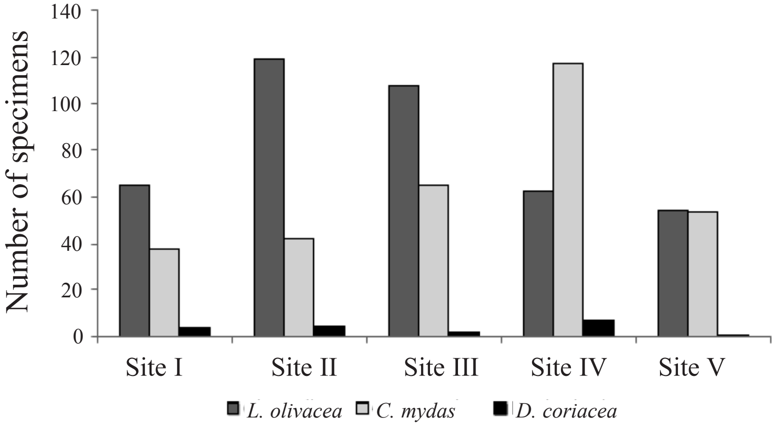

Fig. 3: Frequency of three observed marine turtle species by site in Togo.
Abb. 3: Häufigkeit der drei beobachteten Meereschildkrötenarten an den in Togo untersuchten Strandabschnitten. Site I bis Site V – Abschnitt 1 bis Abschnitt 5.

coriacea. In addition, 25 *L. olivacea* and three *D. coriacea* were recorded on the beaches while laying eggs. Therefore, the overall number of oviposition events recorded during the present study was 78, out of which 71 were produced by *L. olivacea* and seven by *D. coriacea*. No cases of nesting *C. mydas* were recorded. The majority of clutches were located in sites II and III ($\chi^2 = 12.8$, $df = 4$, $P < 0.011$; Fig. 5). Newborn turtles came from 38 nests (48.7 % of all oviposition events registered), out of which 35 were *L. olivacea* and three *D. coriacea* (Table 1).

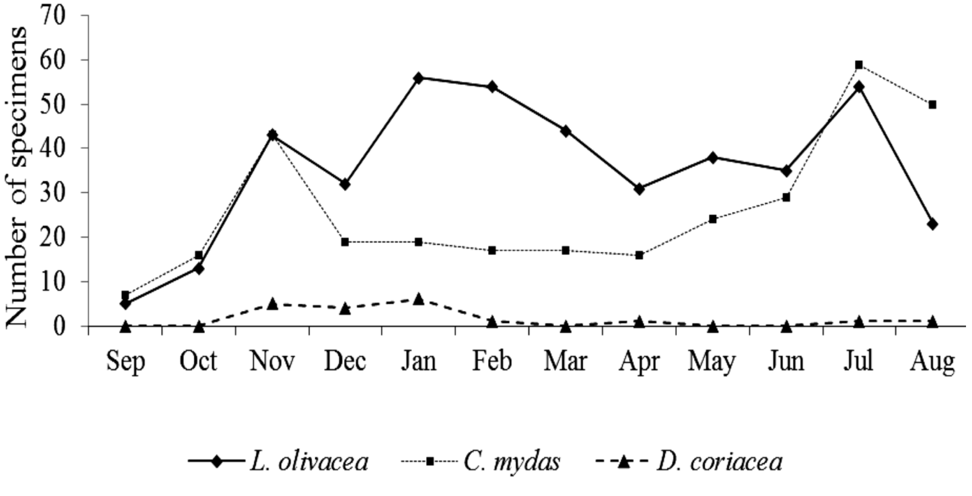

Fig. 4: Frequency of three observed marine turtle species by month in Togo.
Abb. 4: Monatliche Anzahl der drei in Togo beobachteten Meereschildkrötenarten.

Interactions between marine turtles and human activities along the Togolese coast.- The numerical distribution by species and site of (i) individuals captured in the sea (Fig. 6A) and (ii) of corpses ashore (Fig. 6B) revealed contrasting patterns. Indeed, whereas the numbers of specimens observed in the sea were homogeneously distributed across sites in *L. olivacea* and *D. coriacea* ($P > 0.05$, Kruskal-Wallis test), there was a significant excess of *C. mydas* at site IV ($P < 0.001$, Kruskal-Wallis test) (Fig. 6A). Conversely, the number of corpses was homogeneously distributed across terrestrial sites in *C. mydas,* but peaked at site II for *L. olivacea* ($P < 0.001$, Kruskal-Wallis test) (Fig. 6A). The sample size for *D. coriacea* was too small to perform statistical analyses. Over 58 % of individuals ($N = 743$) were incidentally captured in nets placed inshore by fishermen.

Table 1: Synopsis of the data obtained on the occurrence of sea turtle nesting and hatching events along the studied sections of the Togolese coast.

Tab. 1: Die gewonnenen Daten zum Vorkommen von Eiablagen und Schlüpflingen bei den Meeresschildkröten an den untersuchten Strandabschnitten in Togo.

Hatchling - Schlüpfling, Nesting individual - nistende Schildkröte, Plundered nest - geplündertes Nest, alive - lebend, dead - tot, number unknown - Anzahl unbekannt.

Date Datum	Site Ort	Section Abschnitt	Species Art	Notes Anmerkungen
06/11/2012	Hôtel de la Paix	II	*L. olivacea*	4 Hatchlings (alive)
07/11/2012	Hollando	II	*L. olivacea*	6 Hatchlings (5 alive, 1 dead)
25/11/2012	Hôtel de la Paix	II	*L. olivacea*	3 Hatchlings (alive)
29/11/2012	Hôtel de la Paix	II	*L. olivacea*	3 Hatchlings (alive)
26/11/2012	Kotokoukondji	II	*L. olivacea*	13 Hatchlings (7 alive, 6 dead)
13/11/2012	Avépozo	III	*L. olivacea*	2 Hatchlings (dead)
24/11/2012	Avépozo	III	*L. olivacea*	8 Hatchlings (5 alive, 3 dead)
30/11/2012	Gbétsogbé	III	*L. olivacea*	3 Hatchlings (alive)
07/11/2012	Agbavi	IV	*L. olivacea*	4 Hatchlings (alive)
04/12/2012	Hôtel Mercure	II	*L. olivacea*	Nesting individual
22/12/2012	Hôtel Mercure	II	*L. olivacea*	2 Hatchlings (alive)
28/12/2012	Kotokoukondji	II	*L. olivacea*	Nesting individual
03/12/2012	Avépozo	III	*L. olivacea*	Nesting individual
11/12/2012	Avépozo	III	*L. olivacea*	Nesting individual
16/12/2012	Avépozo	III	*L. olivacea*	Nesting individual
14/01/2013	Kotokoukondji	II	*L. olivacea*	Hatchlings (alive, number unknown)
20/01/2013	Kotokoukondji	II	*L. olivacea*	7 Hatchlings (alive)
21/01/2013	Jetée principale	II	*D. coriacea*	25 Hatchlings (alive)
11/01/2013	Avépozo	III	*L. olivacea*	3 Hatchlings (alive)
12/01/2013	Baguida	III	*L. olivacea*	6 Hatchlings (alive)
19/01/2013	Avépozo	III	*D. coriacea*	7 Hatchlings (5 alive, 2 dead)
31/01/2013	Avépozo	III	*D. coriacea*	4 Hatchlings (alive)
25/01/2013	Agodeka	IV	*L. olivacea*	Hatchlings (alive, number unknown)
27/01/2013	Agbavi	IV	*L. olivacea*	Nesting individual
27/01/2013	Adissen	V	*L. olivacea*	Nest with 3 hatchlings (alive)
27/01/2013	Agbodan	V	*L. olivacea*	Plundered nest
22/02/2013	Hôtel Mercure	II	*L. olivacea*	Hatchlings (alive, number unknown)
25/02/2013	Kotokoukondji	II	*L. olivacea*	6 Hatchlings (alive)
18/02/2013	Gbodjome	IV	*L. olivacea*	Nesting individual
21/02/2013	Kpogan	IV	*L. olivacea*	Nesting individual
27/02/2013	Gbodjome	IV	*L. olivacea*	Nesting individual
06/03/2013	Coconut Beach	III	*L. olivacea*	Nesting individual
16/03/2013	Katanga	III	*L. olivacea*	6 Hatchlings (alive)
25/03/2013	Gbétsogbé	III	*L. olivacea*	Nesting individual
27/03/2013	Baguida	III	*L. olivacea*	Nesting individual
06/04/2013	Gbétsogbé	III	*L. olivacea*	Nesting individual
06/04/2013	Coconut Beach	III	*L. olivacea*	Nesting individual
23/05/2013	Gbétsogbé	III	*L. olivacea*	7 Hatchlings (alive)

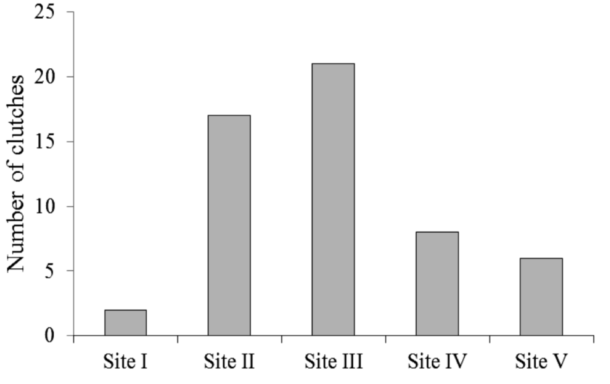

Fig. 5: Cumulative frequency of observed oviposition events by site of three marine turtle species in Togo.
Abb. 5: Anzahl der bei drei Meeresschildkrötenarten insgesamt beobachteten Eiablagen an den in Togo untersuchten Strandabschnitten I bis V.

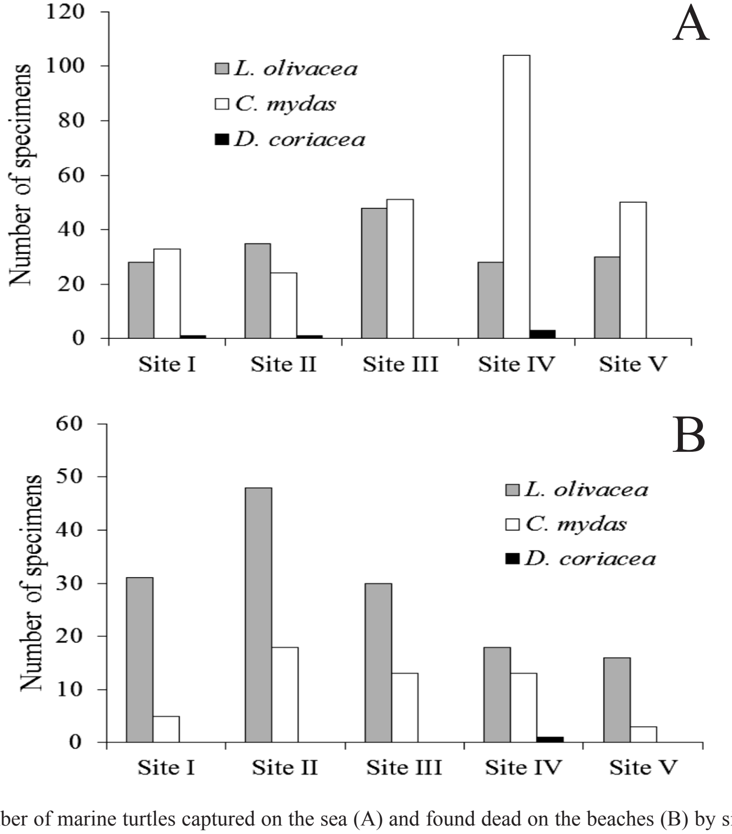

Fig. 6: Number of marine turtles captured on the sea (A) and found dead on the beaches (B) by site in Togo.
Abb. 6: Anzahl im Meer gefangener (A) und tot an Land gefundener (B) Meeresschildkröten an den in Togo untersuchten Transekten.

DISCUSSION

In summary, this study revealed that:

- two species (*L. olivacea* and *C. mydas*) dominated;

- adult sex ratio was skewed towards females in all species, with only females found in *D. coriacea*;

- *Chelonia mydas* exhibited a considerable amount of juveniles and subadults;

- species used the various available Togolese study sections (beaches and adjacent sea tracts) randomly, with a preference for sites II and III as egg-laying areas and other routine activities such as foraging or dispersal, the latter applying to *L. olivacea* only.

- monthly patterns of sightings were similar in *L. olivacea* and *C. mydas* (bimodal, November and July), but with *D. coriacea* occurring in the study area almost only between November and February, with single records in April, July and August.

- the frequency of specimens captured in the sea was homogeneous across sites in *L. olivacea* and *C. mydas*, peaking at site IV for *C. mydas*. Conversely, the frequency of stranded corpses was homogeneous across sites for these two species, but peaked at site II for *L. olivacea*.

- the data on the relative frequency of occurrence of the various species confirmed earlier accounts (SEGNIAGBETO et al. 2013, 2014). However, the Hawksbill Turtle, *Eretmochelys imbricata* (LINNAEUS, 1766), which was reported by SEGNIAGBETO et al. (2013, 2014), was never observed during the present study. *Lepidochelys olivacea* and *C. mydas* are reportedly the most abundant sea turtle species along the West African coast (e.g., CARR & CAMPBELL 1995, FRETEY 2001, AMITEYE 2002), whereas *D. coriacea* is generally less represented (FRETEY 1991, 2001).

- the general dominance of females is most likely indicative of their using of Togolese beaches as egg-laying areas. Preponderance of females over males (adult sex-ratio- 4.8:1) was also found in *L. olivacea* from Oaxaca, Mexico (MONTENEGRO SILVA et al. 1986). The presence of males in the *L. olivacea* sample probably suggests that the Togolese coast is a mating area for this species. West African waters are indeed known to be used for mating activities by *L. olivacea* (e.g., CARR & CAMPBELL 1995; FRETEY 2001; FRETEY et al. 2001).

- the relative abundance of non-adult *L. olivacea* may be interpreted that the Togolose offshore waters constitute a resource-abundant feeding ground for these juveniles (FRETEY 2001; BOWESSIDJAOU et al. 2006; SEGNIAGBETO et al. 2013).

- the fact that clutches were deposited mainly on sites II and III is somewhat surprising. Sites I and II offer sandy substratum on the beach and site II, in addition, moderate light disturbance at night. Site III is instead characterized by a bank of beach rock which constitutes an impediment to the landing of gravid females. The authors suggest that turtles ready for nesting avoided site I despite its suitable substratum because of the intense lighting disturbance at night. The obvious preference for sites II and III is explained by the low light disturbance, which seems important enough to compensate for the nesting inconvenience by beach rocks at site III. Literature is consistent with these findings. For instance, there is evidence that artificial lighting on beaches deters marine turtles from nesting (WITHERINGTON 1992), especially during the new moon phase (SALMON & WITHERINGTON 1995). Previous studies concluded that any artificial light source visible from the nesting beach may disorient sea turtles (e.g., BALAZS 1980; WITHERINGTON & BJORNDAL 1991; GILMAN et al. 2007; SOUTHWOOD et al. 2008).

- the November peaks of activity for *L. olivacea* and *C. mydas* coincide with the nesting season (September to February) of the species in Togo and the whole region of the Gulf of Guinea (FRETEY 2001; SEGNIAGBETO et al. 2013). The July peaks coincide with the mating period (June to October) (FRETEY 2001), but the regular occurrence of turtles over the year shows that even outside the breeding season the Togolese coast represents a feeding ground for these marine reptiles.

- the study area is of primary importance for sea turtle reproduction. SEGNIAGBETO et al. (2013) estimated, for *L. olivacea* and *D. coriacea* collectively, approximately 4,500 to 5,000 offsprings

Fig. 7: Adult female *Dermochelys coriacea* (VANDELLI, 1761) recorded at the coast of Togo.
Abb. 7: Erwachsenes Weibchen von *Dermochelys coriacea* (VANDELLI, 1761) an der Küste von Togo.

Fig. 8: Hatchlings of *Dermochelys coriacea* (VANDELLI, 1761) recorded at the coast of Togo.
Abb. 8: Schlüpflinge von *Dermochelys coriacea* (VANDELLI, 1761) an der Küste von Togo.

between Togo and Benin, given the mean size of the nests of these two species, their mean hatching success and survival rates.

- the records of *D. coriacea* clustered between October and February (breeding season, Figs. 7-8), with sporadic cases occurring during the rest of the year. The observed numbers were too small for any sound conclusions on annual activity rhythms.

- the observed patterns at sites I and II are explained by the high frequency of human activities, thus causing the high number of turtle casualties in these sites (especially *L. olivacea*) compared to their abundance in the sea. The vicinity of site II to the fisheries port, obviously added to increase the probability for a turtle to be killed. Indeed, fishermen's activities are well known to be among the principal causes of marine turtle mortality (e.g., the review by EPPERLY 2003).

Conservation implications.- The study showed clearly that the interactions between marine turtles and human activities along the Togolese coast represents a conservation concern. For instance, at sites I and II, more than half of the recorded individuals were killed by humans, and the corpses stranded on beaches represented 26 % of the total. Further investigations are required to better understand the causes that are responsible for the high proportion of dead marine turtles along the coast of Togo.

Concerning the causes of death, apart from drowning in fishing nets, it is likely that the majority of individuals died due to accidents by propeller induced lesions, given the type of injuries that were recorded in post-mortem visual inspections. The species numerically most affected by this phenomenon was *L. olivacea*, and mainly the female individuals that were arriving to the beaches to lay their eggs. In addition, the largest number of recorded bodies were identified at sites I, II and III, that housed the main port facilities and where there is currently the highest concentration of ships and vessels demonstrating that the port activities can harm marine species on the Togolese coast. Intentional killing of turtles by fishermen is also a regular reason of death for these animals (OKANGNY 2012). This author found that 58 % of coastal fishing gear are concentrated at the fishing port, including a large number of purse seine and gill nets in which the turtles are often caught. The growing number of coastal fishermen (OKANGNY 2012) increases the probability of interactions between sea turtles and humans, which is certainly a conservation concern. In addition, local subsistence consumption of turtles should be monitored. Indeed, female turtles killed on the beaches and individuals caught at the sea and killed for home consumption accounted for 13.2 % of all recorded individuals. A careful program of conservation of marine turtles on the Togolese coast must be defined to ensure future coexistence of coastal human population and marine turtles.

The study indicates that eco-guards are useful to promote active preservation for marine turtles at the local level. In the present case, out of 743 surveyed turtles, approximately 60 % were saved by eco-guards (by releasing into the sea those individuals that were captured by fishermen and still alive at the time of examination), whereas, of the remaining 40 % which could not be saved, over 67 % were corpses discovered on beaches. The present field work, based mainly on eco-guards monitoring, is the first of such type done in Togo, and shows that, with appropriate funding, it is a working strategy of conservation in the West African coasts. Interestingly, it was noticed that eco-guards are highly motivated and wanted to actually participate in all phases of the monitoring program, thus confirming that this conservation strategy is promising for the future.

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AUTHORS: Gabriel Hoinsoude SEGNIAGBETO [1, 2], Dede OKANGNY [2], Komlan AFIADEMAGNO [2], Komlan KPOTOR [2], Daniele DENDI [3], Jacques FRETEY [4] & Luca LUISELLI (Corresponding author < lucalui@iol.it >) [3, 5, 6]

[1] Département de Zoologie et Biologie animale, Faculté des Sciences, Université de Lomé, BP 1515, Lomé, Togo.

[2] AGBO-ZEGUE NGO (Togolese Society for the Conservation of Nature), BP-6057, Lomé, Togo.

[3] IDECC (Institute for Development, Ecology, Conservation and Cooperation), via Giuseppe Tomasi di Lampedusa 33, I-00144 Rome, Italy.

[4] Reptiles & Amphibiens, UMR 7205 OSEB, Département de Systématique & Evolution, Muséum national d'Histoire naturelle, 25 rue Cuvier, 75005 Paris, France.

[5] Centre of Environmental Studies Demetra, Via Olona 7, I-00198 Rome, Italy.

[6] Niger Delta Ecology and Biodiversity Conservation Unit, Department of Applied & Environmental Biology, Rivers State University of Science & Technology, P.M.B 5080, Port Harcourt, Rivers State, Nigeria.