Caretta caretta hatchlings in Yanıklar 2013

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KURZFASSUNG

Das Meeresschildkrötenprojekt zum Schutz der Unechten Karettschildkröte (*Caretta caretta*) feierte dieses Jahr zwanzigjähriges Jubiläum an der Mittelmeerküste in Fethiye, Türkei. Zwei Strände, Yanıklar und Çaliş, gehören zu der dortigen Special Protected Area und werden daher von einer türkischen Universität (2013: Pamukkale Üniversitesi) in Kooperation mit österreichischen Studenten der Universität Wien betreut. Auch dieses Jahr waren die Teilnehmer des Projektes zu einem großen Teil der Nistzeit der Schildkröten vor Ort um Daten bezüglich der adulten Tiere, ihrer Nester als auch der schlüpfenden Jungtiere zu sammeln. Neben den täglich ausgeführten Aufgaben zu diesem Zweck wurden auch Veränderungen der Strände beobachtet und dokumentiert. Die Arbeiten zielten auf einen Informationsgewinn hinsichtlich Nester, Bruterfolg, Prädation, Evertebraten- und Pilzbefall, Inkubationszeit und Mortalitätsrate ab, um dieses Jahr mit vorhergegangenen Jahren vergleichen zu können. Heuer wurden 5430 Eier in 69 Nestern an den Stränden in Yanıklar (Akgöl und Yanıklar Beach inklusive Karataş Beach) gelegt, wobei eine Abnahme gegenüber dem letzten Jahr zu verzeichnen ist. Die Anzahl an Eiern in einem Nest variierte von 31 bis 119, wobei durchschnittlich 78,8 Eier in einem Nest gefunden wurden. Die mittlere Inkubationszeit betrug 49,5 Tage (Variation: 43 – 60 Tage). Die durchschnittliche Schlüpfrate, berechnet anhand der toten Jungtiere und denen, die das Meer erreichten, ergab 76,6 %. Die Sterblichkeitsrate dagegen machte 28,1 % aus. Insgesamt hat die Anzahl der Nester im Vergleich zum Jahr 2012 (79 Nester) abgenommen, verglichen mit 2011 (44 Nester) allerdings gewonnen.

ABSTRACT

The sea turtle field course devoted to the loggerhead turtle (*Caretta caretta*) has been taking place at the Mediterranean coast in Fethiye, Turkey, for the last 20 years. Two beaches, Yanıklar and Çaliş, are part of the Special Protected Area and are therefore managed by a Turkish University (2013: Pamukkale University) in cooperation with students from the University of Vienna, Austria. During a major part of the nesting season of *Caretta caretta*, project participants were present, gathering data on adults, nests and hatchlings. Beyond these duties – performed on a daily basis – changes on the beaches were observed and documented. The data collection was designed to gain of information on nests, hatching success, predation, invertebrate and fungal infestation, incubation time and mortality rate. This year's results are

compared with previous years. This season 5430 eggs were laid in 69 nests on the beaches in Yanıklar (Akgöl and Yanıklar Beach incl. Karataş Beach), which is a decrease compared to last year. Egg numbers in a nest ranged from 31 to 119, averaging 78.7 eggs per nest. This year the mean incubation time was 49.5 days (range: 43 – 60 days). The average hatching rate, including hatchlings reaching the sea and dead hatchlings, was 76.6 %, while the mortality rate amounted to 28.1 %. The number of nests decreased compared to 2012 (79 nests) but considerably increased compared to 2011 (44 nests).

INTRODUCTION

The *Caretta caretta* (Linnaeus, 1758) is one of the still living sea turtle species that breed in the Mediterranean Sea. All together we can only find 6 (7) species of marine sea turtles all over the world. All of them are declared to be endangered or critically endangered by the World Conservation Union (IUCN). This is the major purpose why the sea turtle project in Fethiye (Turkey) takes place. To protect and conserve the Loggerhead sea turtle (*Caretta caretta*). Since 1993 the University of Vienna works in cooperation with several universities in Turkey to fulfil these tasks and preserve the natural habitat of the Loggerhead sea turtle. This year, the University of Vienna concurred with the Pamukkale University.

Along the Turkish coast, there are 21 major nesting sites of *Caretta caretta*, where three of them are designated to be Special Protected Areas (SPAs) (Ilgaz et al, 2012). Near Fethiye there are three nesting beaches, at which the Austrian students worked; Çaliş, Yanıklar and Akgöl. Partly they are very popular to the Turkish people, what makes it difficult for the sea turtles to come to the beach and lay their nests. But this is not only a problem for the adults. Disturbance on the nesting ground, compressing the sand, altering the temperature and unnatural light sources are only some of the factors that can cause hatching failure.

When females reach mating age, which is between 15-25 years, they come closer to the beaches to breed with adult males. This can be dangerous for them, as they have to come to the surface to breathe. It is not uncommon, that they then hit motorboats and get severely injured. They come to their beach of birth then every 2 to 4 years to lay about 80-100 eggs. Every female can lay nests about 2-5 times in one nesting season. A typical egg chamber is about 0.5 m deep and 0.25 m in diameter (Ernst et al, 1994; Spotila, 2004). It takes about 50 - 70 days until the hatchlings are finally developed and dig to the surface to make their way to the sea. Usually they hatch during the night and in batches, which means that the hatchlings emerge in groups of about 10-30 hatchlings. Though there are some that come out later during the day, but these are more vulnerable to predation and heat stress. The temperature is not

only an important factor on their way to the sea but also in the nest during development of the embryo. At a temperature of exact 30°C both females and males develop. Does the temperature in the nest rest above 30°C, the embryos are more likely to become females – beneath 30°C they are more likely to become males (Hays et al., 1992).

MATERIAL AND METHODS

On June 30, participants of the sea turtle project from the University of Vienna arrived in Yanıklar and stayed until September 14. Over this period of time morning shifts were walked on a daily basis starting at 05:30 a.m. as well as night shifts starting at 10 p.m. When the hatching period began on the two beaches Akgöl and Yanıklar (inclusively Karataş beach), night shifts were terminated.

During the morning shifts, groups of 2 to 3 students walked along the beach in a parallel line – at regular intervals – close to the vegetation zone, the middle of the beach and close to the waterline. Duties of the morning shifts included counting and following hatchling tracks, checking if the hatchlings reached the sea, were predated, lost, or caught in debris or stones. Further tasks were recording nesting and hatching data, clearing the way to the sea, and documenting uncommon incidents like vehicle tracks, as well as finding and marking unknown nests.

In case of tracks indicating a formerly unknown, so-called secret nest, data regarding the position of the nest was collected. To prevent the nest from being lost stones were laid in a semicircular shape around it, the opening facing the water. In order to find the egg chamber, two small twigs were connected by a string, placing one of them above the nest opening. Additionally, nests were triangulated (Fig. 1). On that account, three different arbitrary landmarks were chosen to quantify the distances to the nest position. Also, the distance to the sea was measured. The exact position of the nests was marked on the data sheets.

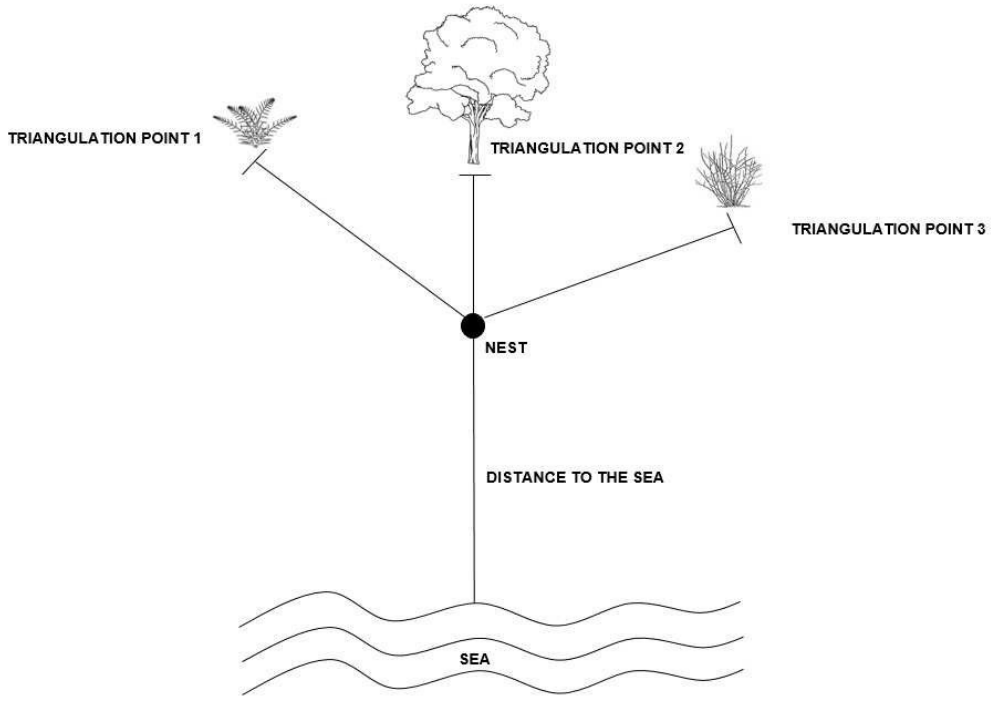

Figure 1: Determination of the nest position based on triangulation
Abbildung 1: Bestimmung der Nestposition durch Triangulationsvermessung

Nests were examined every morning with particular interest in hatching nests. In order to monitor living hatchlings with problems during the emerging process due to stones, roots, litter or dead hatchlings, controls were performed by digging a few centimetres into the nest by hand. In the case of obstacles blocking the way, these were removed. Dead hatchlings found in or on the nests were buried away from the nests to prevent attraction of predators. Depending on the condition of living hatchlings as well as the time and position of the sun, those were released into the sea or taken to the camp. If hatchlings were too weak to be released immediately or it was to late during the day they were taken to the camp to be released at night. In this instance hatchlings were kept in a covered bucket with moist sand covering the bottom. They then were released to the sea during the night, a couple of metres from the waterline, at a dark beach section in order to avoid disorientation caused by artificial light. The hatchlings were counted to those reaching the sea.

Excavations were performed after a period of four days following a nests last hatching event. Therefore the nest was carefully dug up and the complete content removed. This was sorted into empty shells, unimpaired eggs and dead hatchlings. Furthermore the development of the unimpaired eggs was determined and categorized by opening and grouping into unfertilized and fertilized eggs. The fertilized eggs were differentiated into early (< 10 mm, white, unpigmented carapace, blood formation on extra embryonal membranes; Fig. 9), mid (10-30 mm, scaled but unpigmented carapace; Fig. 10) or late embryonic stage (> 30 mm, scaled and pig-

mented carapace; Fig. 11). Living hatchlings found during an excavation were released into the sea. Infestation of invertebrates was recorded on the data sheets and by use of photographs. Supplementary measurements involved the depth to the top of eggs, to the bottom of eggs, the diameter of the egg chamber and the distance to the sea.

RESULTS

In total 69 nests were found this year: 49 in Yanıklar and 20 in Akgöl. One more nest was expected to be located in Akgöl but could not be found for excavation and therefore is assumed to be mistaken as nest as a result of flying predators deporting hatchlings. Six nests (Y10, Y12, Y13, Y15, YS28 and A5) hatched after the Austrian students had left, hence were excavated by Turkish colleagues. In sum, there were 34 secret nests in Yanıklar and 15 in Akgöl, which makes a total of 71% of nests that had most likely been laid before the arrival of the Austrian participants on June 30. Generally 29 % of all nests were found within the Austrians observation period.

This year, no hatcheries were necessary. Due to the sufficient distances to the sea, no nest was at risk of being flooded.

In total 5430 eggs were laid over the whole breeding season, whereof 3894 were found in Yanıklar and 1536 in Akgöl. The lowest number of eggs encountered in a nest was 31 (Y10) while the highest was 119 (AS10). In average, this reveals 78.7 (SD ± 17.3) eggs per nest. Of all eggs 9 % (490) were unfertilized and 91% (5430) fertilized. Within the fertilized eggs 3785 empty shells and 1074 dead embryos were counted, including 655 early stage, 37 mid stage and 382 late stage embryos (Fig. 2)

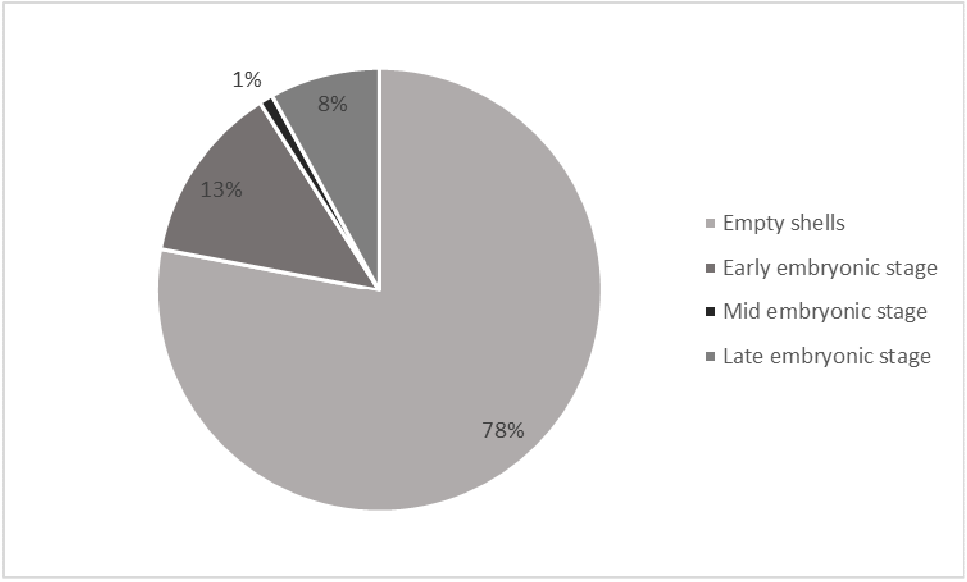

Figure 2: Categories of the total number of fertilized eggs in percentage.
Abbildung 2: Kategorien der Gesamtanzahl der befruchteten Eier in Prozent.

Eggs with an uncommon diameter of about 1-2 cm (Fig. 12) were detected in three nests (Y7 – 1, YS4 – 1, YS32 - 3). Furthermore two normal sized eggs connected to each other were found in one nest (YS25, Fig. 14).

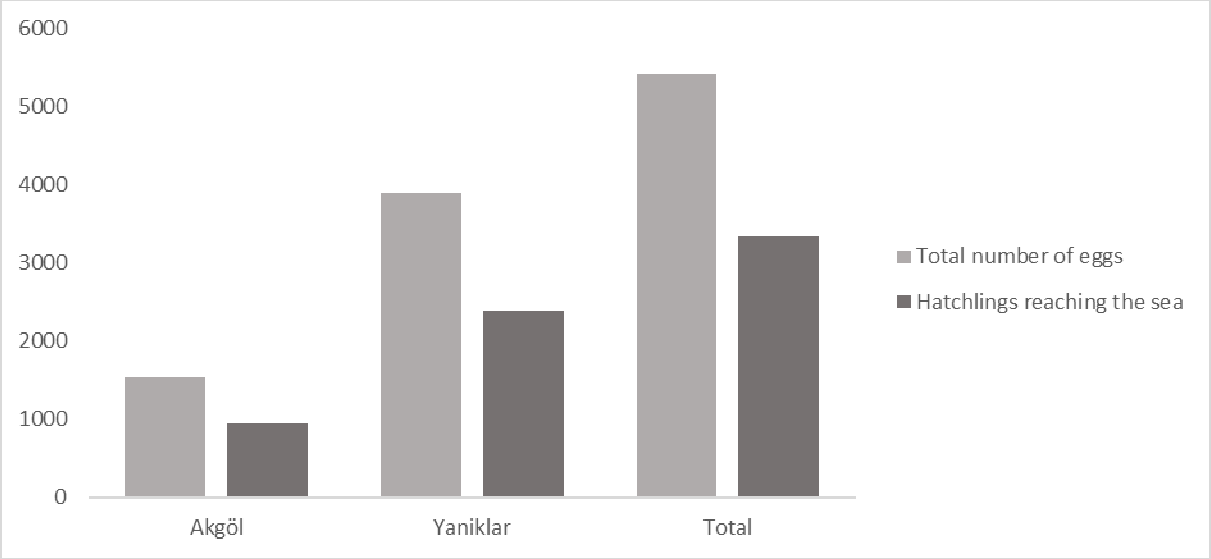

Figure 3: Relation of the number of eggs and the hatchling reaching the sea.
Abbildung 3: Gesamtanzahl der gefundenen Eier und der Hatchlinge die das Meer erreichten.

Altogether 3785 of 4940 fertilized eggs hatched (Akgöl: 1182, Yanıklar: 2603) yielding an average of 54.9 (SD ± 24.1) eggs hatching per nest. The maximum number of hatchlings reaching the sea (3332) is identified by the number of empty shells minus dead hatchlings. This method was chosen due to the high inaccuracy of counting hatchling tracks. The maximum number of hatchlings reaching the sea was compared to the total of eggs found (Fig. 3). The total hatching rate was 76.6% (dead hatchlings and hatchlings reaching the sea are included) whereby the rate was 83.0% in Akgöl and 74.0% in Yanıklar. The highest number of hatching eggs in a nest was 91 (YS24).

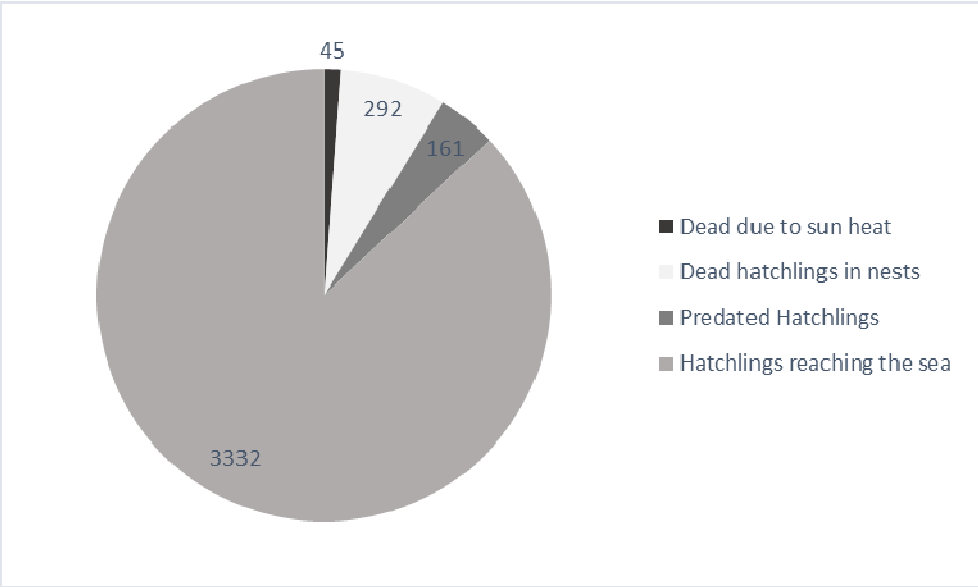

Figure 4: Number of dead hatchlings due to predation and sun heat, dead hatchlings in nest and maximum number of hatchlings reaching the sea.
Abbildung 4: Anzahl der toten Hatchlinge aufgrund von Prädation und Austrocknung durch die Sonne, tote Hatchlinge im Nest und maximale Anzahl der Hatchlinge die das Meer erreichten.

In total 498 hatchlings where found dead: 58.6% (292) were discovered dead in the nest, 32.3% (161) were predated and 9.0% (45) died due to sun heat (Fig. 4).

Major predators were birds, dogs and crustaceans (Ghost crabs). Five nests (Y2, Y11, YS8, YS13, YS27) were dug up by unspecified predators, whereby 32 eggs were predated in one nest (Y11) and 3 eggs in another (YS27). Furthermore egg predation by invertebrates was reported in 13 nests (A1, AS6, Y3, Y4, Y9, YS6, YS7, YS8, YS18, YS21, YS24, YS32, YS33), however was not reported in detail (predators and number of infested eggs unspecified). Moreover discoloured eggs were found in various nests of both beaches (e.g.: AS16). These were assumed to be affected by fungal infestation.

The mean distance to the sea was 20.6 m (SD ± 7.4). Averaged the nests were closer to the sea in Yanıklar (16.8 m.; SD ± 7.5) than in Akgöl (26.1 m; SD ± 8.0). Although it has to be mentioned that in Akgöl were only a few nests very far from the shore, while nests were generally closer to the vegetation in Yanıklar. During excavation, the egg chamber was measured yielding averages in diameter of egg chamber (0.24 m; SD ± 0.07), depth to top of eggs (0.31 m; SD ± 0.07) and depth to bottom of eggs (0.45 m; SD ± 0.06).

Twenty of 69 nests were laid during our observation time and therefore the incubation time could be evaluated. Since all other nests were laid before Austrian participants arrived, no incubation time could be calculated for those nests. The average incubation time was 49.5 days (SD ± 4.5). The minimum time was 43 days (Y2) while the maximum was 60 days (Y4). A difference in the average incubation time could be observed among the beaches: In Akgöl it was 47.0 days (SD ± 3), in Yanıklar 50.5 days (SD ± 4.6).

DISCUSSION

In Yanıklar more than twice as many nests were found compared to Akgöl. This is of course due to the totally difference in the geomorphology of the two beaches. The nesting beach in Yanıklar is about 3.8 km long while the beach in Akgöl has a total length of about 1.5 km. The beach in Akgöl starts with a huge hotel complex, where during the night, many lights are turned on and music is playing very loud. Therefore this is not the favoured place for turtles to lay their eggs, even though the beach is sandy. Then it continues with rather inhospitable gravel and only a small part of the beach, the last 100 m is sandy again. Unfortunately this is a very popular place and the anthropogenic influence is very high here. Yanıklar beach also starts with a big hotel complex but then there is a very long part where the conditions for the female to lay nests during the night are very good. It is a mix of sand, gravel, litter and wood. Near the end of the beach there again is a bar with many sunshades and sun beds which disturb the turtles. In Yanıklar beach the hatchlings have to overcome many more obstacles such as debris or big stones where they might get stuck. This increases of course the predatory and dehydration risk. This is also reflected in the average distance to the sea. In Akgöl the adult female laid the nest in about 26.1 m (SD ± 8.0) distance to the sea, while in Yanıklar the mean distance to the sea amounted to be only 16.8 m (SD ± 7.5). For the turtle it is also very important that the nest is not to close to the shore, as it can be flooded easily. This year we had three nests that were placed closer than 10 m to the shore. This might cause problems as they get flooded very easily and therefore are also most probably influenced by temperature gradients and gas exchanges. They all come to totally different hatching success. Starting at 13.8% in Y6 it goes on to 39.3% in Y14 and finally even 98.8% in Y8. Compared to last year, where there was one nest very close to the shore with 100% hatching success, and compared to 2009 where there were three nests close to the shore with very low hatching success, we cannot really predict whether a hatchery would have been more successful. Interesting is, that the nests close to the shore in 2009 and 2012 were placed in Akgöl and not in Yanıklar which probably can be explained as these nests were on the very end of the beach in Akgöl which is only about 25 m broad.

Compared to the measurements of last year the mean nest depth came to the same results (2013: 0.45 m SD ± 0.06; 2012: 0.44 m). This is also in line with the results of a study by Kraemer and Bell (1980) where a mean nest depth of 0.43 m SD ± 0.07 was reported.

The time an embryo needs to get fully developed and finally hatch is called incubation time. In the last years this developmental period shortened with every year a few days. In 2009 it averaged out to 52.9 (SD ± 6.2) days, while in 2010 it was only 48 days. In 2011 it decreased

again by 3 days to 45.5 days on average and increased by 3 days again in 2012. This year the average incubation time was 49.5 days (SD ± 4.5). This is in the natural range of 44-64 days (Stachowitsch and Fellhofer, 2013) as there are many factors that influence the incubation time. First of course there is the temperature that can shorten the incubation period. This was investigated by Mrosovsky and Yntema (1980) who then stated that the temperature and the oxygen level both have great influence on the development. Then there is the moisture level of the sand that affects the growth of the embryo. In wet sand eggs of *Caretta caretta* have longer incubation times (McGhee, 1990), which could mean that the shorter incubation times in Yanıklar are referable to drier sand. Margaritoulis (2005) stated also, that shorter incubation times produce mainly female hatchlings which could mean that in the past years more female than male hatchlings have developed. Other factors that are not only influencing the incubation period but also the egg development itself are of course anthropogenic. As already mentioned sandy beaches are very popular to visitors who mostly come with the car and therefore compress the sand and the nests beneath. Also very common is the use of sun beds and sun shades which have a high influence on the temperature of the sand underneath. Even more problematic is the fact that the sunshades have to be placed into the sand which might damage eggs. All of these factors affect the egg chamber or its environment and therefore the development of the eggs resulting in a decrease of the hatching rate.

Further the embryo itself can also die by natural causes such as fungal infestation, invertebrate predation or the embryo fails to hatch because of failed embryonic development. The mortality rate that was calculated of predated and desiccated hatchlings, hatchlings that were found dead in the nest and embryos that did not fully develop (early, mid and late stage) amounted to 28.12%. Embryonic failure can be caused by microbial infection, developmental arrest and developmental abnormities. Additional factors can be inundation, insufficient gas exchange, insect larvae as well as objects such as stones or roots blocking the path of hatchlings (Peters et al., 1994; Margaritoulis, 2005). But also high nest temperature can evoke the death of embryos (Matsuzawa et al., 2002). During the excavations we also found abnormal coloring in some eggs (Fig. 8). In all cases the embryo did not develop. McGhee (1990) stated that moist sand is a good breeding ground for fungal growth which can be lethal to the embryos.

We also found many insect larvae in the nests and eggs (Fig. 13). These may also cause embryonic death. In this year we had 13 reported cases of invertebrates in nests. Divided into the two beaches there were 2 infested nests in Akgöl and 11 in Yanıklar. One reason for a higher

rate in Yanıklar can be the fact that the vegetational boundary is much closer to the shore than in Akgöl. This shorter distance can be the reason for invertebrates to detect the nests easier.

In 3 nests we found a total of 5 abnormal small eggs. Figure 12 shows two normal sized eggs and one smaller, yolkless egg with only a diameter of 15 mm. These were also found in *Caretta caretta* nests at Cape Romain, South Carolina, USA (Caldwell, 1959) and on 3 occasions on Sanibel-Captiva Islands, Florida, USA in the years 1969 and 1970 (Le Buff et al., 1971). The role of these egg-like forms is not finally investigated but it is proposed that they either have a place filling function or are some sort of mutation.

In total the Austrian participants counted 2120 hatchling tracks but 3785 empty shells were found. Reasons for this discrepancy are wide-ranging. Often the structure of the beach made it impossible to see all tracks as there were stones, vegetation and litter blocking the way. When there were more hatchlings hatching at the same time they often followed the first track and therefore only one track was visible.

Margaritoulis (2005) explained that it is common to have fluctuations in nesting effort every 2-3 years as a result from the specific reproductive characteristics of sea turtles, where females do not nest every year but several times in one season (Fig. 5). In total we can see a decrease in the number of nests that were found. In 1995 there was a peak with 190 nests while in 2004 only 36 nests were laid. This may be a cause of the decrease of the sea turtle population and increase of anthropological disturbance. It has also to be said, that in total there were more nests in Yanıklar than in Akgöl as this beach is much longer and has more sandy parts.

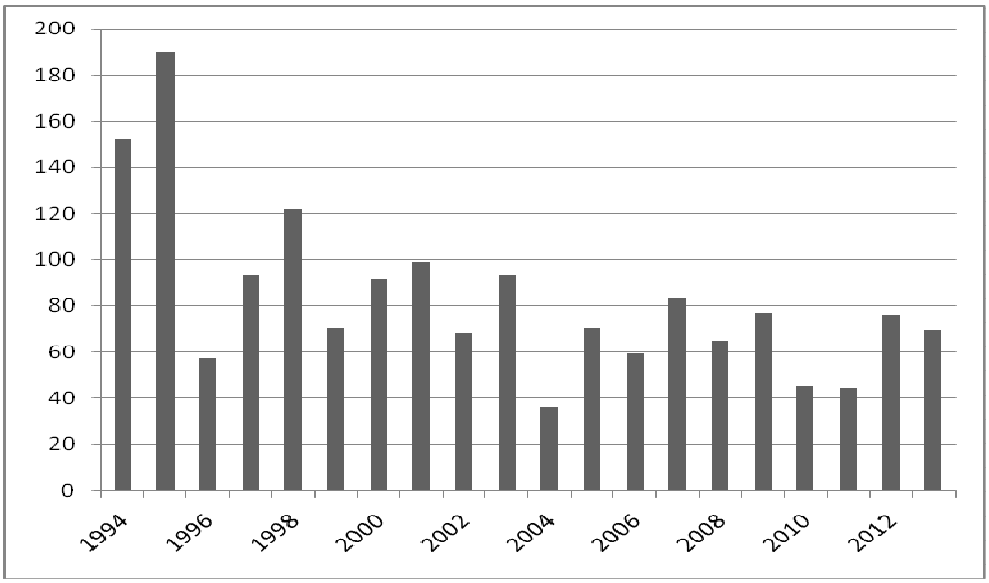

Figure 5: Total number of nests from 1994 to 2013
Abbildung 5: Gesamtzahl der Nester von 1994 bis 2013

On average there were 3654.6 (SD ± 1412) hatchlings reaching the sea over the last 20 years. In 1998 there was an absolute peak of 7800 hatchlings reaching the sea (Fig. 6). If this is compared to the total number of nests, we can see that 1998 was the third strongest year with 122 nests. Since 2001 the number of hatchlings reaching the sea is fluctuating around 4000 but not getting any higher any more. 2004 and 2011 were very weak years where the number of hatchlings reaching the sea dropped down to < 2000. These were, compared to the total number of nests, also very weak years with less than 60 nests.

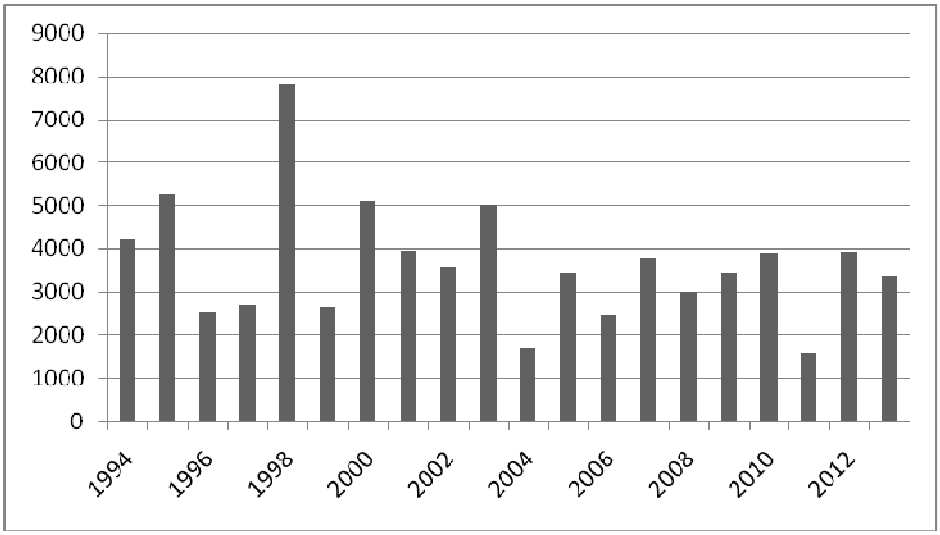

Figure 6: Maximum hatchlings reaching the sea
Abbildung 6: Maximale Anzahl der Hatchlinge die das Meer erreicht haben

Comparing Figure 6 and 7 show a resemblance in the total number of eggs being laid and the hatchlings reaching the sea. Again 2004 and 2011 show the lowest values. This fits with the Figures 5 and 6. Margaritoulis (2005) stated that variations in the number of laid eggs do not necessarily coincide with the number of emerged hatchlings.

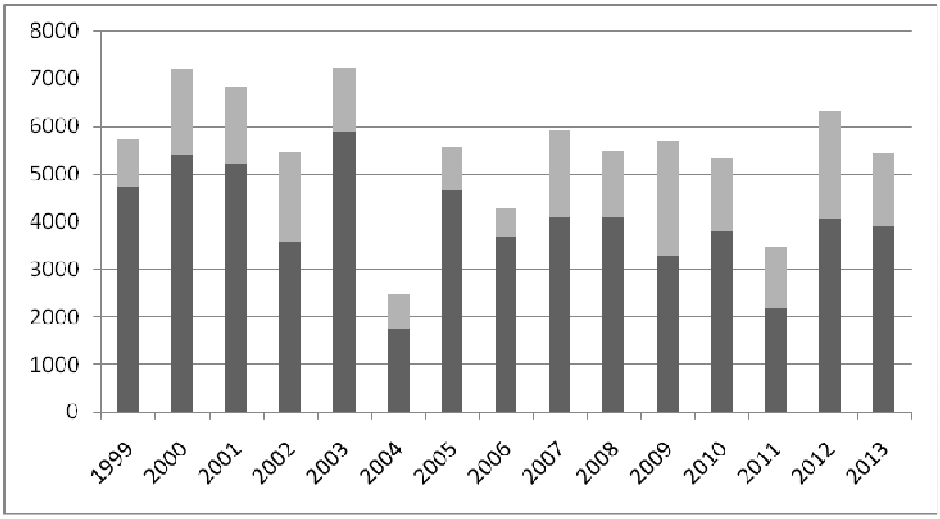

Figure 7: Comparison of maximum number of eggs in Yanıklar (darkgrey) and Akgöl (lightgrey)
Abbildung 7: Vergleich der Maximalanzahl der Eier in Yanıklar (dunkelgrau) und Akgöl (hellgrau)

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APPENDIX

Figure 8: Discolored egg by potential fungal infestation (Photo: O. Macek)
Abbildung 8: Verfärbtes Ei durch möglichen Pilzbefall

Figure 9: Early stage embryo (Photo: T.Schaer)
Abbildung 9: Embryo in frühem Stadium

Figure 10: Mid stage embryo (Photo: C. Schragl)
Abbildung 10: Embryo im mittleren Stadium

Figure 11: Late stage embryo (Photo: C. Bauer)
Abbildung 11: Embryo im späten Stadium

Figure 12: Place-filler egg (Photo: C. Bauer)
Abbildung 12: Platzhalterei


Figure 13: Coleoptera Larvae (Photo: C. Bauer)
Abbildung 13: Käferlarve


Figure 14: Two eggs that were grown together (Photo: C. Bauer)
Abbildung 14: Zwei zusammengewachsene Eier

Changes on ÇalışBeach 2013

Bettina Kliesspiess & Laura Wemer

KURZFASSUNG

Dieses Jahr (2013) ist das 20-jährige Jubiläum des Meereschildkröten-Projektes, welches im Jahr 1993 von der Universität Wien gemeinsam mit einigen türkischen Partneruniversitäten zum Schutz der *Caretta caretta* (Unechten Karettschildkröte) gegründet wurde. In diesem Sommer (28. Juni bis 14. September 2013) reisten wieder Studenten der beiden Universitäten nach Fethiye, an die zwei, als Naturschutzgebiete deklarierten, Strände Çalış und Yanıklar.

Neben den natürlichen Faktoren, die zur Regulierung der Population der Unechten Karettschildkröte beitragen (z.B. Prädation), stellt der wachsende Tourismus in Çalış eine immer größer werdende Bedrohung für die Meeresschildkröte dar. Um das Ausmaß des Tourismus und seinen Einfluss auf *Caretta caretta* zu dokumentieren, wurde am Strand von Çalış im Bereich Çiftlik eine Erhebung der Anzahl der Sonnenschirme, Strandliegen und vom Inventar der Bars (z. B. Tische, Sitzsäcke, etc.) durchgeführt. Diese Daten wurden mit den Zahlen aus den Arbeiten der vorhergehenden Jahre verglichen, um etwaige Änderungen festzustellen.

Im Vergleich zu 2012 verringerte sich die Zahl der Sonnenliegen und Sonnenschirme in Çiftlik. In früheren Jahren war die Zahl jedoch geringer als 2013.

Es gab einige positive Veränderungen in Çaliş: die alten Mistkübel wurden durch neue ersetzt, die größer und stabiler sind. Außerdem platzierte die Organisation FETAB in Çalış die Liegen und Sonnenschirme wieder in zwei Reihen, wodurch dazwischen eine Nistzone entstand.

Wir konnten aber auch negative Veränderungen beobachten. Autos und Zelte wurden fast jeden Tag in der Picnic-Area gesichtet. Es gab auch eine neue Disco, Bakraç genannt, im Auftrag derer eine hölzerne Plattform, eine Bühne und eine riesige begraste Fläche am Strand entstand. Außerdem wurde an dem vorher unberührten Strandgebiet hinter dem Surf Café das neue Spor Café errichtet.

ABSTRACT

2013 marks the 20th anniversary of the sea turtle field course, designed to protect *Caretta caretta* (loggerhead turtle) in cooperation between the University of Vienna and Turkish partner universities.

Although the beaches of Fethiye (Çalış and Yanıklar) are officially declared as Special Protected Areas (SPA), tourism is increasing every year, particularly in Çaliş. Besides natural factors such as predation, tourism is a huge threat for the nesting success and for the survival of the sea turtle population. Our long-term monitoring efforts here enable us to document the changes at these beaches over the years.

To depict the influence of tourism on the nesting success of the loggerhead turtle, the numbers of sunbeds, umbrellas and other types of facilities belonging to the bars along the beach of Çalış (in the area of Çiftlik) were counted and compared with the data collected in past years.

The total number of the sunbeds and umbrellas in Çiftlik decreased somewhat compared with last year, but the value was still higher than in all the years before 2012.

There were some positive changes compared to last year, for example there were more garbage bins. The organization FETAB continued to place the parasols and sunbeds in the Çalış area in two distinct lines as they have done in the recent past, so that the nesting zone between them remained free. Negative developments were also recorded, most importantly a new bar/restaurant (Spor Café) on the last stretch of untouched beach, and a new disco (Bakiraç Beach Park) which erected a wooden platform, a stage and a large grassy area on the beach. Vehicles and tents were present nearly every day (and night) at the picnic area.

INTRODUCTION

Fethiye is a small district within the province Muğla on the south-western coast of Turkey. This area adjoins the Turkish Aegean Sea, part of the Mediterranean Sea. This area is a well-known tourist destination. ÇalışBeach and Yaniklar together belong to the 12 most important nesting beaches of *Caretta caretta* in Turkey (MEDASSET 2012). *Caretta caretta* is classified as an 'endangered species' in the red list of the IUCN (International Union for the Conservation of Nature and Natural Resources) since 1996 (IUCN Red List 2013). Fethiye is a Special Protected Area (SPA, Council of Ministers' Decisions 88/13019, 12.06.1988) and there are efforts to protect the biodiversity in these areas. Note also that Turkey is party to certain Conventions aiming at protecting biodiversity, for example the Barcelona Convention, which was founded for the protection of the Mediterranean Sea, especially to counteract pollution.

ÇalışBeach can be divided into the promenade section, where FETAB (Fethiye Turizm Altyabi Birligi) is responsible for the beach furniture, and the Çiftlik section, which includes a picnic area and also many bars and restaurants on the beach; in this section, the bar owners arrange the beach furniture due to their desire.

Unfortunately, the tourism industry puts major pressure on sea turtles, especially regarding their nesting activities on the beaches. There has been a constant decline of nest numbers over the years on the beaches in Fethiye (Ilgaz et al. 2006), with tourism no doubt playing a key role in this trend. Many hotels, restaurants and bars were constructed, and these buildings limit the natural habitat of the Loggerhead turtle on land. Large numbers of sunbeds and parasols constitute obstructions for both, the hatchlings and the adult female sea turtles. In the aquatic zone, pollution along with motor boats and jet skis are the main problem.

After attaining sexual maturity, at an age between 12 to 30 years (marinebio.org 2013) the female *Caretta caretta* returns to the beach where she was born, during the night, to dig a nest. She lays 23 - 198 eggs per clutch (Van Buskirk & Crowder 1994). The females rarely switch to another nesting beach. While on land, the female is slow-moving and vulnerable. If she perceives a threat, she will return to the sea. People on the beach during the night constitute such a threat for the sea turtles. Therefore it is forbidden to stay on Çalışbeach from 8 pm to 8 am. There was an information desk set up during the breeding season for preventing that tourists harm the reproduction cycle of the Loggerhead turtle. One of the main problems is the light pollution due to the hotels, bars and the promenade light. Therefore a new bar or restaurant constitute a really big problem for the sea turtles. At the vulnerable hatching event, the sea turtles orientate by light, the natural light source is dispersed by the moon reflections from the sea, whereby the hatchlings normally orientate. The light pollution on the promenade constitutes a brighter light source, than the sea horizon and the hatchlings run in the wrong direction. Thus many hatchlings fall prey or they desiccate during their unsuccessful search for the sea. According to those risks the nests have to be protected - with cages the hatchlings can be kept together and shelter them. Unfortunately, sometimes these cages got removed by the tourists or they threw their waste in them. The waste in the cages has bad consequences for the development of the hatchlings. By shading the nest, the temperature of the nest decrease, altering the sex ratio (Yntema C.L. & Mrosovsky N. 1980). Cooler temperatures in the nest during the night are one cue to start emerging: if the nest is artificially shaded, the hatchlings can begin to emerge due to the lower temperature even during the day. When this happens there is the risk of mortality due to the sun. During the breeding season of *Caretta caretta* the picnic area of Çiftlik is crowded – the people light bonfires and cook, roll out large carpets and even camp here. These circumstances make it difficult for the hatchlings to find their way to the sea and also for the females to find a suitable location for their nests.

In the course of patrolling every night and every morning during the nesting season 2013, we recorded potential problems and alternated circumstances compared to earlier years. Within the Çiftlik section the sunbeds and parasols were counted to compare the result with the data from the last years. Positive and negative changes were recorded.

MATERIAL AND METHODS

On the beach of Çalis, Fethiye, students from the University of Vienna and the University of Pamukkale monitored the nesting of *Caretta caretta* (Loggerhead Turtle). Every day the students patrolled the beach (length approximately 3.5 km) in three shifts, beginning on 28 June and finishing our work on 14 September 2013 (Turkish students started their work in May and stayed until September).

During the morning shift (6 am to appr. 8 am), the main task was to triangulate the protective cages, which were put on the nests, to make sure that they were not moved. On night shifts (10 pm to 2 am), the beach was scanned for tracks of adults and hatchlings.

During these shifts we documented problematic conditions and changes, e.g. waste, tents or cars on the beach, waste in the protective cages, new facilities etc. Furthermore, we counted sun beds, umbrellas and other inventory belonging to bars situated on the beach of Çalışin the area of Çiftlik and compared our results to those of the earlier years to determine potential changes.

RESULTS

Positive changes

The first positive change from the previous years was the installation of a drainpipe at the beach shower along the promenade. Now, water is disposed into the drainage system rather than directly onto the beach (Fig. 2). The tourism organization FETAB (Fethiye Union of Tourism and Infrastructure) made a good effort to keep open a broad nesting zone between beach furniture at the waterline and parasols and sunbeds on the upper parts on the beach next to the promenade once again (Figs. 3-5). The number of dustbins on the beach increased and they were partly bigger and more robust than in the last years (Fig. 6). The clay jugs used in past years were problematic because they were small and often broke, leaving behind shards. Furthermore, there was a new sign placed on the picnic area of Çiftlik (Fig. 7). The sign informs the tourists that they are on a beach where sea turtles nests and therefore need to adhere to a certain code of behavior.

Negative changes

Bakraç, a new disco, was opened this season. The beach entrance of this disco was a wooden platform topped by a pavilion (Fig. 8). There were also two wooden platforms; each had 3 sunbeds on it. At night they used a bright movable flood-light which pointed into the air. In August this disco set up a stage next to the waterline (Fig 9). Behind the disco was an irrigated grassy area (Fig. 10). In front of this disco was a huge floating-platform-construction (made out of metal and styrofoam) placed on the beach (Fig. 11). Moreover, there was another new Café next to the Surf Café, called Spor Café. In 2012, here was a wooden hut on wheels at this place. This has now been replaced by a permanent structure. The Spor Café also set up 4 new rows of sunbeds and parasols. The new Spor Café also erected a new volleyball court (Fig. 12). New trees and grass areas were planted around the Spor Café. The Escape Beach Club and the Surf Café placed big rugs on the beach (Fig. 13).

Table 1 lists all tourism facilities on the beach in Çiftlik and the sunbeds and parasols of each establishment. The numbers of rows of the sunbeds and parasols, horizontal to the waterline, were also counted. The highest number of sunbed rows was 6 rows, lined up by the Onur Beach and Güvens Restaurant. The highest number of sunbeds was present at the Jiva Beach Resort. There was an increase of sunbeds from 134 to 148 sunbeds at the Jiva Beach Resort. In total there were 215 bean bags provided by several bars and restaurants; this was 5 more than last year 2012. Some of them were damaged and their Styrofoam contents were distributed on the sand (Fig. 14).

Table 1: Number of sunbeds, parasols and rows of beach furniture in Çiftlik 2013
Tabelle 1: Anzahl der Sonnenliegen, Sonnenschirme und Anzahl der Reihen dieser Strandmöbel in Çiftlik 2013

Location	**Sunbeds**	**Parasols**	**Rows**	**Other observations**
Mekan Restaurant (former Otantic)	80	8	3	Tables at each umbrella
Kaptan Kafe	51	25	4	5 tables, volleyball net and ca. 9 new trees
Koca Çalışbeach (former Turkuaz Garden Beach)	59	30	3	26 bean bags
Escape Beach Club	62	13	3	At waterline rugs at the sunbeds, Acacia trees
Bakraç Beach Park	34	15	1	Two wooden platforms with each 3 sunbeds, stage on beach, pavilion entrance onto beach
Surf Café	115	64	5 – 3 – 5 (the rows were split)	99 bean bags, rugs at the umbrellas, 6 wooden platforms
Spor Café	22	18	4	Table with 4 chairs, volley ball and new planted grass and trees
Sunset Beach Club	103		4	The last 3 rows under a big ca.50x4m umbrella
Jiva Beach Resort	148	62	4	-
Dirlic Café	65	34	4	1 beanbag
Onur Beach Güvens Restaurant	72	41	6	These two restaurants could not be separated clearly
Yörük Çadiri	60	30	2	-
Caretta Beach Club	118	62	4	89 bean bags
Sum Çiftlik	**989**	**436**	**-**	**215 bean bags**

The total number of the sunbeds in Çiftlik decreased compared with last year, but was higher than in the preceding 3 years. The same trend was observed relating to parasols (Fig. 1).

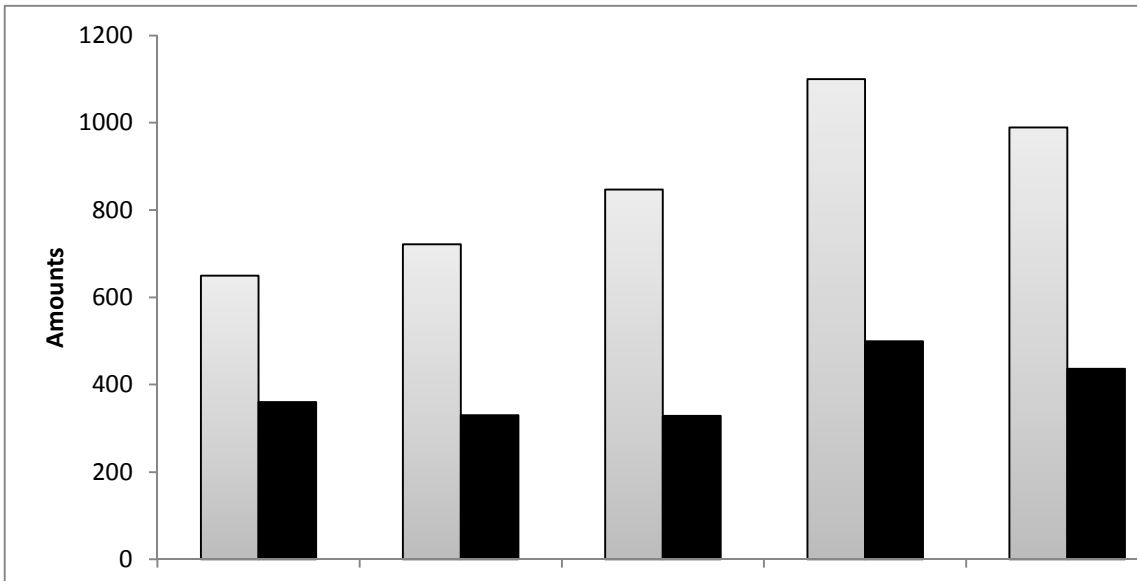

Figure 1: Number of sunbeds and parasols during the last 5 years in Çiftlik
Abbildung 1: Änderung der Anzahl der Sonnenliegen und Sonnenschirmen im Laufe der letzten 5 Jahre in Çiftlik

During summer, primarily in July, many bonfires were lit at night, especially at the picnic area. Nearly every night in the breeding season of *Caretta caretta*, cars parked on the beach. Often there were deep vehicle ruts on the beach, mostly at the picnic area and at the area of Çalıştepe (Fig. 15). Some tents were set up on the beach, again mainly at the picnic area, in which people spent the night (Fig. 16).

The amount of waste on the beach continued to be high, as in past years. Much waste was observed on the beach or next to the containers (Fig. 17). The picnic area was highly polluted with plastic bottles, plastic cups, cigarette butts and organic wastes (food remains). Waste was also found in the nest cages, even though the cages were labelled with signs which pointed out that this is a sea turtle nest.

Finally one new road was built; which leads parallel to the beach, it passes over behind the Bakraç Disco until the Surf Café (Fig. 19). It passes directly behind the many beach establishments and will certainly lead to increased traffic alongside the beach. Another road was enlarged, which were leading away from the main road in Çalışand cross over the new road (Fig.19).

DISCUSSION

Interestingly, there was a nest record this year in ÇalışBeach: 35 nests were recorded, the highest number since 1994. Some changes slightly improved the environment for the sea turtles, for example the drainpipe installed at the beach shower. Before this renovation, the water ran directly onto the beach, which changed the temperature, moisture and compactness of the sand in the immediate surroundings. Such conditions can hamper nesting and hatchling emergence. Inundation can even stop the development of sea turtle embryonic stages.

Furthermore, the FETAB organization kept free a nesting zone between the first and the second beach furniture row once again, and the sunbeds were piled during the night in Çaliş. These actions improved the situation of the nesting beach, although the sunbeds still represent a major obstacle for *Caretta caretta* (Fig. 4 & Fig. 5).

A new sign was erected at the picnic area of Çiftlik, but the location of the sign was not optimally selected: it was not positioned at a "tourist hotspot" or at a key entrance path to the beach. The remnants of the old sign were still there and not removed (Fig. 7).

The bad situation concerning waste on the beach did not change noticeably compared to earlier years. On one hand, such debris can complicate the crawl of the hatchlings towards the sea (Triessnig et al., 2012), and on the other hand the litter often ends up in the sea and can harm the adult sea turtles, especially when they eat pieces of plastic (see Stolzlechner, this report). Despite the presence of information signs on the nest cages, they were often filled with litter. This shades the nests, which means that the temperature in the nest decreases, potentially altering the sex ratio in the nests (Yntema & Mrosovsky 1980). Moreover, liquids could run out of dumped plastic bottles, harming egg development.

Every night, especially in July, many people sat down at the picnic area to eat and celebrate. In addition to making excessive noise and lighting bonfires, they left huge amounts of waste on the beach, which causes problems for *Caretta caretta*, as mentioned above.

All these actions probably discourage surfacing adult female sea turtles and may irritate emerging hatchlings.

As described in the results, a new bar (Spor Café) and a new disco (Bakraç Beach Park) opened up this year. Due to these two additional tourist facilities the light pollution increased (see Preinfalk, this report). The moveable flood light and the loud bass music of Bakraç Beach Park can disorient hatchlings and force adult turtles to stop the nesting process and to turn around and leave the beach. Behind the Bakraç Beach Park there were a large new grassy area; this former beach-breach zone is now irrigated, completely altering this habitat directly adjoining the beach (Fig. 10). In August the disco set up a stage directly at the shoreline. The

events there were loud and caused light pollution, beyond presenting a physical barrier for hatchlings. During the whole breeding season the beach was also occupied by a wooden platform of the Bakraç Disco, restricting nesting opportunities for the adult female *Caretta caretta* (Fig. 8). A big floating platform was stored on the beach near the shoreline at the Çiftlik area; it consisted of large Styrofoam blocks within a metal frame and metal barrels. This may cause a big pollution, due to the Styrofoam and constitute a further barrier for the loggerhead turtles (Fig. 11).

We identify the new Spor Café as a major problem. This establishment was erected on the last remaining stretch of unobstructed beach in all of Çaliş. Every known disturbance occurred: sunbeds, parasols, lamps, plants and a volleyball court (Fig. 12). The latter represents a problem because, if a sea turtle nest is laid in the field, the eggs can be harmed by the pressure of the volleyball players. This sport also alters the sand structure. Future problems can be expected here due to the planted trees and grassy areas. The roots of plants, for example of acacia trees, spread in all directions and impede sea turtle nesting in an extensive area around the trees themselves. The grassy area, which no doubt needs to be watered, will be an additional obstacle to nesting and hatching.

A new road was constructed parallel to the beach behind the Surf Café and the Bakraç Disco. The new road opens up new possibilities for people to drive and park along the beach with their cars. For a higher volume of traffic on the beach the enlargement of a road, which leads from the main road to the new built road, may also contribute.

Although the total number of sunbeds and parasols in Çiftlik decreased compared with last year, it is still higher than the number in the years before 2012 (Ertekin & Zauner 2012). As mentioned above, the sunbeds and parasols present obstacles for *Caretta caretta* adults and hatchlings, lowering their chance of finishing the nesting process, respectively of surviving and reaching the sea. Other beach furniture such as tables and beanbags can shade so-called secret nests, blocking egg development.

Finally, we should also mention that “party boats” occasionally passed by at a distance of only a few meters from the shoreline at night. This constitutes a serious threat to adult sea turtles and even the hatchlings, which can be hit by the propellers.

Concluding, we can state that some efforts were made to improve the situation of the loggerhead turtle in Çalışbeach, but that the ongoing habitat destruction and disruptive activities are a cause for serious concern.

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APPENDIX

Figure 2: A new drainpipe was installed on the promenade shower
Abbildung 2: Ein neues Abflussrohr wurde an der Dusche montiert
(Foto: M. Stachowitsch)

Figure 3: Nesting zone between first and second parasol-rows have been kept free
Abbildung 3: Nistzone zwischen der ersten und der zweiten Sonnenschirmreihe wurde freigelassen
(Foto: G. Kautek)

Figure 4: Nesting zone has been kept free from parasols; 2011
Abbildung 4: Nistzone zwischen den Sonnenschirmreihen wurde freigehalten 2011
(Screenshot: Google Maps)

Figure 5: Nesting zone not kept free in 2009
Abbildung 5: 2009 wurde keine Nistzone freigehalten
(Screenshot: Google Earth)

Figure 6: Dustbins were more solid and bigger than last year
Abbildung 6: Mistkübel waren massiver und größer, als die der letzten Jahre
(Foto: M. Stachowitsch)

Figure 7: A new sign was erected at the picnic area (posts of old sign still standing)
Abbildung 7: Neues Schild wurde auf der Picnic-Area aufgestellt (Die Pfosten des alten Schildes wurden nicht entfernt)
(Foto: M. Stachowitsch)

Figure 8: New Disco Bakraç - with wooden platform entrance and wood fencing and flooring on the beach
Abbildung 8: Neue Disco Bakraç - mit Holzplattform am Stand
(Foto: M. Stachowitsch)

Figure 9: Stage positioned on beach by Disco Bakraç
Abbildung 9: Bühnenteil aufgestellt von der Disko Bakiraç
(Foto: M. Stachowitsch)

Figure 10: An irrigated grassy area behind Bakraç Disco in former back-beach area
Abbildung 10:Eine bewässerte Grünflache hinter der Bakraç Disco
(Foto: M. Stachowitsch)

Figure 11: Swimming platform placed on the beach at Disko Bakraç
Abbildung 11: Auf dem Stand abgestellte Schwimmplattform
(Foto: M. Stachowitsch)

Figure 12: New Spor Café with volleyball court on last untouched stretch of beach
Abbildung 12: Neues Spor Café mit Volleyballfeld am letzten bisher unberührten Standabschnitt
(Foto: M. Stachowitsch)

Figure 13: Surf Café - Rugs on the beach
Abbildung 13: Surf Café – Teppiche am Stand
(Foto: M. Stachowitsch)

Figure 14: Styrofoam pellets from torn bean bag at Dirlic Café
Abbildung 14: Kaputter Sitzsack hinterlässt Styroporkügelchen im Sand beim Dirlic Café
(Foto: B. Kliesspiess)

Figure 15: Vehicle ruts on the picnic area
Abbildung 15: Wagenspuren auf der Picnic Area
(Foto: K. Egger-Peitler)

Figure 16: Tent at picnic area
Abbildung 16: Zelt auf der Picnic Zone
(Foto: C. Fellhofer-Mihcioglu)

Figure 17: Waste on the beach next to the container
Abbildung 17: Abfall am Strand neben Müllkontainer
(Foto: M. Stachowitsch)

Figure 18: Two new roads, one leading to the beach , the other running parallel to the beach
Abbildung 18: Zwei neue Straßen, eine führt zum Stand hin, die andere verläuft parallel zum Stand
(Foto: G. Kautek)

Changes in Yanıklar/Akgöl

Raffaela Lesch, Cornelia Mähr

KURZFASSUNG

Dieser Bericht gibt einen Überblick über Veränderungen an einem Niststrand der Unechten Karettschildkröte (*Caretta caretta)* in Yanıklar und Akgöl. Unter der Betreuung von türkischen Universitäten (2013 Pamukkale Universität, Denizli) und der Universität Wien wurde dieses Projekt vor 20 Jahren (1994) ins Leben gerufen, um die Unechte Karettschildkröte und deren Niststrände in Fethiye, zu erforschen und schützen.

Durch Vergleich der Entwicklung der verschiedenen Strandabschnitte der letzten 20 Jahre soll gezeigt werden, ob die erarbeiteten Lösungen und Bemühungen dazu beitragen das Zusammenleben für die Tiere sicherer und nachhaltiger zu gestalten. Die Hauptprobleme und Gefahren für die Tiere gehen von durch Menschen geschaffene Problematiken, wie Strand- und Meeresverschmutzung, Lichtverschmutzung, Veränderung der Strandstruktur, sowie der Verwendung motorisierter Fahrzeuge im Wasser und am Strand und von für den Tourismus zur Verfügung gestellten Gebrauchsgegenständen, wie Sonnenliegen und Schirmen, aus.

Die in diesem Bericht bearbeiteten Strandabschnitte Akgöl und Yanıklar gehören zum Strandverlauf Fethiye, der Teil einer SEPA (Special Environmental Protected Area).

In Yanıklar konnten dieses Jahr keine großen Veränderungen oder Beeinträchtigungen festgestellt werden. In Akgöl hingegen sind drastische Veränderungen zu verzeichnen. Der Flusslauf, der den See am westlichen Ende Akgöls ins Meer entwässerte, wurde zugeschüttet, ebenso wurden erstmals Sonnenliegen (16 Stück), Schirme (11 Stück) und eine Kabine am westlichsten Punkt des Akgöl Strandes aufgestellt, der seit 20 Jahren einen Hotspot für die Eiablage darstellt. Weiters erhöhte sich die Anzahl der Pavillions vor dem Karaot Restaurant von drei auf 12 Stück und eine überdachte Terrasse mit befestigtem Boden wurde errichtet.

ABSTRACT

This report provides an overview over the current situation, the development and conditions of the beach system Yanıklar and Akgöl concerning the nesting possibilities and successful nestings of the loggerhead turtle (*Caretta caretta*). Under the supervision of Turkish universities (2013 Pamukkale University, Denizli) and the University of Vienna, this field course was initiated 20 years (1994) ago to aid and support the sea turtle population nesting in this important area, being one of 14 key nesting beaches in Turkey.

By comparing the development of the different beach sections over the last 20 years we want to determine whether our efforts have helped to enable a safer and more sustainable environment for the turtles. The problems and threats for the animals are mainly human-caused and include pollution of the sea and beach, light pollution, modification of the beach structure, use of motorised vehicles in the water and on the beach, and amenities for tourism such as sunbeds and parasols.

The beach sections Akgöl and Yanıklar treated in this report are part of the larger Fethiye beach system, declared a SEPA (Special Environmental Protection Area).

No major changes were documented in Yanıklar this year, but the beach in Akgöl experienced dramatic changes. The streambed at the western end of the beach was filled up, sun beds (16), parasols (11) and a cabin were put up at the westernmost part of the beach for the first time in 20 years. This is a nesting hotspot. Furthermore the number of pavilions in front of the Karaot restaurant increased from three to 12 and a terrace with paved ground was built.

INTRODUCTION

The loggerhead turtle (*Caretta caretta*) is the most frequent turtle found in the Mediterranean Sea with an estimated 5000 individuals. (Demetropoulus, A. & Hadjichristophorou, M. 1995) The main nesting areas are in Greece, Turkey and Cyprus (Bolton & Witherington 2003). In Turkey there are 14 major nesting beaches of which three (Fethiye, Dalyan and Patara) are declared SPAs (Special Protected Areas) by the Barcelona Convention in 1976.

The sea turtle course team's study site has been and still is Fethiye. The beach system is divided into three areas: Akgöl, Yanıklar and Çalış. (Fig. 1) This report concentrates on Akgöl (1.5 km) and Yanıklar (4 km), which were monitored by one of our two teams on site. Two big holiday resorts (Majesty Club Tuana & Lykia Botanica Beach & Fun Club) and some small camping sites and beach cafés are located along Akgöl and Yanıklar. Over the years it has become clear that the main priority and challenge of the course is to document problems and offer solutions related to tourism and the overuse of the beaches, including raising the awareness of tourists and local residents.

Alongside collecting data from the nests and female adults, another main task was to document the changes and conditions found on the beaches by measuring the temperature and light intensity and documenting construction activities as well as the furniture set up on the beach during our time of stay. Sunbeds, parasols and pavilions were counted partly in front of most hotels, cafés and lodges to compare them with the numbers of the last years and to be able to draw conclusions on the developments and trends.

The loggerhead turtle is listed as “endangered” by the IUCN (Internationl Union for Conservation of Nature and Natural Resources) since 1996. Tourism therefore is a dilemma that hampers the preservation of these animals. On the one side, tourism is causing most of the problems on the nesting beaches and coastal areas, but on the other side tourism is a forum for informing people about the importance of our work. To satisfy touristic demands, the space remaining for turtles is becoming smaller and smaller. Hotels enlarge their facilities and parts of the beach used for tourists become increasingly larger. Moreover, tourists often don´t live up to the rules designed for the protection of the animals. A case in point is the limitation of entering the beach at night.

Furniture left on the beach during the night can hinder the female sea turtles from entering the beach to lay their eggs. Furthermore, shade projected by pavilions and parasols can influence the sand temperature of the nest: the sex of the animals is determined by the sand temperature small changes in direct sun exposure can lead to extreme sex ratios or even kill the embryos. When the eggs start to hatch, the hatchlings orientate themselves mainly toward the brightest light they can find to go directly into the sea. Normally that should be the moon shining over the ocean, since the turtles hatch during the night, but tourism also causes lots of light pollution; this severely disturbs their navigational abilities.

Another big problem tackled by the sea turtle course is the use of motorized vehicles on the beach and in the water. The compacting of the sand above a nest by a car driving over it can damage the eggs underneath or hinder hatching.

To identify each nest, successive numbers were given to them according to their discovery date. In case the nest wasn´t discovered shortly after it has been laid based on tracks or through observation, it was marked with an “S” and given a separate number. This system ensured that every nest could be observed and documented individually.

Hence the loggerhead turtles reproductive ability depends on natal homing it is essential for the species survival to sustain the beach with its characteristics. Since the beach in Akgöl was subject to great changes and new usage this year one of the main focuses of this report is devoted to Akgöl.

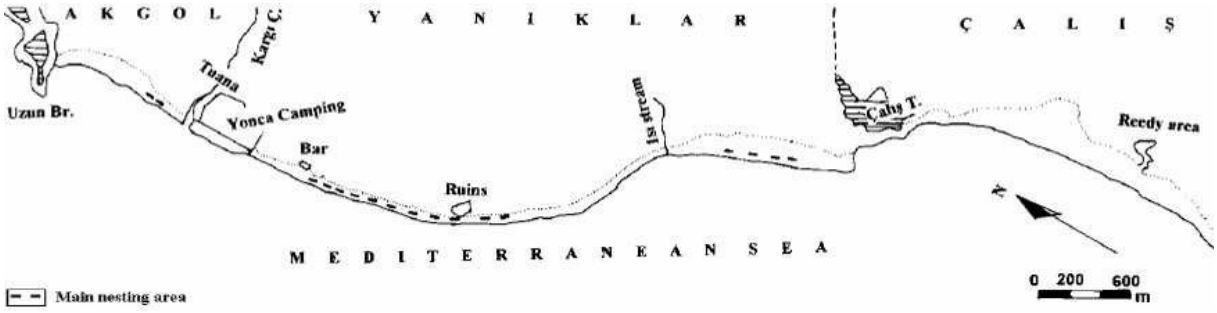

Figure 1: Sketch map of Fethiye beach (Turkozan et al., 2005)
Abbildung 1: Skizze der Strände rund um Fethiye (Turkozan et al., 2005)

MATERIAL AND METHODS

Teams of the sea turtle course observed the beach during the whole nesting season. Students from the University of Vienna were present from 30 June until 15 September 2013. During this time, data was collected by taking photos, measuring temperature and light density, nest and beach observation and excavation. Apart from the standard work, special occurrences such as cars on the beach, bonfires, dead turtles, litter, tracks of motorized vehicles and fishing activities were documented by taking notes and photographs.

Furthermore, most parasols, sunbeds and pavilions were counted and documented to enable comparison about the touristic development over the years. Light pollution was minimized by turning lamps off or covering up the sea facing part of the lamps. The first shift started at sunrise at about 6 am in the morning. Two teams with two team members each walked either Yanıklar or Akgöl and documented data on the turtles and nests. Until the first nest started hatching (26 July), night shifts started at 10 pm.

RESULTS

Condition of the beaches

Both the beach sector of Akgöl (Onur Camp to Uzun Burun) and Yanıklar (Doğa Camp to Small Beach) offer different conditions for turtles to lay their eggs. The turtles preferably lay their eggs in the areas where pebbles (>10mm) or sand dominate.

All the nests of the 2013 season on the Akgöl side of the beach were located west of the Majesty Club Tuana and most of them, similar to the past years, at the westernmost end of the beach which poses the nesting hotspot in Akgöl. Furthermore sandy areas suitable for nests are located close to the vegetation west of the Majesty Club Tuana and in front of the new Karaot restaurant (the old “Starfish Cafe”). These were also preferentially used by turtles this year. Moreover, some nests were also present in the suboptimal area mostly consisting of pebbles and very little sand surrounding the Karaot restaurant. These hatchlings had to overcome a broad sector of pebbles and stones to reach the sea. Unlike last year, no nest was

found in front of Yonca Lodge or at any place of the Akgöl beach sector from the Onur camp to the Majesty Club Tuana. The sand in front of the Majesty Club Tuana is very hard, helping to explain why no turtle found this area to be suitable for nest laying, even though one track was found there this year.

Like in past years, the majority of nests were found at the westernmost end of the Akgöl beach, between the Uzun Burun cliff and where the outflow of the lake Akgöl used to be. Hence the reeds were removed extensively and the riverbed of the Akgöl lake was flattened and filled up, the natural outflow got blocked and therefor wetness due to the dammed-up water poses a great threat to the optimal nesting conditions by trickling through the substrate. This drastic change may cause the loss of this hotspot within a short period of time. These dramatic manipulations prevented the meaningful application of ditches and therefor cars were able to enter the beach unhindered. Although a barrier should have prevented the entering of the beach between 8 pm and 8 am the abidance of these rules wasn´t to be observed. All this has degraded Akgöls former optimal nesting area. These changes force the turtles to build their nests in more or less wet sand which can affect the hatchlings development and makes it more difficult for the hatchlings to reach the surface (Serp 2001).

In the Yanıklar beach sector the condition of the beach remained mostly the same as last year. Most of the nests were located in the small stripes above the flotsam which were suitable for nesting almost continuously from the most western end of the beach to the “Lonely Tree”. Since this sandy strip is narrow and the waterline is dominated by cobbles (>64mm) and stones and therefore not suitable for nests, most of the nests were found close to the vegetation. There the eggs are threatened by being overgrown by roots. The hatchlings also have to overcome the broad belt of flotsam consisting of driftwood and different types of litter.

The region between the “Lonely Tree” and the river before the “Buffet Restaurant Akmaz”, called “Picnic Area”, is divided into a steep waterline zone consisting of cobbles and a flat, sandy part before the pine trees, which would offer the turtles good nesting conditions. Nonetheless, only one nest was found at the very beginning of the “Picnic Area”. Furthermore, this year the “Picnic Area” was divided into two sectors by a large fallen pine tree (Fig. 4 & Fig. 5) in the appendix.

East of the “Buffet Restaurant Akmaz” the beach changes from a narrow one to a flat, wide one. Along the waterline it is still dominated by cobbles, but further landwards a broad sandy region is present, which is partially overgrown with loose dune vegetation.

The easternmost sector of Yanıklar is called Karatas or Small Beach and has very fine sand. This year 2 nests were located there. Hence it is a very popular beach amongst locals and tourists, left behind litter and vehicles driving and crossing the beach pose a significant threat. Therefor a barrier was made out of stones stuck into the sand in September (Fig. 9). This spontaneous effort by the Austrian team kept cars off the beach compared to last year (Fig. 10), but came far too late in the season.

Vehicles and vehicle tracks

As addressed above, many cars parked on Akgöl beach this year. Vehicle tracks were recorded on the beach, near the sea and on the beach close to the lane leading to the Karaot Buffet (Fig 11. and Fig. 12). On Yanıklar beach, vehicle tracks were found close to the Caretta Beach Bar and on Small Beach (Fig. 13), on which a caravan was parked for several weeks (Fig. 14). In the past years trenches were dug (Fig. 6) and a row of stout wooden stakes were erected as a barrier for cars at the end of Akgöl. This year, however, the flattening of the beach and the broad entrance due to the removed vegetation made it no longer feasible to construct barriers to keep drivers from entering the beach. The barriers in the past years proved to have been successful (Fig. 6): this year the back of the beach (Fig. 7 and Fig. 8) was heavily parked with cars compared to last year.

Information boards

Only the frames of the information board close to the Caretta Beach Bar were still standing. The information itself was lost (Fig. 15 and Fig. 16). On a positive note, two new boards next to the Onur Camp and on the beach near the Karaot Buffet in the direction of the Akgöl Lake were installed (Fig. 17 and Fig. 18).

Lights

Like in the past two years, the lights of jetties at the Majesty Club Tuana were switched off during night time. One of the two street lamps along the beach proved to be very problematic especially during the hatching season, causing the hatchlings to crawl away from the sea and into the scrubs. It was turned off on 7 August after the problem was discussed between the sea turtle team and the restaurant owner (Fig. 19). The biggest change on Akgöl beach in relation to light pollution is the new Karaot restaurant. These bright neon lights fixed on the side of the restaurant facing the sea lit the beach up until approximately 2 a.m and had a huge impact on the hatching turtles, disturbing their sense of orientation.

At Yanıklar beach the Lykia Botanica Beach & Fun Club apparently replaced several lamp posts with new ones. As in the past year, the sides of the lampshades facing the sea were painted black (Fig. 37).

Fishing

Last year local residents were seen using nets and rods at the beach and from small up to medium-sized fishing boats as close as 100m to the beach. Tourists were seen using fishing rods in shallow water along both beaches and some people went spear fishing. This year fishing boats were also seen and the tourists fished along the beach. On some nights, between 10 and 12 p.m., sometimes up to 1 a.m., people were seen walking along the beach and lighting up the water to fish for crabs.

Litter

Various types of garbage remain a problem (Fig. 20). A positive development was the installation of two big rubbish bins at Small Beach (Fig. 21).

Fireplaces

Like in past years, many fireplaces were found along the beaches.

Water sport activity

The Detay Water Sports & Diving Center offers water sport activity both at the Majesty Club Tuana and the Lykia Botanica Beach & Fun Club. It owns catamarans, paddleboats, surfboards, sails and kites, canoes, jet skis, speedboats, which are stored at the Majesty Club Tuana, and surfboards and paddleboats, which are stored at Lykia Botanica Beach & Fun Club (Table 1). The amount of water sports vehicles remained the same as last year. Like in past years they continued moving between the two hotels to pick up and entertain their guests, often at high speed and very close to the shore. A large amount of the water sport activity took place inside the swimming zone, defined here as the first 200 m off the beach, which should be prohibited to water sport vessel operators. The SEPA even stipulates one nautical mile as being forbidden (Thake 2011).

Swimmers further away from the beach but within the buoys were called upon to leave the area to make room for water sports activities.

Table 1: Numbers of water sport vehicles (shared between Majesty Club Tuana and Lykia Botanika Beach & Fun Club) in the years 2005-2013
Tabelle 1: Anzahl von Wassersportgeräten (von Majesty Club Tuana und Lykia Botanika Beach & Fun Club gemeinsam verwendet) in den Jahren 2005-2013

Vehicles	2005	2006	2007	2008	2009	2010	2011	2012	2013
Paddleboats	2	2	*	4	4	*	*	*	□
Canoes	11	7	*	8	12	*	*	*	□
Sailing boats	1	2	*	2	2	*	*	3	3
Motorboats	3	4	6	6	9	9	9	9	9
Jet skis	0	0	6	0	7	*	5	*	*

Legend:* no records (keine Daten vorhanden), □ no data collected (keine Daten gesammelt)

Beach facilities

Yonca Lodge

The amount of pavilions and sunbeds and parasols remained the same this year (Table 2). The short boardwalk, which was present the last year, was still present on the beach.

Table 2: Numbers of beach facilities at Yonca Lodge in the years 2011-2013
Tabelle 2: Anzahl der Strandeinrichtungen der Yonca Lodge in den Jahren 2011-2013

Yonca Lodge Facilities	2011	2012	2013
Sunbeds	20	19	19
Wooden pavilions	1	2	2
Parasols	*	5	5
Sun roofs	*	9	9
Small tables	*	*	*

Legend:* no records (keine Daten vorhanden)

Majesty Club Tuana

The Majesty Club Tuana is the biggest holiday resort both on the Yanıklar/Akgöl sector and as already mentioned above as one of the two centres of water sport activity. The sunbeds were set up in four rows, the first three rows took up about half of the broad side of the beach (Table 3). Furthermore it has to be taken in account, that the sunbeds were moved by the tourists during the day. At the two ends of the sector of the Majesty Club Tuana the boats of the Detay Water Sports & Diving Center were positioned. Next to the centre there was a volleyball court. The wooden walkway, connecting the entrance of the hotel with both sides of the sunbed areas and forward to the jetties was enlongated for about 8 metres (Fig. 22 and Fig. 23). One side of the jetties was for the boats and water sport activity the other one had a rectangular swimming zone enclosed by buoys for the tourists. During night time, loud music continued to be played up until two o'clock in the morning but hardly any people were seen at the beach at night.

Table 3 Numbers of Majesty Club Tuana beach facilities in the years 2005-2013 Tabelle 3: Anzahl der Strandeinrichtungen des Majesty Club Tuana in den Jahren 2005-2013

Majesty Club Tuana									
Facilities	2005	2006	2007	2008	2009	2010	2011	2012	2013
Sunbeds	214	248	310	326	268	233	201	170	□
Sun roofs**	33	33	33	33	33	40	34	*	*

Legend:* no records (keine Daten vorhanden), **parasols replaced by sun roofs of roughly the same size in 2010 (Schirme 2010 durch Pavillions von der gleichen Größe ersetzt), □ no data collected (keine Daten gesammelt)

Karaot restaurant and the cabin at the end of Akgöl

At the same place where the former Starfish Cafe used to be, a new restaurant named "Karaot restaurant" was installed. This new restaurant made, as already mentioned above, a significant contribution to the light pollution on this beach section. Furthermore the new restaurant erected – in addition to the 3 pavilions present in 2011 and 2012 – 11 finished wooden pavilions with 7 parasols, one not yet finished pavilion 12 parasols and one roofed terrace (Table 4). This major change can be seen by comparing photos from 2011 and 2013 (Fig. 24, Fig. 25, Fig. 26, Fig. 27, Fig. 28 and Fig. 29). The cabin at the end of Akgöl beach belongs to the same owner as the Karaot restaurant. It includes the small cabin, a tent, three tables, nine chairs, one parasol and one shower in addition to the 16 sunbeds, 10 parasols, placed close to the water line (Fig.30, Fig. 31, Fig. 34 and Table 5). The lane leading to the beach was blocked by a barrier with the request of an entrance fee (Fig. 33)

Table 4 Number of former "Starfish Cafe" and, in 2013, Karaot restaurant beach facilities in the years 2011-2013
Tabelle 4: Anzahl der Strandeinrichtungen des ehemaligen "Starfish Cafe" und im Jahr 2013 Karaot Restaurant in den Jahren 2011- 2013

Former Starfish Cafe now Karaot Restaurant			
Facilities	2011	2012	2013
Sunbeds	22	27	20
Wooden pavilions	3	3	12
Parasols	13	7	12
Roofed terrace 30*3 m with a cobbled floor	*	*	1

Legend:* no records (keine Daten vorhanden)

Table 5: Numbers of beach facilities at the cabin at the end of Akgöl in the years 2011-2013
Tabelle 5: Anzahl der Strandeinrichtungen der Hütte am Ende von Akgöl in den Jahren 2011-2013

Akgöl Bufet			
Facilities	2011	2012	2013
Sunbeds	0	0	16
Wooden pavilions	0	0	0
Parasols	0	0	11
Tables	0	0	3
Chairs	0	0	9

Legend:* no records (keine Daten vorhanden)

Onur and Doğa Camp

The number of sunbeds and pavilions increased from altogether 16 sunbeds to 29, both camps combined, and one additional wooden pavilion was placed on the beach by Onur camp. Of the 29 sunbeds, 17 belonged to Onur Camp and 12 to Doğa Camp (Table 6). At the Doğa Camp a new volleyball court was established (Fig. 38).

Table 6: Numbers of beach facilities at Onur Camp in the years 2011-2012
Tabelle 6: Anzahl der Strandeinrichtungen des Onur und Doğa Camps in den Jahren 2011- 2013

Onur and Doğa Camps			
Facilities	2011	2012	2013
Sunbeds	17	16	29
Wooden pavilions	0	0	1
Parasols	0	0	0
Sun roofs**	4	4	1
(one permanent since 2013 sized 20*3 m)			

Legend: *no records (keine Daten vorhanden), **new in the year 2011 (neu im Jahr 2011)

Lykia Botanika & Fun Club

As mentioned above, in earlier years the parasols were replaced by sun roofs in 2010 (Wiemers 2011) (Table 7). The wooden boardwalk that was removed in 2011 was not replaced. Several of the lamp posts behind the beach were replaced (Fig. 37). The volleyball court remained present just like in the recent years. During night time, music was played less often than the daily music from the Majesty Club Tuana, but with a higher volume. Very few people were observed dancing at the small dance floor adjacent to the beach.

Table 7: Numbers of Lykia Botanika Beach & Fun Club beach facilities in the years 2003- 2013
Tabelle 7: Anzahl der Strandeinrichtungen des Lykia Botanika Beach & Fun Club in den Jahren 2003-2013

Lykia Botanika Beach & Fun Club											
Facilities	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Sunbeds	151	144	150	153	134	191	157	157	120	145	□

Legend:* no records (keine Daten vorhanden), □ no data collected (keine Daten gesammelt)

Buffet restaurant Akmaz

The number of sunbeds and parasols increased from 33 and 4 to 40 and 15, respectively. Moreover, 16 small tables were added as well as seven benches and four tables further landwards directly in front of the restaurant (Fig. 39, Fig. 40 and Fig. 41 and Table 8).

Table 8: Numbers of beach facilities at the Restaurant Akmaz in the years 2011-2013
Tabelle 8: Anzahl der Strandeinrichtungen des Restaurants Akmaz in den Jahren 2011-2013

Buffet Restaurant Akmaz			
Facilities	2011	2012	2013
Sunbeds	0	33	40
Parasols	0	4	15
Small tables	0	0	16

Caretta Beach Bar

At the Caretta Beach Bar the number of sunbeds increased from 19 to 47, and five additional small tables were installed, but there were no parasols present this year. (Fig. 42 and Table 9)

Table 9 Numbers of beach facilities at the Caretta Beach Bar in the years 2011-2013
Tabelle 9: Anzahl der Strandeinrichtungen der Caretta Beach Bar in den Jahren 2011-2013

Caretta Beach Bar			
Facilities	2011	2012	2013
Sunbeds	19	19	47
Parasols	10	10	0
Small tables	0	0	5

DISCUSSION

This year the beaches Yanıklar and Akgöl faced mostly similar problems as in the last years. The fact that most of the beach consists of cobbles, stones and pebbles more or less close to the vegetation complicates the turtles' search for a suitable nesting place. The biggest threats to the area are the significant changes on the nesting hotspot at the western end of Akgöl. There changes of the condition of the beach, an immense increase in tourism and light pollution and vehicles sum up to the biggest change of the year 2013. The latest levelling there endangers the few suitable regions. The bulldozed area of the riverbed in Akgöl is responsible for the fact that the outflow no longer reaches the sea. Now the water drains through the former optimal nesting site and no doubt decreases the quality of the beach in this area for nesting sea turtles. The sand is wet and harder, potentially increasing the mortality of the embryos and hatchlings in nest that are dug. It influences their development through the

temperature and because of the moisture the structure of sand can become more adhesive, making it more difficult for the hatchlings to reach the surface.

During levelling the substrate gets hardened: eggs can be destroyed and hatchlings may become stuck and unable to reach the surface.

The expanding tourism remains an increasing problem. People camping directly next to nests (Fig. 32), moving sand (Fig. 35), and altering markings (Fig. 36) and boats surrounding the nests are a prominent feature (Fig. 43). On the contrary the amount of beach facilities from last year to this one have even further increased (Table 10).

Table 10: Numbers of all the beach facilities(includes sunbeds, parasols, wooden pavilions, sun roofs, chairs, tables, small tables and roofed terraces) in the years 2011-2013
Tabelle 10: Zahlen aller Strandgegenstände in den Jahren 2011-2013(Sonnenliegen, Sonnenschirme, Pavillons, Sonnendächer, Sesseln, Tische, Tischchen und überdachte Terrassen)

	2011	2012	2013
Onur and Doga Camps	21	20	31
Yonca Lodge	21	35	35
Former Starfish Cafe now Karaot restaurant	38	37	45
Restaurant Akmaz	0	37	71
Caretta Beach Bar	29	29	52
Akgöl Cabin	0	0	39
All beach facilities excluding those of Majesty Club Tuana and Lykia Botanika & Fun Club	109	158	273

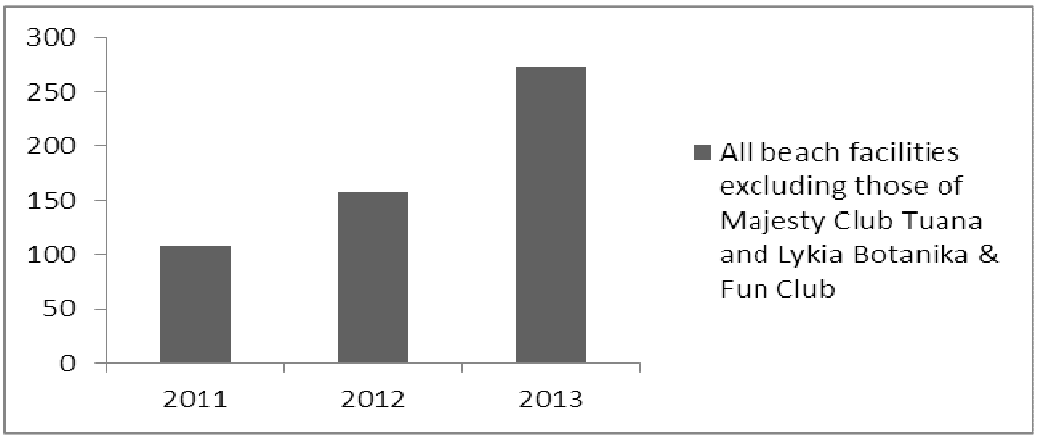

Figure 2: Alle Strandgegenstände (Sonnenliegen, Sonnenschirme, Pavillons, Sonnendächer, Sessel, Tische, Tischchen und überdachte Terrasse) des Onur and Doga Camps, der Yonca Lodge, dem früheren Starfish Cafe und jetzt Karaot Restaurant, dem Restaurant Akmaz, der Caretta Beach Bar und der Kabine in Akgöl in den Jahren 2011- 2013
Abbildung 2: All beach facilities(includes sunbeds, parasols, wooden pavilions, sun roofs, chairs, tables, small tables and roofed terraces) of the Onur and Doga Camps, the Yonca Lodge, the former Starfish Cafe now Karaot restaurant, the restaurant Akmaz, the Caretta Beach Bar and the Akgöl Cabin in the years 2011- 2013

As it can be seen in table 3 and 7 the The Majesty Club Tuana and the Lykia Botanica Beach & Fun Club Figure own the highest amount of beach facilities, which includes sunbeds and

sun roofs. However the expansions of these remain the same or even show some declines. Note however the immense changes on the other camps, lodges and restaurant within the last three years. In the figure 2 the increase through this short period can be seen, the figure 3 specifies on how much each establishment has gained through the years.

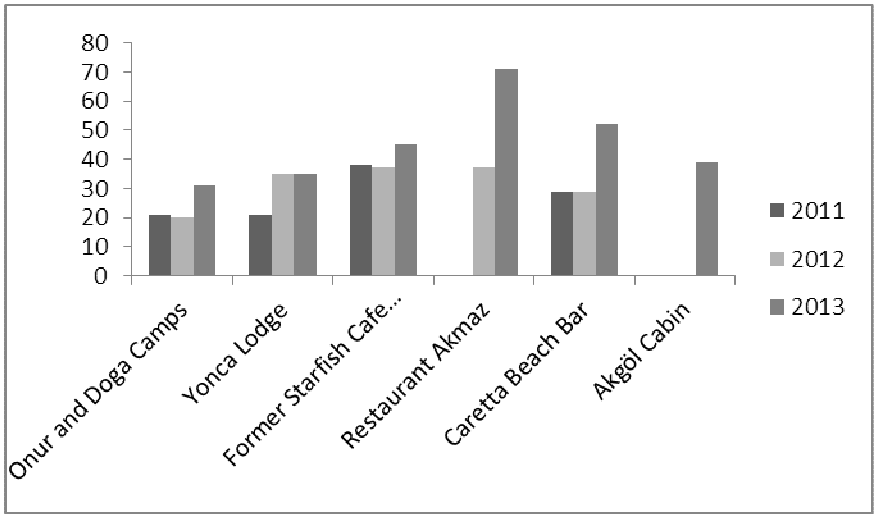

Figure 3: All beach facilities (includes sunbeds, parasols, wooden pavilions, sun roofs, chairs, tables, small tables and roofed terraces) in the years 2011- 2013 showing all the institutions
Abbildung 1 Alle Strandgegenständen(Sonnenliegen, Sonnenschirme, Pavillons, Sonnendächer, Sessel, Tische, Tischchen und überdachte Terrasse) in den Jahren 2011- 2013 mit besonderem Augenmerk auf die Institutionen

The touristic effects were especially prominent in Akgöl, where an apparent change in ownership of the former "Starfish Cafe", now Karaot restaurant, brought major changes. The fact that, within one year, an increase of 7 additional sunbeds, 9 wooden pavilions, 5 parasols and 1 roofed terrace around the Karaot restaurant could be observed is very alarming. Even more is the development at the nesting hotspot in Akgöl, where out of nowhere a new cabin along with 16 additional sunbeds, 11 parasols, 3 tables and chairs were installed. The sunbeds, pavilions and small tables reduce the area where turtles are able to lay their nests. Sunbeds close to the sea hinder the turtles to even reach the nesting area. The considerably increased light pollution by the restaurant may prevent adult turtles from nesting and lead the hatchlings into the wrong direction. A reduction in the amount of lights in general would be desirable. At least a limitation to the restaurant area, so that the neon light does not directly face the sea, should be considered as a possible action. It would also be helpful if the lamps were exchanged into yellow or orange lamps, which are less attractive to hatchlings (Witherington & Bjorndal 1991). To point out the positive changes, it can be mentioned that the problematic street lamp was turned off, however only after the affected nest had already started hatching and a few were lost because of that lamp. The darkening of the lampshades of the new lamps

at the Lykia Botanika Beach & Fun Club is another important step to keep the hatchlings from crawling in the wrong direction.

The problematic amount of water sport activity remained an unsolved problem and the first 200m close to the beach, reserved for swimmers, still weren't respected by the Detay Water Sports & Diving Center. The water sport activities are problematic for several reasons. Water sport vessels release their emissions into the sea. Many water sport vessels are loud and can disturb marine life. Furthermore, the turtles can be and are injured and killed by collisions with boats (Thake 2011).

Like in the past year the sunbeds at the Majesty Club Tuana were set up in four rows. The sunbeds and the boardwalks block the turtles from finding a place to lay their eggs and digging an egg chamber (Bernolle & Schweiger 2012). Last year a nest was laid near Yonca Lodge where there is also a wooden boardwalk and the hatchlings had to detour around it. These boardwalks are in general very problematic. The long wooden boardwalks at the Majesty Club Tuana however pose an even bigger risk if a turtle put its eggs in a nest behind it because it is fixed parallel to the waterline. The reason, why this poses such a big risk is the fact that the hatchlings are unable to reach the sea. They cannot crawl over or around the board and either die of predatory or heat.

More vehicles were able to reach the beach in Akgöl due to landscaping activity. This is very problematic because vehicles can run over nests and harden the substrate and hinder the hatchlings from emerging and reaching the ocean. The tracks vehicles leave behind can cause hatchlings to enter and follow them, trapping them in the deep ruts left behind in the sand. There they face predation and the heat.

The ditch behind a part of Small Beach was a step in the right direction. Since it extended only part way between the road and beach, the additional stone row put up by the sea turtle team was a necessary addition. This should be expanded next year. The effect of the missing ditches at the end of Akgöl was clear. Many vehicles parked on the beach. This situation needs to be rectified before the next nesting season.

At Yanıklar beach the new volleyball court at the Doğa Lodge takes away further nesting areas.

The new information boards that were set up to help inform visitors about the importance of this area would have been more helpful if they had been placed on more prominent locations than Onur Camp and halfway on Akgöl beach. These sites are not the most popular places of the beach and are probably seen only by a small proportion of the total visitors. They should

be placed at the entrance to the beach, especially at the westernmost part of Akgöl and the other one either in front of the Majesty Club Tuana, or at the eastern end of Yanıklar or at the entrance of Small Beach.

Fishing as one of the two biggest threats to sea turtles worldwide remains a potential danger on these nesting beaches for the hatchlings and adult turtles. Nets used for fishing are potentially lethal for sea turtle hatchlings, in the water as well as on the beach, because they become entangled and drown or dehydrate and die in the heat (Triessnig et al., 2012) Adults easily get caught in the nets, swallow hooks and collide with fishing boats and become injured. In a specially protected area, these threats should be banned within at least a certain distance from the beach. The litter on both beaches continues to be an unsolved problem. The removal of garbage from the oceans is one of the big worldwide challenges and one of the two major threats to turtles. A small step forward at our study site was two garbage containers that were put up at Small Beach, among the most polluted stretches of Yanıklar.

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APPENDIX

Figure 4: Picnic Area" west of the Akmaz river 2013 with a big fallen pine tree (Stachowitsch)
Abbildung 4: „Picnic Area" westlich des Akmaz Flusses 2013 mit einer großen umgestürzten Kiefer

Figure 5: "Picnic Area" west oft the Akmaz river 2012 (Stachowitsch)
Abbilung5: „Picnic Area" westlich des Akmaz Flusses 2012

Figure 6: Digging ditches to bar vehicle access; Akgöl 2012 (Fellhofer)
Abbildung 6: Errichtung von Gräben um die Zufahrt von Fahrzeugen zu verhindern; Akgöl 2012

Figure 7: Situation in Akgöl 2013 (Stachowitsch)
Abbildung 7: Situation in Akgöl 2013

Figure 8: Situation in Akgöl 2012 (Pilwax)
Abbildung 8: Situation in Akgöl 2012

Figure 9: Barrier out of stones on Small Beach 2013(Stachowitsch)
Abbildung 9: Absperrung aus Steinen in Small Beach 2013

Figure 10: Small Beach 2012 without any barriers (Stachowitsch)
Abbildung 10: Small Beach 2012 ohne jegliche Absperrungen

Figure 11: Vehicle tracks close to a nest in 2013 (Mähr)
Abbildung 11: Fahrzeugspuren nahe eines Nests in 2013

Figure 12:Vehicle tracks over a nest in 2012 (Stachowitsch)
Abbildung 12: Fahrzeugspuren über einem Nest in 2012

Figure 13: Vehicle tracks on “Small Beach” 2013 (Stachowitsch)
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Temperature measurements in the nests oft the loggerhead sea turtle, *Caretta caretta,* conducted at Yanıklar Beach in Fethiye, Turkey

Teresa Schaer

KURZFASSUNG

Um die Unterschiede der Temperaturen und Inkubationszeiten in Nestern der Unechten Karettschildkröte (*Caretta caretta*) feststellen zu können, wurden drei Nester am Strand von Yanıklar / Fethiye mit Tiny Tags (Batteriebetriebene Computerchips)ausgestattet. Die mittlere Temperatur in den Nestern liegt zwischen 30°C und 31°C, die mittlere gemessene Lufttemperatur während der gesamten Dauer der Messungen (75 Tage) liegt 0,8°C höher. Y12 weist den geringsten Nisterfolg und die niedrigsten Nesttemperatur im Vergleich zu den beiden anderen Nestern auf. Der Nisterfolg der Nester im Vergleich ist Y7: 65%, Y9: 69% und Y12: 49%. Schattenspende Vegetation vermindert, und die Entfernung zum Meer beeinflusst, den Schlupferfolg der Nester.

ABSTRACT

To determine the differences in incubation temperature, period and hatching success, 3 different nests of the loggerhead sea turtle (*Caretta caretta)* at the beach of Yanıklar/Fethiye were equipped with tiny tags (battery-powered data loggers)

The mean temperature of the three nests was between 30°C and 31°C and the mean air temperature was 0.8°C higher during the period of measurement (75 days). Nest Y12 had the lowest hatching success and the lowest nest temperature. The hatching success of the three nests was Y7: 65%, Y9: 69%, and Y12: 42%. Shading greenery lowers, and the distance to the sea affects the hatching success of the nests.

INTRODUCTION

The loggerhead sea turtle (*Caretta caretta*) and the other six still existing sea turtle species rank among the most endangered species of our oceans. Therefore all of them are officially protected by the Convention on International Trade in Endangered Species of wild Fauna and Flora (CITES, Annex I; Classified as "vulnerable" or "endangered"(Demetropoulos & Hadjichristophorou 1996) and the International Union for Conservation of Nature and Natural Resources (IUCN; www.iucn.org). The habitat and the nesting sites (mainly in the Mediterranean Sea) of sea turtles are partly designated as SPAs (3 out of 14 nesting sites in Turkey: Dalyan, Patara and Fethiye = Specially Protected Areas) within Natura 2000 and the Barcelona Convention.

Along Turkeys' Mediterranean shores there are regularly nesting two species, the loggerhead and the green sea turtle (*Chelonia mydas*). After the female has buried the eggs in a suitable substrate, she leaves the nest and the incubation begins.

Sex determination in nearly all reptiles is affected by incubation temperature (Bull, 1980) and, as turtles are reptiles, the nest temperature affects the sex determination of the turtle's embryos (Bull & Vogt 1979, Mrosovsky 1980). This so-called "Temperature-dependent Sex Determination" (TSD) is influenced by the temperature in and around the nest.

The substrate (sand or gravel) buffers the air temperature and protects the embryos from daily temperature changes, helping ensure the hatchlings development.

If the mean temperature in the nest lies above 29°C (Kaska et al. 1998), more females will hatch, but if the value is lower, more male turtles will hatch. A constant basic temperature between 28.6 °C and 29.7 °C leads to a 1:1 sex ratio in the nest (Zbinden et al. 2006).

Temperature changes and the differences between day and night function as an attenuator, therefore the mean temperature does not go beneath the mean ideal temperature, balancing in the sex ratio. The environmental temperature not only controls the sex of the individuals but also the incubation period (correlating as well to nest depth). The warmer the surrounding area, the shorter the developmental time of the nest. Piggelen and Strijbosch (1993) stated that the average of incubation period of *Caretta caretta* is 57 days. Not only sun and sand provide heat, but also the developing embryos radiate a metabolic heat, which, however, has no influence on the sex determination (Booth & Astill, 2001).

20 Austrian students worked together with Turkish students from the University of Pamukkale (Pamukkale Üniversitesi, Denizli) in Fethiye (36°37'14"N, 29°6'51"E) at the beach of Yanıklar (39°52'60"N, 26°46'0"E) and at the beach of Çalış (38°58'53" N, 34°52'1" E) from

July to September in order to gather information about the loggerhead sea turtle and collect data to help preserve this endangered turtle in the future.

Using data loggers, buried in different nests (3), I tried to determine the incubation time under different conditions (month, distance to the sea, air and nest temperature). The focus was on the total incubation time of the nests, as well as on which nest hatched first and which was the last. Furthermore, I point out which factors may influence the incubation period (temperature variations in the nest) and how the surrounding temperature affects the incubation.

MATERIAL AND METHODS

Data logger

The used loggers were battery-driven data loggers produced by the company "Gemini Data Loggers" UK Ltd. (Tiny tag: Talk 2 loggers, TT40) at the size of, and housed in, a 35mm film canister (Fig. 1) and a small packet with desiccant to avoid humidity build-up in the canister.

The loggers were programmed by Christine Fellhofer-Mıhcıoğlu and provided by the University of Vienna. The tiny tags are temperature measurement units, programmed to take a measurement every 72 minutes. One logger can accumulate up to 1800 data points and is able to measure from -40°C to +85°C. Between 0°C and +80°C they provide an accuracy of +/- 0.2.

In summer 2013, three tiny tags were buried (July - September) at the beach of Yanıklar.

- Logger in Yanıklar:
    1. Tiny tag Nr.: 3 (TT III)
    2. Tiny tag Nr.: 5 (TT V)
    3. Tiny tag Nr.: 6 (TT6 VI)

Fig.: 1: Tiny tag VI data logger with the 35mm film canister and packet with desiccant (Photo: T. Schaer).
Abb.: 1: Daten Logger VI mit der 35 mm Filmdose und dem Säckchen mit Trockenmittel.

Details on the different nests

- Tiny tag III was placed in nest Y7 on the 12.7.2013. The nest was laid on 9.7.2013; the distance to the sea was 21.2 m, to the vegetation 3.8 m.
- Nest Y9 contained TT V and was laid on 12.7.2013 and located 14.5 m from the sea. The nest was equipped with the logger directly on 12 July.
- TT VI was buried on 20.7.2013 in nest Y12 at a depth of 32 cm. The nest was laid on 18.7.2013 and had a distance of 15.8 m to the sea.

Data collection

The tiny tags were put into the different nests in the morning shift and in newly dug ones (max 2 days later) to provide full data sets. Before burying the tiny tags, they were kept in the refrigerator to visualize clearly when the nest measurement started.

When putting in the data loggers, the nests had to be opened until the first eggs became visible; the loggers (labeled with number and date) were then put in the egg chamber on top of the eggs. The depth in which the loggers were placed was noted in order to record depth-specific temperature differences among the nests. Four days after the last hatchling appeared at the different nests, the tiny tags were removed. The data were downloaded, transferred to Excel format, and analyzed in Vienna.

Measurement of the air temperature

The air temperature was recorded with a digital thermometer daily at about 6°° and 12°° plus at 22°° starting on 30 June until 13 September (by the students). The recorded temperature and the wind conditions (calm, light, heavy) were noted on data sheets. The thermostat used (Fig. 1) was the same model in both camps. The temperature was measured always in the same place, on the beach of Yanıklar, in the sun, directly in front of the camp, to avoid discrepancies. The thermometer was kept in one hand, making sure the thermistor hung freely and did not touch the sand or wood. The collected data by the students may vary in accuracy because of the sensitivity of the thermometer towards the wind.

RESULTS

Air temperature

The air temperatures in figure 2 were measured by the students and show the actual temperature during the period from 1 July until 14September. The highest peaks were recorded on 29 and 31July, i.e. 42°C at 12°. The lowest temperatures at midday were on 11 July and 7 September (21.8 °C).

The highest temperature during the morning measurements (6°°) was 24.8 °C on 10 July and the lowest one on 7 September (17.2°C).

The peak in the evening measurements (22°° pm) occurred on 8 July and was 28.5°; the lowest temperature was recorded on September 11th (19.1 °C).

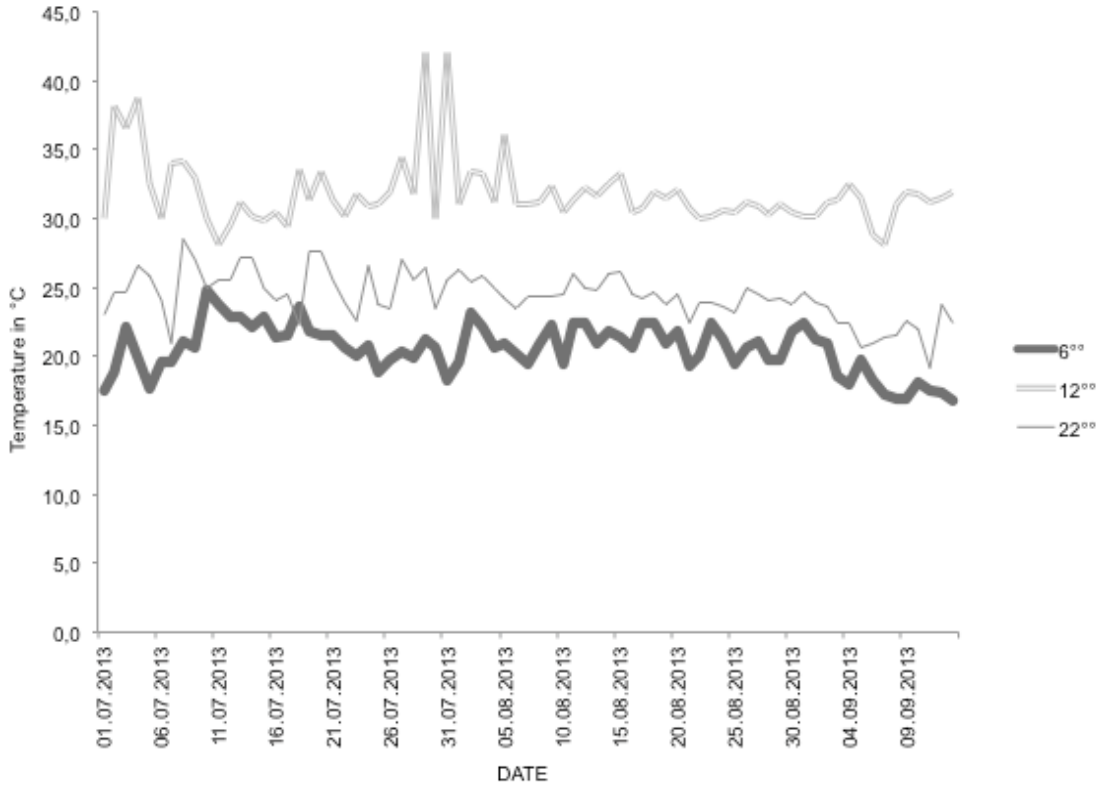


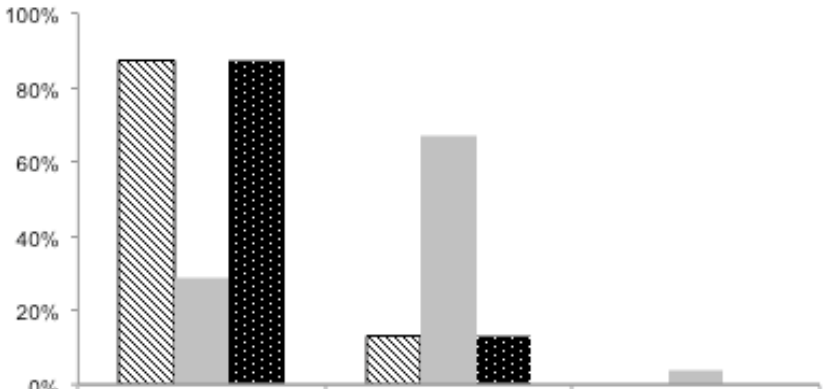
Fig. 2: The recorded daily air temperatures in 2013 at about 6°° and 12°° and 22°°. y-axis: temperature in °C; x-axis: timeline, starting on 1st July, ending on 13th September.

Abb. 2: Die aufgezeichneten absoluten Temperaturen im Jahr 2013 um ca. 6°°, 12°° und 22°° Uhr. Y-Achse: Temperaturen in °C; die x-Achse: Zeitachse, beginnend am 1.Juli,endend am 13. September.

Wind conditions

The wind conditions (in percent) during the 75 days of data recording (1.7.2013-13.9.2013) are shown in figure 3. At 6°° the wind was 87% calm, 13% low and 0% stormy. The midday

measurements show that the wind was 29% calm, 67% low and 4% stormy. The corresponding values in the evening (22°°) were 87% calm, 13% low and 0% stormy.



	calm	low	stormy
6°°	87%	13%	0%
12°°	29%	67%	4%
22°°	87%	13%	0%

Fig. 3: Wind conditions during the 75 days of data collection. Y-axis: wind conditions (percent), The table shows whether the wind was calm, low or stormy at the different times of data collection (6°°, 12°° and 22°°).
Abb. 3: Wind-Verhältnisse während der 75 Tage andauernden Datenaufnahme. Die y-Achse zeigt die Windverhältnisse (Prozent), die Tabelle zeigt ob der Wind während der Zeit der Datenaufnahme ruhig, leicht oder stürmisch war (6°°,12°° und 22°° Uhr).

Nest and tiny tag data

- Y7

Nest Y7 was located on 9.7.2013 and was provided with TT III on 12.7.2013, providing a well a full data set. This nest was 3.8 m away from the vegetation and 21.1 m from the sea (Tab.1A), containing 75 fertilized eggs; only 49 hatchlings reached the sea. The logger was buried in a depth of 31 cm. The nest and the logger were excavated on 6 September.

- Y9

Nest Y9 had a distance of 13 m to the vegetation, 14.5 m to the sea and was located on Yanıklar beach (Tab. 1A) This nest contained logger TT V. It was dug by an adult loggerhead female on 12.7.2013 and equipped with the logger on the same day in a depth of 27 cm. Out of 65 fertilized eggs; only 39 reached the sea (Fig. 4). The nest and the logger were excavated on 10.9.2013 and compared to nest Y7 and Y12 (Tab. 1&3).

This nest was laid on 18.7.2013 and the logger was excavated on 13.9.2013. The logger was put into the nest on 20.7.2013, two days after the nest was laid. The excavation on 28 September revealed that 73 eggs were fertilized and 31 hatchlings reached the sea. (compare Fig. 4). Table 3 provides further information such as the distance to the sea, which was 15.8 m and

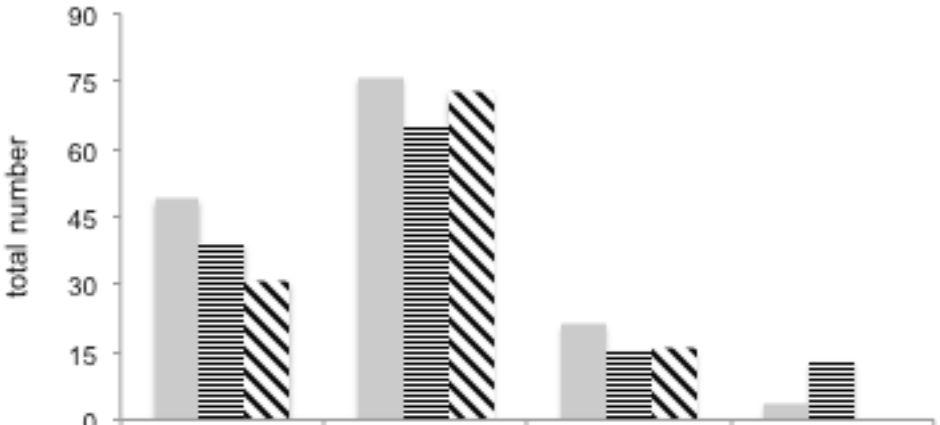
similar to nest Y9 (Tab. 1 and Fig. 4). Though the distance to the sea was nearly the same, the distance to the vegetation differed due to the varying width of the beach (Tab. 1A).
For further information on the different nests, such as first and last hatch day, see Table 1.

Table 1: The three nests and tiny tag data
Tabelle 1: Daten der drei Nester und der Tiny Tags.

Information	Nest Y7	Nest Y9	Nest Y12
Date of the clutch	09.07.13	12.07.13	18.07.13
Data logger buried	12.07.13	12.07.13	20.07.13
First hatch date	29.08.13	30.08.13	no data
Last hatch date	02.09.13	06.09.13	no data
Depth: top of eggs (cm)	31	27	no data
Nest distance to the sea (m)	21.1	15.5	15.8
Distance to vegetation (m)	3.8	12.9	0
Position	close to vegetation / far from sea	far from vegetation & sea)	close to vegeta-tion
Total number of fertilized eggs	75	65	73
Hatchlings reached the sea	49	39	31
Hatching success	65%	60%	42%
Excavation date (logger and nest)	6.9.2013	10.9.2013	Exc: 28.9.2013 Logger:13.9.2013
Duration of measurement in the nest	51 days	62 days	51days
Incubation time	55 days	49 days	no data
Tiny tag number	TT 3	TT 5	TT 6

Nesting success

Comparing the three nests (Y 7,9,12) the data show that nest Y7 was the most successful one: 49 hatchlings out of 76 fertilized eggs reached the sea.
Figure 4 also reveals that Y12, however, had 3 eggs fewer than Y7 and was less successful: 31 hatchlings from 73 fertilized eggs reached the sea. Furthermore, Y7 was positioned nearly as close to the vegetation as Y12, but further away from the sea than Y9 and Y12 (Fig. 1A).
Y12 was located directly next to/in the vegetation- as seen below, the distance to the vegeta-tion is 0 m.



	Hatchlings reaching the Sea	Total number of fertilized eggs	Distance to the sea (m)	Distance to the vegetation (m)
Y 7	49	76	21,1	3,8
= Y 9	39	65	15,5	12,9
Y12	31	73	15,8	0

Fig. 4: Comparison of the 3 nests Y7, Y9 and Y12. x-axis: hatchlings reaching the sea, total number of fertilized eggs and distance to sea and vegetation. The table shows the total numbers.
Abb.4: Vergleicht die 3 verschiedenen Nester: Y7, Y9 und Y12. Die x-Achse: Schlüpflinge die das Meer erreicht haben, die Anzahl aller befruchteten Eier und die Entfernung zum Meer und zur Vegetation. Die Tabelle zeigt die genaue Anzahl.

Nest daily maximum temperatures and time

Comparing the 3 different nests, the maximum temperatures-per day are shown in figure 5. A steady trend and the highest temperature were recorded in nest Y9 (black thick line) on 12 days in August (31.4 °C). The nest had an incubation time of 49 days.

Y7's high temperature measurements were on 18 and 19 August 2013, showing 33,7 °C during the incubation. The lowest values in nest Y7 were collected on the last three days before excavation (30,0 °C, 8-10.9.2013).

The incubation time for this nest was 55 days.

For nest Y12 no data are provided concerning the incubation time.

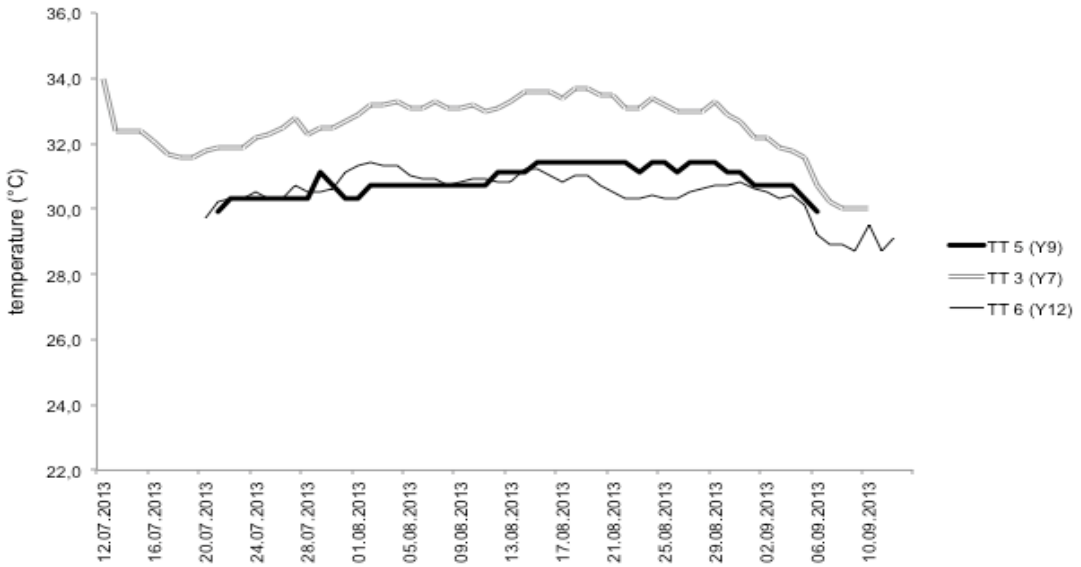


Fig. 5: Maximum nest temperatures per day provided by data loggers (Y9: thick black line, Y7: grey double line, Y12 black thin line). Y-axis: temperature in °C; y-axis: date.
Abb. 5: Maximale Temperaturen pro Tag, dargestellt durch die Daten der Tiny Tags (Y9: dicke schwarze Linie, Y7 graue Doppellinie und Y12: dünne schwarze Linie). Y-Achse: Temperatur (°C); x-Achse: Datum.

Temperature minimum per day during incubation

The lowest temperatures per day are visualized in figure 6.

Mostly, the temperature minimum per day is more constant compared to the maximum per day. The graph shows a loss of temperature down to 12-13 degrees on the excavation date when the logger were put into the refrigerator to clearly show the end of the measurement.

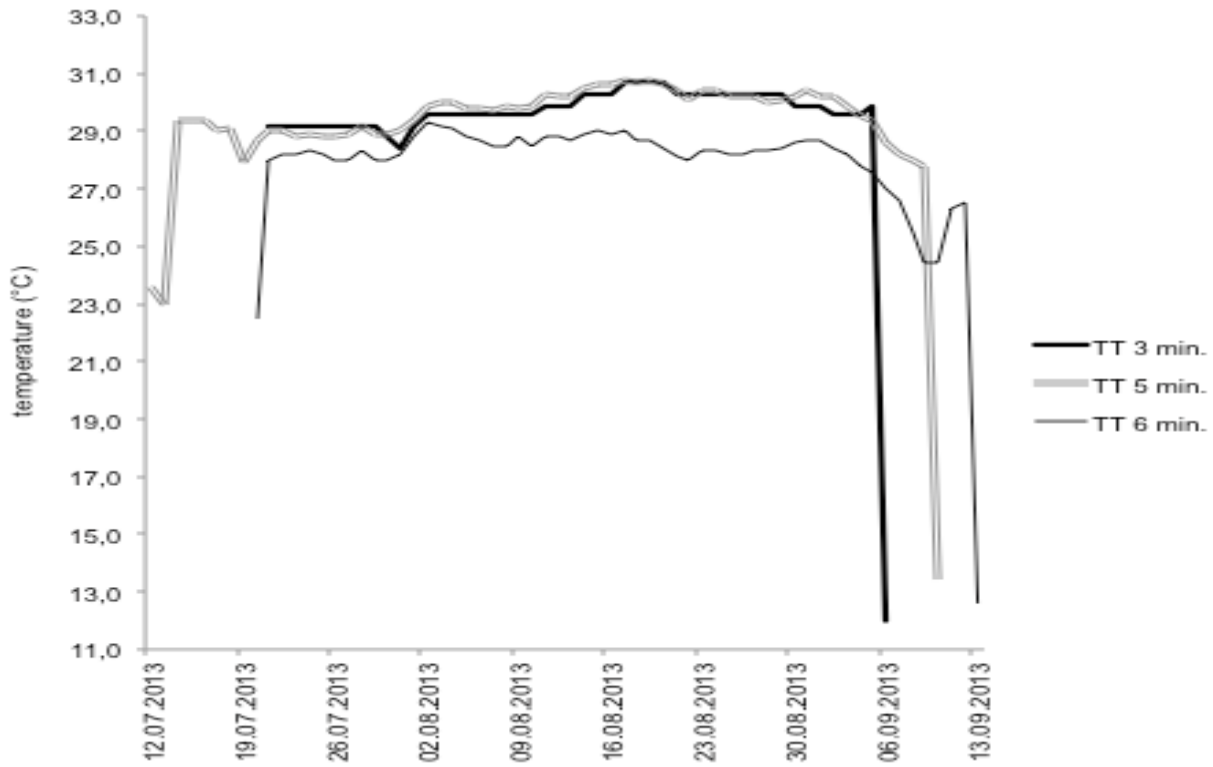


Fig. 6: Minimum nest temperatures per day, in comparison (TT3: thick black line,TT5: grey double line ,TT6 black thin line). Y-axis : temperature (C°), y-axis: date.
Abb. 6: Minimale Temperaturen verglichen untereinander(TT3: dicke schwarze Linie, (TT5 graue Doppellinie TT6: dünne schwarze Linie). Y-Achse: Temperatur (°C),, x-Achse: Datum.

Mean nest temperatures

Looking at the recorded mean temperatures during the whole incubation time, figure 7 reveals that Y3 was the nest with the lowest mean temperature (30.0°C). TT6 presents a mean temperature of 30.4°C and TT5 of 31°C.

Comparing this to the mean air temperature, all three nests had a lower mean temperature than the mean air temperature at 12°°.

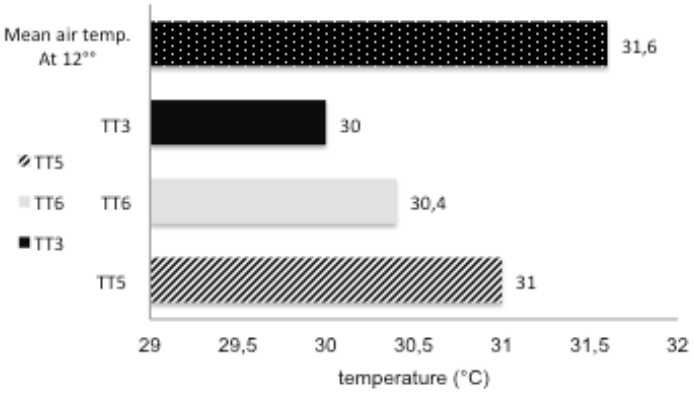


Fig. 7: Mean temperatures of the different nests, in comparison Y9 (TT5), Y7 (TT3) and Y12 (TT6) and to the mean air temperature (at 12°°) are shown on the x-axis. y-axis: temperature (°C)
Abb. 7: Durchschnittliche Temperaturen der verschiedenen Nester verglichen mit der durchschnittlichen Lufttemperatur (12°°). X-Achse: Y9 (TT5),Y7 (TT3), Y12 (TT6). y-Achse: Temperatur (°C).

Total temperature measurements

- Tiny tag 3:

Was buried four days after the nest was built (Tab.1) on the 12.7.2013 and excavated on 6 September. Figure 9 shows the temperature of the nest during the total period.

The timeline reveals that nest Y7 does show an increase (maximum) or decrease (minimum) over the whole period but points out as well a constant temperature ranging between 28°C and 32°C. In the beginning, when the logger is buried, the temperature in the nest is lower, and then it increases relatively to the air temperature, as the nest temperatures are linked to the air temperature. The tiny tag recorded a temperature decrease down to 12.0 °C after the excavation when put into the refrigerator to clearly visualize the end of the measurement (Tab.1& Fig. 6). The incubation time for this nest was 55 days.

The following figures (Figs. 9-11) show the temperature measurements during the time of measurement in the nest. The x-axis shows the timeline and the y-axis shows the temperature in degrees Celsius (°C).

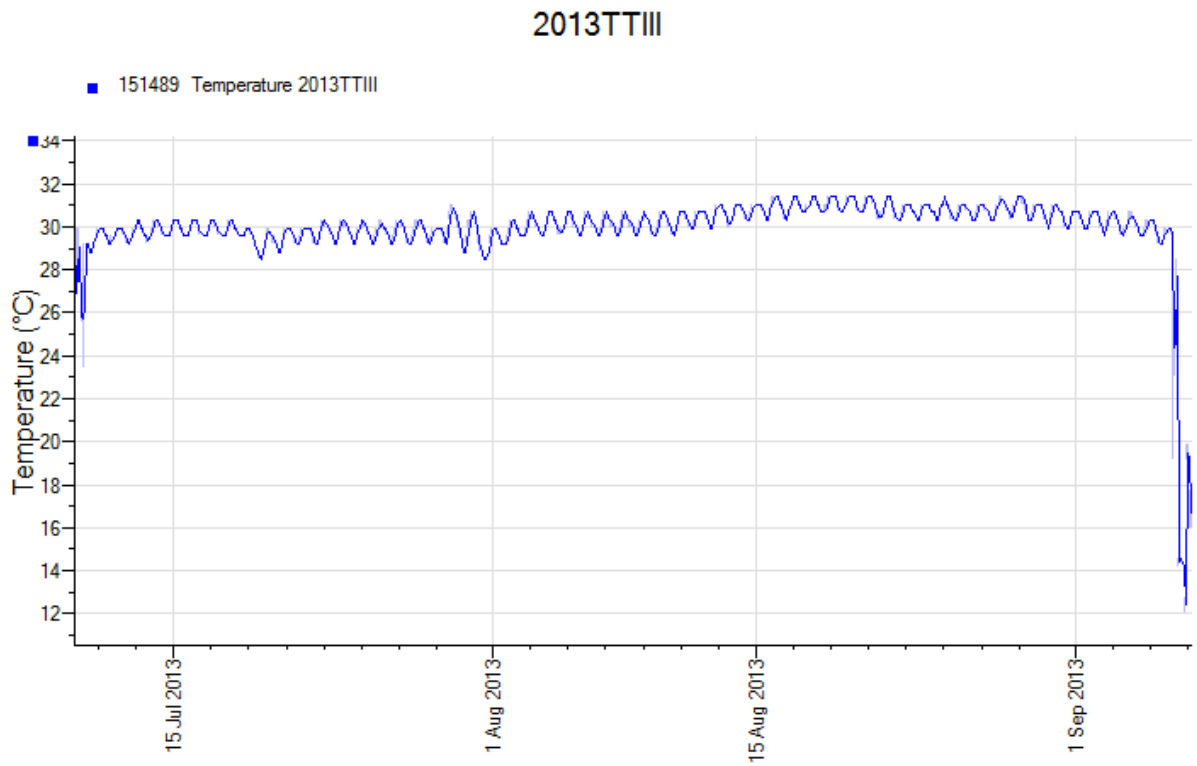


Fig. 9: Temperature measurements of tiny tag 3 in nest Y7.
Abb.9: Temperaturmessungen des Tiny Tags 3 in Nest Y7.

- Tiny tag 5:

Tiny tag TT5 was buried in nest Y9 on 12.7.2013 and taken out of the nest on the excavation date (10.9.2013, Tab. 2). The recorded maximum temperature was 34.0 °C (Fig. 6). Fig. 10 shows a constant increase of temperature till the highest maximum and then a steady decrease till 6.9.2013. The incubation time for this nest was 49 days.

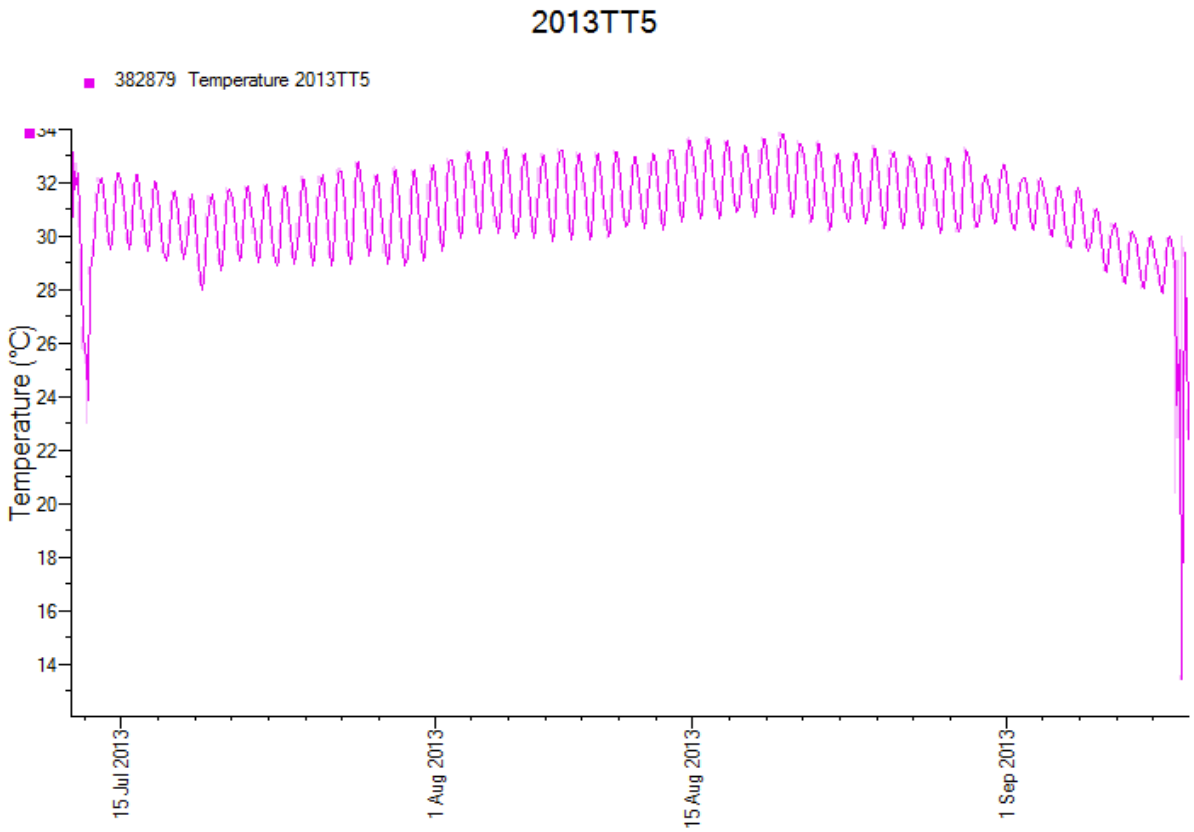


Fig. 10: Temperature measurements of tiny tag 5 in the nest Y9.
Abb.10: Temperaturmessungen des Tiny Tags 5 in Nest Y9.

- Tiny tag 6

Figure 11 shows that the temperature in nest Y12 during the incubation time is not as steady as the other tiny tag data. During the whole incubation time, the temperature falls and rises. The logger was buried on the 20.7.2013 – two days after the clutch was laid.

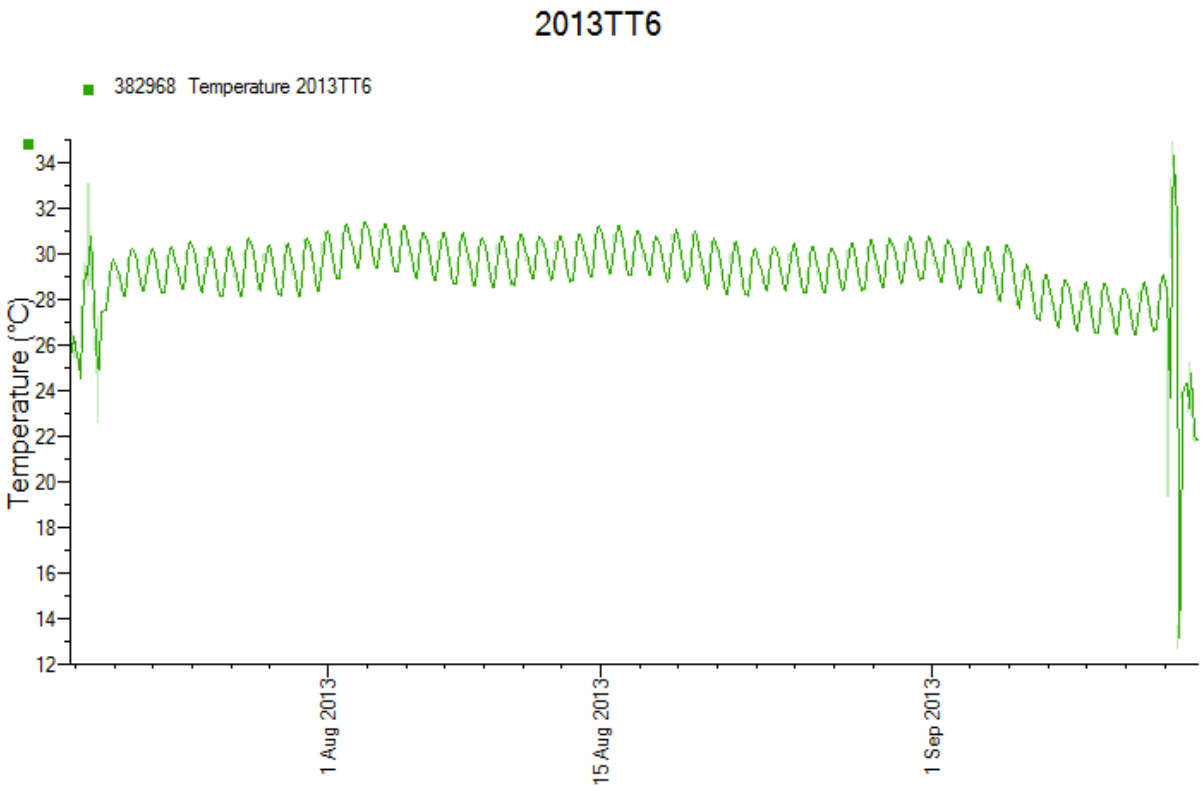


Fig. 11: Temperature measurements of tiny tag 6 in nest Y12.
Abb.11: Temperaturmessungen des Tiny Tags 6 in Nest Y12.

Logger data compared to each other

Comparing the three logger data in an overlay (Fig. 12) reveals that TT5 (pink) had the highest temperature during the measurements.

TT6 (green) presents the lowest temperature during the whole time of measurement.

TT3 (blue) presents (compared to the other logger) a temperature midway between the others and the shortest incubation time. The overlay starts at 12.7.2013 and ends on 13.9.2013.

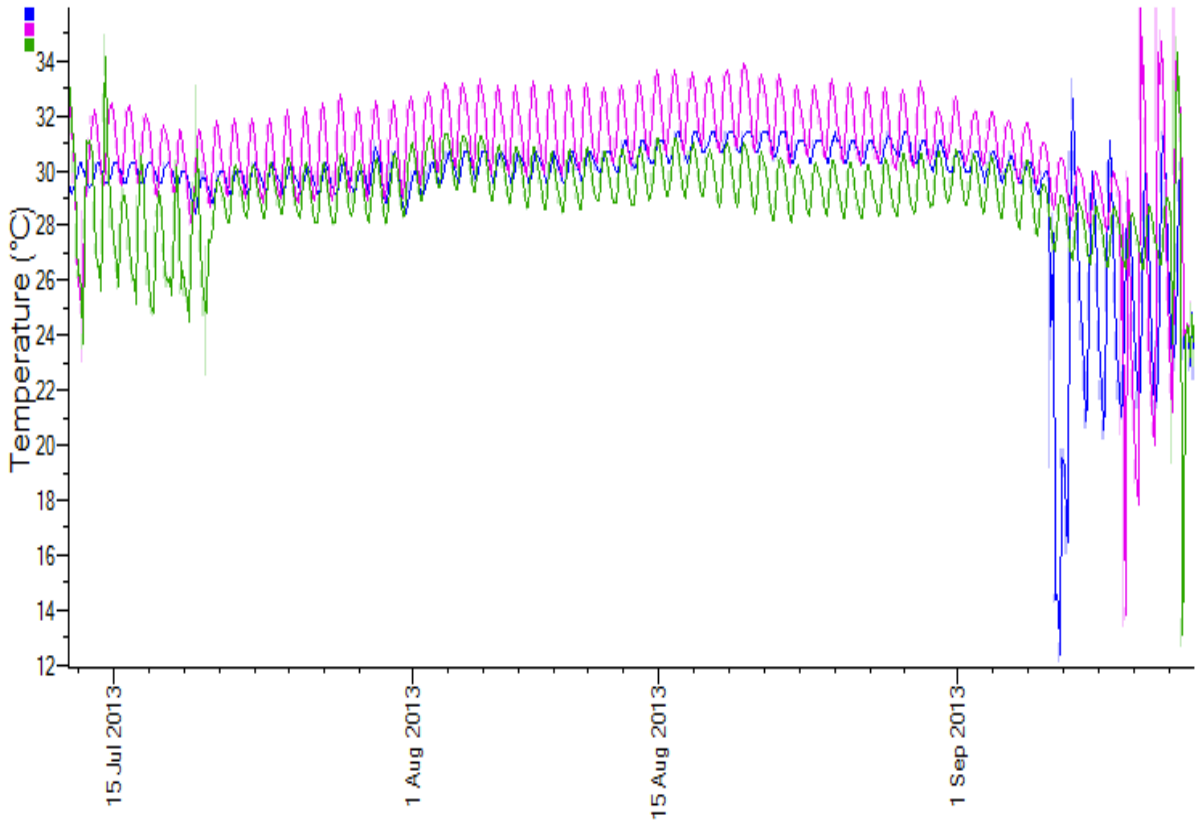


Fig. 12: Tiny tag (3=blue, 5=pink, 6=green) overlay in the time from 12.7.2013 till 13.9.2013. X-axis: time, y-axis: temperature (°C)
Abb. 12: Überlagerung der Tiny Tag (3=blau, 5=pink, 6=grün) Kurven während des Zeitraumes von 12.7.2013 bis 28.9.2013. X-Achse: Zeitraum, y-Achse: Temperatur (°C).

DISCUSSION

The air temperature measured by the students shows a higher variation in the particular measurement hours (Fig. 2) than the logger data in the nests do. Therefore, the daily ups and downs in air temperature are dampened considerably in the nests. The reason why the daily nest temperatures vary more than the air temperatures is because of the microclimate in the nest. Additional factors that influence the nest temperature are the distance to the sea or vegetation. The nest climate is influenced by many factors such as conditions of the beach, sand, humidity, salinity, water potential, exchange of gases and water, the structure of the beach, the climate and air temperature (Ackerman 1997).

The highest air temperature was recorded in July, reaching 42°C, and the lowest was recorded in September, i.e. 17.2°C. The highest temperature in the nests was 34.4°C and the lowest never fell below 20°C.

Another reason for higher variation between nest and air temperature could be the wind (Fig. 3), which could have had an effect on the thermostat and not on the tiny tag. Another factor for a more constant temperature in the egg chamber is the microclimate provided by the eggs themselves and environmental factors.

The thermal conditions through the 75 days of recording showed that the wind was calm most of the time, except the measurements at 12 o'clock, when the wind was most of the time low (67%). As the wind was not blowing strongly, it should not have had any effect on our nests in Turkey. If the water rises far up the beach due to wind, it can impact reproduction, for example lowering the number of nests and the hatchlings (Pike & Steiner 2007).

Nest data reveal that the nests had a different hatching success (Tab. 1), perhaps reflecting the different positions of the nests (Fig. 1A). Comparing the total number of fertilized eggs and the hatchlings that reached the sea, the respective success rates of the nests were: Y7 65%, Y9 69%, and Y12 42%. Hier kann noch die durchschnittliche hatchsuccessrate eingefügt aus Literatur hinzugefügt werden.

A reason for the low hatching success of Y12 could be the position of the nest. The nest was laid closest to the vegetation. Right behind the nest was lying a forest and to the right hand side (looking at the nest) a shading greenery (fig 1A "high bush") inhibited direct sunlight before midday. Comparing the positions of the nests in fig. 1A, shows that Y12 was positioned directly next to shading vegetation and consequently exposed less to solar radiation (positioned SW). Studies on *Chelonya mydas* and the influence of shading greenery to the nest revealed that it does not have a high impact on the nest. Metabolic heating seems to influence the nest far more (Booth & Astill 2001; Van de Merwe et al. 2006).

The incubation period is correlated with the temperature, and loggerhead sea turtles have an average incubation time of 57 days (Van Piggelen & Strijbosch 1993). Our nests had an incubation time of 55 days (Y7) and 49 days (Y9).

Comparing the distances to the sea between the nests (Fig. 1A & Tab.1), Y9 and 12 show a similar distance of 15.5 m (Y9) and 15.8 m (Y12). Though it is the same distance to the sea, the distance to vegetation varies a lot more. Y12 was laid directly next to the vegetation, and nest Y9 at 12.9 m from the vegetation. The different numbers also reflect the varying width of the beach.

Y7 was dug close to the vegetation (3.8 m) but not influenced by shading greenery and the farthest position from the sea (21.1 m) and yet this nest had the highest hatching success (Tab. 1 & Fig. 4). Maybe the surrounding substrate (lack of big stones/trash/wood in the hatchlings' path) made it easier for the Y7-hatchlings to reach the sea. Note, however, that nest site selection by turtles is influenced by a wide range of selective forces (Pike & Stinger 2007)

Interestingly, nest Y9 needed seven days till the last hatchling emerged from the nest. Hatching in Y7 was completed in five days, which may indicate looser sand or fewer stones blocking the way to the surface (see also Tab. 1). No information is available about the duration of the hatching period of nest Y12.

The daily temperatures measured by the different data logger compared to each other show that Y9 presented a constant and a maximum nest temperature of 31.7°C on several days. No other nest had a similar constant temperature. The highest temperature in nest Y12 was 34 °C. Regarding the fact that this temperature was measured on the day when the logger was taken out of the nest, it could indicate one point of measurement after the logger was taken out of the nest measuring the air temperature. .

All tiny tags show a decrease in temperature down to 12-13 °C because they were put into the refrigerator to clearly show when the measurements ended.

Comparing the mean nest temperatures during the incubation of the nests shows a temperature range of 30-31 °C in all the nests. The mean air temperature is 0.8°C higher than the mean nest temperature. Studies on this topic revealed that the mean incubation temperature during the incubation period lies more likely above 29.0°C throughout the Mediterranean (Godley et al. 2001).

The temperature measurements of the data loggers during the whole incubation time (overlay; Fig. 12) show that nest number 12 (green) is the nest with the lowest temperature during the whole time of incubation (Tab.1). It shows further an in- and decrease in temperature, which

differs from the other nests. Nest 7 and 9 increased in temperature till the highest peak and then steady decreased till the lowest point of measurement.
The substrate in which the nests were laid differs between the three nests. Y12 was positioned in sand what could have made it easier for the hatchlings to find their way to the surface. The hatching success of Y12 still is the lowest but it could have been even lower if the nest would have been dug into substrate, which contained big stones. If the position (nearly in the vegetation) of Y12 influenced the hatching success because of roots growing into the nest is not clear. The shading greenery (fig. 1A "high bush") seems to have influenced the nest a lot.
Y6 was laid close to the vegetation, not behind shading greenery, and into sand mixed with few stones. The substrate, which surrounded the hatchlings of Y9, was sand mixed with stones varying in size. Though it has the highest hatching success.

Concluding, I would like to point out that further studies need to be conducted on this topic and more nests need to be equipped with data loggers to be able to better protect this highly endangered species. Climate changes (global warming) influences the loggerhead female's nesting behavior. The turtles lay there clutches earlier in the season, what shortens the nesting season and is correlated to the sea surface temperature (Pike & Stiner 2007). The temperature determines as well the sex of reptiles (Bull 1980, Hays et al. 2003) and a higher mean nest temperature (>29 °C) could lead to a higher numbers of females (Kaska et al. 1998) As climate change influences the population of the *Caretta caretta* (and all other sea turtles) we need to learn more about the incubation temperatures and the effect on the nest when climate changes.

APPENDIX

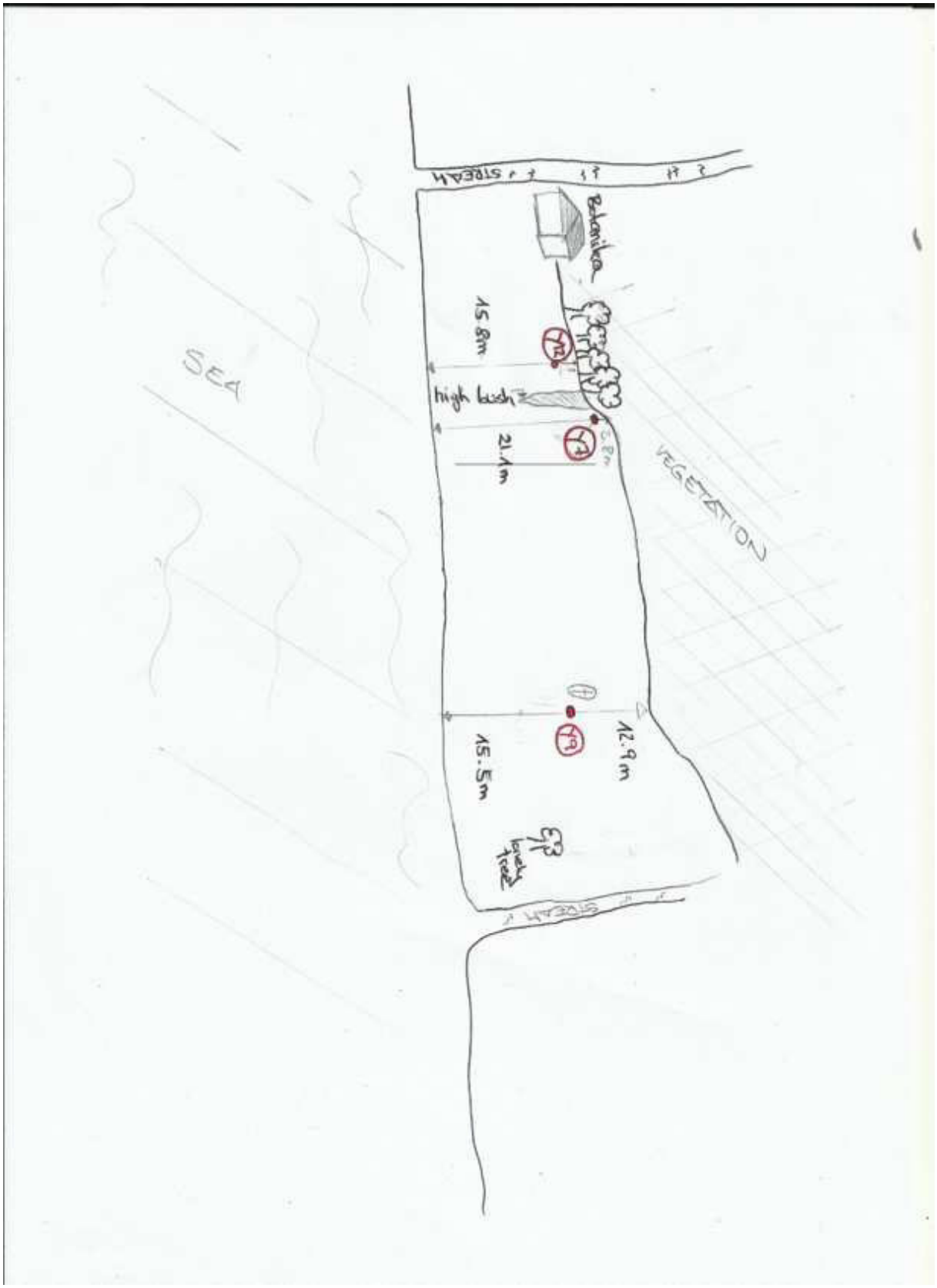


Fig.1A: Position of the nests with the 3 tiny tags on Yanıklar beach.
Fig.. 1A: Position der Nester in Yanıklar mit den 3 Tiny Tags.

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Dead Sea Turtles in Fethiye, Turkey Summer 2013

Lisa Stolzlechner

ABSTRACT

In Mediterranean Sea, loggerhead sea turtles (*Caretta caretta*) and Green sea turtles (*Chelonia mydas*) nest. Both species are endangered according to the IUCN classification. The chief causes for the population's strong decrease are collisions with boats, pollution of the sea, fishing, dredging and blast operations as well as the loss of nesting areas due to constructions on beaches.

In summer of 2013 from June to September, 10 adult, dead sea turtles were found in Fethiye, Çalış, Yanıklar and Ölüdeniz. These included 8 loggerhead sea turtles and 2 Green sea turtles. Photographs of the dead animals were taken along with data concerning found-date/-place, species, sex, size, injuries and presumable causes of death. Some approaches are discussed that should be disseminated and implemented in order to save more sea turtles from human-caused deaths.

ZUSAMMENFASSUNG

Im Mittelmeerraum nisten die Unechte Karettschildkröte (*Caretta caretta*) sowie die Grüne Meeresschildkröte (*Chelonia mydas*). Beide Arten sind von der IUCN als bedroht eingestuft. Die Hauptursachen für den Rückgang der Populationen sind Kollisionen mit Booten, Verschmutzung der Meere, Hochseefischerei, Bagger- und Sprengarbeiten, sowie der Verlust der Nistplätze durch Verbauung.

In den Sommermonaten Juni-September 2013 wurden 10 tote, adulte Meeresschildkröten in Fethiye, Çalış, Yanıklar und Ölüdeniz gefunden. Dabei handelten es sich um 8 Individuen der Art *Caretta caretta* und 2 Individuen der Art *Chelonia mydas*. Die Tiere wurden fotografiert und Daten bezüglich des Funddatums/-orts, der Art, des Geschlechts, der Größe, der Verletzungen und der vermuteten Todesursachen wurden aufgenommen. Zusätzlich wurden Lösungsansätze diskutiert, die im Sinne der Meeresschildkröten verbreitet und durchgeführt werden sollten.

INTRODUCTION

Three species of marine turtle – *Caretta caretta, Chelonia mydas* and *Dermochelys coriacea* – have been reported in Turkish waters (Baran and Kasparek 1989, Baran et al. 1998). Only the first two are known to nest on the Turkish coast of the Mediterranean, whereby a lower number of green sea turtles (*Chelonia mydas*) are nesting in southern turkey.

Loggerhead sea turtles are known for their distinctive large head and powerful jaws. The carapace is slightly heart-shaped and reddish brown in adults. They inhabit tropical to temperate regions worldwide (NOAA – National Oceanic and Atmospheric Administration). Due to the fact that many nesting populations are in decline, loggerheads are a CITES Appendix I species and are listed as endangered by the World Conservation Union (IUCN – International Union for Conservation of Nature, CITES – Convention on International Trade in Endangered Species). Green sea turtles (*Chelonia mydas*) are also globally endangered and the Mediterranean subpopulation has recently been classed as critically endangered (IUCN).

In general sea turtles have to suffer many anthropogenic threats in the open Sea, for example marine pollution, long line and trawl fishery, shipping traffic, especially near the coast (Hutchinson & Simmonds, 1991). Mortality causes are mainly fishing activities such as entanglement in fishing gear but also the swallowing of marine debris like plastic (Tomás et al. 2001), but turtles can also become entangled in gillnets, pund nets and the lines associated with longline (NOAA).

In the following report data about dead sea turtles found in Çalış and Yanıklar beach, Fethiye harbor and Ölüdeniz was processed. Together with students from the University of Pamukkale, students from the University of Vienna collected data of stranded dead Loggerhead and Green sea turtles in summer 2013.

MATERIAL AND METHODS

Çalış

In summer 2013 from the end of May to middle of September shifts were done by Turkish and Austrian students at 6 a.m., 10 p.m. and midnight. 2 to 4 persons walked along the beach to observe whether there are any tracks, adult sea turtles or/and hatchlings. With every shift there was brought a field data booklet, a torch, a measuring tape, a red light, a walkie-talkie, a pencil, a permanent marker, a tape, spare nest signs and ropes for fixation, a metal sand probe, tags and a large wooden caliper. Morning shift's monitoring started from the eastern end of the promenade westwards up to Çalış tepe. Nightshifts ended at the surf café, where a 15 minutes break was taken till it was turned back.

Participants of the team communicated with walkie-talkies when seeing an adult or dead sea turtle. To reduce the attention of the tourists to the animal's measurements and photos had to be taken as quick and inconspicuous as possible. Measurements were done by a wooden caliper for the straight carapace width/length and a measuring tape for the curved carapace width/length (Fig. 1). The Individuals were under examination whether they have any injuries, missing parts, tags or deformations. The age was estimated and the sex determined. All these date were noted in a data sheet (see appendix).

After examination the dead sea turtles were taken by investigations to bury them at an unknown place. Some of them where put into a big plastic bag and carried on with a wheelbarrow for removal from the beach. One autopsy was done (Fig. 2.2).

Fig. 1: Measurements by the wooden caliper for collecting data about the dead sea turtles
Abb. 1: Messungen mit dem Messschieber an einer toten Meeresschildkröte
(Photo by Lisa Stolzlechner).

Yanıklar

In summer 2013 from the beginning of June till middle of September shifts were done by Austrian students only. The luggage that was needed equated the one that was used in Çalış. Two students walked along the beach of Agköl and 2 the beach from the camp to Karataş Beach and back. In the beginning also nightshifts were done. 3 people walked simultaneously along the beach till the so-called "lonely tree". After the nesting season was over, just morning shifts were done.

RESULTS

In summer 2013 8 loggerhead turtles *Caretta caretta* in Göcek, Yanıklar, Fethiye harbor, Çalış and Ölüdeniz and two green sea turtles *Chelonia mydas* in Yanıklar were found. 3 of them supposedly drowned in a fisher net, 1 had a fisher line around its front flipper, 5 had injuries made by a boat propeller, 1 had plastic in its throat and 1 was completely dried car-

cass (just head and right flipper were present). Each sea turtle is described individually below, table 1a and 1b show an overview of the collected data.

1. On 23 June 2013 around 3 pm there was found a loggerhead turtle (*Caretta caretta*) in Göcek, Fethiye (Fig. 2.1, 2.2). It was discovered fresh dead by a fisherman, drowned in a fisher net. According to the tail-length and an autopsy made by Turkish students of the Pamukkale University, this sea turtle was female. The straight carapace measurements were 70 cm long (straight carapace length, SCL) and 55 cm wide (straight carapace width, SCW). The curved carapace measurements were 72 cm in length (curved carapace length, CCL) and 68 cm in width (curved carapace width, CCW). The body did not show any abnormalities or wounds. No tag was found.

2. On 27 June 2013 students found a Loggerhead turtle (*Caretta caretta*) in Yanıklar during a shift (Fig. 3). The sex could not be determined because parts of the sea turtle were missing, so only the head and the right flipper were left. They didn't find a tag and due to the missing parts they couldn't do any measurements.

3. On 28 June 2013 at about 6 pm coast guards found a decomposed Loggerhead turtle (*Caretta caretta)* in the harbor of Fethiye (Fig. 4). According to its tail length it was female. The straight carapace measurements were 72 cm long (straight carapace length, SCL) and 57 cm wide (straight carapace width, SCW). The curved carapace measurements were 74 cm in length (curved carapace length, CCL) and 60 cm in width (curved carapace width, CCW). Parts of the carapace showed damages from a boat propeller. No tag was found.

4. On 30 June 2013 at about 1 pm students found a dried carcass Green turtle (*Chelonia mydas)* in Yanıklar beach (Fig. 5). It was a juvenile turtle; therefore it could not be determined whether it was male or female. The straight carapace measurements were 40 cm long (straight carapace length, SCL) and 35 cm wide (straight carapace width, SCW). The curved carapace measurements were 43 cm in length (curved carapace length, CCL) and 37 cm in width (curved carapace width, CCW). No tag was found.

5. On 17 July 2013 at about 3 pm a washed up decomposed Loggerhead turtle (*Caretta caretta)* was found in front of Sat Beach Restaurant in Çalış beach (Fig. 6). According

to its tail length it was female. The straight carapace measurements were 74 cm long (straight carapace length, SCL) and 58 cm wide (straight carapace width, SCW). The curved carapace measurements were 77 cm in length (curved carapace length, CCL) and 70 cm in width (curved carapace width, CCW). The left flipper was missing, but it is assumed that this happened long time ago. No other injuries found, it supposedly drowned in a fisher net. No tag was found.

6. On 27 July 2013 at about 2 pm a washed up loggerhead turtle (*Caretta caretta)* was found at the beach in Ölüdeniz (Fig. 7). A journalist of the national channel (TRT) has been called to do a report. Its tail was wrapped by a rope for transportation which made it probably longer than it was before. Therefore it could not be determined whether it's male or female. The straight carapace measurements were 73 cm long (straight carapace length, SCL) and 58 cm wide (straight carapace width, SCW). The curved carapace measurements were estimated. It was about 78 cm in length (curved carapace length, CCL) and 73 cm in width (curved carapace width, CCW). There was a fisher line around its left flipper. No tag was found.

7. On 1 August 2013 students found a washed up decomposed loggerhead turtle (*Caretta caretta)* in front of Sat Beach Restaurant in Çalış beach (Fig. 8). According to the tail length it was a male individual. The straight carapace measurements were 76 cm long (straight carapace length, SCL) and 58.3 cm wide (straight carapace width, SCW). The curved carapace measurements were 78 cm in length (curved carapace length, CCL) and 74 cm in width (curved carapace width, CCW). There was an old scarf found on its carapace. It supposedly drowned in a fisher net. No tag was found.

8. On 27 August 2013 students found a washed up decomposed loggerhead turtle (*Caretta caretta)* in front of Lily's Steakhouse in Çalış beach at 3:30 pm (Fig. 9). According to its claws it was supposed to be female. The straight carapace measurements were 60 cm long (straight carapace length, SCL) and 44.6 cm wide (straight carapace width, SCW). The curved carapace measurements were 63 cm in length (curved carapace length, CCL) and 59.5 cm in width (curved carapace width, CCW). Its tail was missing, half left front flipper and both eyes. Beside the missing parts there was found a plastic piece in its esophagus through opening the animal's beak.

9. On 2 September 2013 at 8:45 pm there was found a washed up fresh dead loggerhead turtle (*Caretta caretta)* in Çalış beach (Fig. 10). According to its tail length it was male. No measurements were done due to the fact that its carapace had big damage from a propeller. It was almost cut in half. No tag was found.

10. On 13 September 2013 at 9 am a green sea turtle (*Chelonia mydas*) was washed up in Yanıklar beach (Fig. 11). According to its tail length it was male. The straight carapace measurements were 79 cm long (straight carapace length, SCL) and 62 cm wide (straight carapace width, SCW). The curved carapace measurements were 85 cm in length (curved carapace length, CCL) and 74 cm in width (curved carapace width, CCW). Its condition was partially decomposed and it had cuts on its right side. No tag was found.

Table 1a: Dead adult sea turtles found at Fethiye in summer 2013
Tabelle 1a: Tote adulte Meeresschildkröten gefunden in Fethiye im Sommer 2013

Turtle species	1.Individual *Caretta caretta*	2. Individual *Caretta caretta*	3.Individual Caretta caretta	4.Individual *Chelonia mydas*	5.Individual *Caretta caretta*
Date of find	23.06.13	27.06.13	28.06.13	30.06.13	17.07.13
Site to find	Fethiye, Göcek	Yanıklar beach	Fethiye harbor	Yanıklar beach	Çalış beach
Condition	fresh dead	dried carcass	decomposed	dried carcass	decomposed
Sex	female	undetermined	female	undetermined	female
SCL (cm)	70	/	72	40	74
SCW (cm)	55	/	57	35	58
CCL (cm)	72	/	74	43	77
CCW (cm)	68	/	60	37	70
Injuries	/	just head and right flipper present	propeller damage	/	left front flipper missing
Possible cause of death	drowned; found dead in fisher net	/	/	/	drowned in fisher net

Table 1b: Dead adult sea turtles found at Fethiye in summer 2013
Tabelle 1b: Tote adulte Meeresschildkröten gefunden in Fethiye im Sommer 2013

Turtle Species	6.Individual *Caretta caretta*	7.Individual *Caretta caretta*	8.Individual *Caretta caretta*	9.Individual *Caretta caretta*	10. Individual *Chelonia mydas*
date of find	27.07.13	01.08.13	27.08.13	02.09.13	13.09.13
Site to find	Ölüdeniz beach	Çalış beach	Çalış beach	Çalış beach	Yanıklar beach
Condition	fresh dead	decomposed	decomposed	fresh dead	decomposed
Sex	undetermined	male	female	male	male
SCL (cm)	73	76	60	/	79
SCW (cm)	58	58.3	44.6	/	62
CCL (cm)	(78)*	78	63	/	85
CCW (cm)	(73)*	74	59.5	/	74
Injuries	fisher line around its left flipper	cut on carapace (seems to be old)	tail, eyes and half left front flipper missing; a piece of plastic in pharynx	propeller damage, carapace almost cut in half	cut on right side
Cause of death	/	drowned in fisher net	/	/	/

DISCUSSION

In summer 2013 participants of the sea turtle course in Fethiye, Turkey found 10 dead sea turtles. This is the highest number of sea turtle strandings during the last 14 years (Table 2.).

Our findings of dead or severely injured sea turtles in the last 14 years represent a minimum estimate. We assume a much higher number of unreported cases. 7 of the 10 sea turtles died ongoing human impacts on them along the coastline of Fethiye. 3 of them were found drowned in fisher nets and 4 of them had ship-propeller damages (these injuries could have also happened after the death of the sea turtle).

Lewison et al. (2004) estimated that 60,000- 80,000 loggerheads are caught in the Mediterranean based on by-catch data. Trammel nets, which are deployed in depths between 50 m and 100 m, also contribute to the by-catch of turtles (Carreras et al. 2004). Captured sea turtles may drown, first becoming comatose and eventually dying.

There are strategies that allow sea turtles survival. Comatose turtles cannot swim and are often thrown back into the sea in this condition. Keeping them on board for some time may be one strategy to allow them to recover (Casale et al. 2004).

According to the high number of sea turtles, which died or got injuries because of a ship propeller, the solution would be to construct a version that prevents sea turtles from swimming into the ship propeller.

Pollution is another dangerous threat for the sea turtles. One turtle was found with plastic in the pharynx (Tab. 1). Over 20% of loggerhead turtles examined at Malta for instance were

contaminated with plastic or metal litter and hydrocarbons. The nature of the contamination suggests that the number of sea turtles suffering from pollution is certainly higher (Gramentz D. 1988).

In summary it can be said, that there are possible solutions for some dangers induced by humans. This information needs to be spread and brought to tourists and fishermen in the main affecting area to use sea turtle friendly fishing nets and to not through plastic into the sea.

Tab. 2: Dead and severely injured adult turtles found in Çalis (C), Yanıklar (Y) and Ölüdeniz during the last 13 years (CC = *Caretta caretta*, CM = *Chelonia mydas*, TT = *Trionyx tringuis*, f = female, m = male, n.d. = not determined, a = adult, j = juvenile)
Tab. 2: Tote Schildkröten gefunden in Çalis (C), Yanıklar (Y) und Ölüdeniz in den letzten 12 Jahren (CC = *Caretta caretta*, CM = *Chelonia mydas*, TT = *Trionyx tringuis*, f = weiblich, m = männlich, n.d. = nicht aufgenommen, a = adult, j = juvenil)

Year	Species	Site of find	Date of find	Sex	Age	Injuries	Probable cause of death
2000	CC	F	31.07.-31.08.	f	a	still alive with injuries of the head	injured by a blunt object
2001	CC	C	n.d.	f	a	swallowed fish hook	fish hook
2002	CC	F	n.d.	n.d.	n.d.	very decomposed, age and sex unknown	n.d.
2003	CC	Y	04.09.	m	n.d.	decomposed and gnawed, especially in the skull area	n.d.
	CM	F	n.d.	f	n.d.	bursted carapace; broken flipper	ship propeller
2004	CM	C	24.08.	m	j	small right hind limb; raw parts of bottom slide of throat	caught up in a fisherman's net, drowned
	CC	F	end of June	n.d.	n.d.	carapace torn open	ship propeller
2005	no dead turtles recorded						
2006	CC	C	June	f	a	right hind limb missing, perhaps hereditary	n.d.
	CC	C	19.08.	f	a	front extremity and eye missing	n.d.
	CC	C	25.08.	n.d.	n.d.	back part of body missing	n.d.
	CC	Y	July	m	n.d.	head and body skeletonized, hole in skull	ship propeller
	CM	C	September	f	j	one eye missing	n.d.
	TT	C	August	n.d.	n.d.	no external injuries	n.d.

Tab. 2: Dead and severely injured adult turtles found in Çalis (C), Yanıklar (Y) and Ölüdeniz during the last 13 years (CC = *Caretta caretta*, CM = *Chelonia mydas*, TT = *Trionyx tringuis*, f = female, m = male, n.d. = not determined, a = adult, j = juvenile)
Tab. 2: Tote Schildkröten gefunden in Çalis (C), Yanıklar (Y) und Ölüdeniz in den letzten 12 Jahren (CC = *Caretta caretta*, CM = *Chelonia mydas*, TT = *Trionyx tringuis*, f = weiblich, m = männlich, n.d. = nicht aufgenommen, a = adult, j = juvenil)

Year	Species	Site of find	Date of find	Sex	Age	Injuries	Probable cause of death
2007	CC	C	07.08.	m	a	head injuries, decomposed	maybe collision with boat
	CM	C	05.08.	f	j	head injuries; parts of the flipper missing	maybe killed by a human
	CM	C	02.09.	f	j	carapace torn open, injury extending down to the plastron	ship propeller
	CM	F	04.09.	m	a	still alive! No external injuries; unable to dive	alive
2008	CC	Y	02.07.	m	n.d.	scars on top of head, cut on the side of the body, carapace damaged	maybe boat accident
	CC	C	04.07.	f	n.d.	n.d.	n.d.
	CC	C	15.07.	m	n.d.	fishing line around neck, 80% of carapace missing	n.d.
	CC	F	30.07.	n.d.	n.d.	n.d.	n.d.
2009	CC	C	04.08.	f	a	left flipper entangled with a fishing net, fishing hook	n.d.
	CM	C	05.08.	f	n.d.	n.d.	n.d.
2010	CC	Y	21.07.	f	a	decomposed	maybe strike on the head
	TT	C	16.08.	n.d.	n.d.	hole in the carapace	ship propeller
2011	CC	C	24.07.	n.d.	a	decomposed, cuttings on carapace, head, three flippers and tail missing	boat collision
	CC	Y	27.07.	n.d.	a	hole in the carapace, head missing	maybe strike on the head
	TT	C	June	n.d.	n.d.	decomposed, carapace injuries	n.d.
2012	CC	Y	03.07.	n.d.	j	decomposed, smashed head, holes in bones	maybe killed by a human
	CC	F	03.07.	m	j	swallowed fish hook	fish hook, drowned
	CC	F	09.07.	f	j	swallowed plastic bag	plastic bag, starvation
	CC	C	12.07.	f	j	swallowed plastic bag	plastic bag, starvation
2013	CC	F	23.06.	f	a	n.d.	Drowned in fisher net
	CC	Y	27.06.	n.d.	n.d.	head and right flipper left	n.d.
	CC	F	28.06	f	a	propeller damage	ship propeller
	CM	Y	30.06.	n.d.	j	n.d.	n.d.
	CC	C	17.07	f	a	Left flipper was missing	Drowned in fisher net
	CC	Ö	27.07.	n.d.	a	Fisherline was around its left flipper	n.d.

Tab. 2: Dead and severely injured adult turtles found in Çalis (C), Yanıklar (Y) and Ölüdeniz during the last 13 years (CC = *Caretta caretta*, CM = *Chelonia mydas*, TT = Trionyx tringuis, f = female, m = male, n.d. = not determined, a = adult, j = juvenile)
Tab. 2: Tote Schildkröten gefunden in Çalis (C), Yanıklar (Y) und Ölüdeniz in den letzten 12 Jahren (CC = *Caretta caretta*, CM = *Chelonia mydas*, TT = *Trionyx tringuis*, f = weiblich, m = männlich, n.d. = nicht aufgenommen, a = adult, j = juvenil)

Year	Species	Site of find	Date of find	Sex	Age	Injuries	Probable cause of death
2013	CC	C	01.08.	m	a	cut on carapace	drowned in fisher net
	CC	C	27.08.	f	j	decomposed, tail, eyes and half left front flipper were missing; piece of plastic in pharynx	n.d.
	CC	C	02.09.	m	n.d.	propeller damage, carapace was almost cut in half	ship propeller
	CM	Y	13.09.	m	a	cut on right side	ship propeller

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APPENDIX

Fig. 2.1: Carapace view of a stranded female Loggerhead sea turtle (*Caretta caretta*) in Fethiye (Photo by Musa Azmaz).
Abb. 1.1: Carapax Ansicht der gestrandeten weiblichen Unechten Karettschildkröte (*Caretta caretta*) in Fethiye.

Fig. 2.2: Autopsy of a stranded female Loggerhead sea turtle (*Caretta caretta*) in Fethiye (Photo by Musa Azmaz).
Abb. 1.2: Autopsie einer gestrandeten weiblichen Unechten Karettschildkröte (*Caretta caretta*) in Fethiye.

Fig. 3: Dried carcass of a Loggerhead sea turtle (*Caretta caretta*) on Yanıklar beach, Fethiye where just head and right flipper were left (Photos by Eyup Baskale).
Abb. 3: Der getrocknete Tierkörper einer Unechten Karettschildkröte (*Caretta caretta*) am Strand von Yanıklar, bei Fethiye, nur der Kopf und der rechter Flipper waren vorhanden.

Fig. 4: View of a decomposed stranded female Loggerhead sea turtle (*Caretta caretta*) with a ship propeller damage in Fethiye harbor (Photos by Eyup Baskale).
Abb. 4: Carapax Ansicht der zersetzten, gestrandeten weiblichen Unechten Karettschildkröte (*Caretta caretta*) mit einer Schiffsschraubenverletzung im Hafen von Fethiye.

Fig. 5: View of a dried carcass Green sea turtle (*Chelonia mydas*) with a ship propeller damage found in Yanıklar beach (Photos by Eyup Baskale).
Abb. 5: Ansicht einer Grünen Meeresschildkröte (*Chelonia mydas*) (bereits vertrocknet) mit einer Schiffsschraubenverletzung am Strand in Yanıklar.

Fig. 6: View of a stranded female Loggerhead sea turtle (*Caretta caretta*) in Fethiye, left, front flipper was missing (Photos by Musa Azmaz).
Abb. 6: Ansicht der gestrandeten weiblichen Unechten
Karettschildkröte (*Caretta caretta*) in Fethiye, linke Vorderflosse fehlte.

Fig. 7: View of a stranded loggerhead sea turtle (*Caretta caretta*) found in Ölüdeniz, its sex was undetermined (Photo by Mustafa Uslan). Abb. 7: Ansicht einer gestrandeten Karettschildkröte (*Caretta caretta*), die in Ölüdeniz gefunden wurde, das Geschlecht ist unbestimmt.

Fig. 8: View of an adult partially decomposed male loggerhead sea turtle (*Caretta caretta*), which was found in Çalış beach (Photos by Musa Azmaz).
Abb. 8: Ansicht einer adulten, teilweise zersetzten männlichen Karettschildkröte (*Caretta caretta*), die am Strand in Çalış gefunden wurde.

Fig. 9: View of a decomposed, female Loggerhead sea turtle (*Caretta caretta*) found in Çalış beach with a piece of plastic in its pharynx (Photos taken by Lisa Stolzlechner, Musa Azmaz).
Abb. 9: Ansicht einer zersetzten, weiblichen Karettschildkröte (*Caretta caretta*), gefunden am Strand in Çalış mit einem Stück Plastik in ihrem Pharynx.

Fig. 10: View of a decomposed male Green sea turtle (*Chelonia mydas*) that had cuts on its right side and was found in Yanıklar beach (Photo by Michael Stachowitsch).
Abb. 10: Ansicht einer zersetzten männlichen Grünen Meereschildkörte (*Chelonia mydas*), gefunden wurde sie am Strand in Yanıklar und hatte Schnitte and der rechten Seite.

Bachelor Thesis

Light pollution along the beach promenade in Çalış, Fethiye, Turkey

Lichtverschmutzung an der Strandpromenade in Çalış, Fethiye, Türkei

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KURZFASSUNG

Der Strand in Çalış entlang der Promenade war auch dieses Jahr (2013) sehr stark von künstlichem Licht belastet. Grund für diese extreme Lichtverschmutzung ist der durch den Tourismus stark entwickelte Ausbau von Lokalitäten, Hotels und Restaurants. Ein Großteil der Lokalitäten versuchte mit Hilfe dekorativer Beleuchtung, wie zum Beispiel große Menü-Schilder oder bunten Lichtern, Aufmerksamkeit zu erregen. In diesem stark vom Menschen beeinflussten Gebiet, wird die Unechte Karettschildkröte (*Caretta caretta*), welche den Strand in Çalış als Nistgebiet verwendet, vollkommen außer Acht gelassen. Künstliches Licht ist für Meeresschildkröten eine starke Störungsquelle, da es das natürliche Verhalten der nistenden Schildkröten und Hatchlinge stark beeinträchtigt. Es wurden alle Lichter, welche den Strand entlang der Promenade beleuchten, gezählt. Ein Lux-Meter ermittelte die Lichtintensität jedes Standortes. Danach folgte ein anschließender Vergleich der gewonnen Daten, mit den Daten aus den vorigen Jahren. Aus den insgesamt 946 gezählten Lichtquellen, ergab sich ein Mittelwert von 15.4 lux um 22:00 und 12.4 lux um 00:30. Dies bedeutet einen Anstieg der Lichtintensität entlang der Promenade im Vergleich zum letzten Jahr, wobei die Anzahl der gemessenen Lichter abgenommen hat. Den höchsten Lux Wert erreichte ein Tourismus Informationsstand mit 49.5 lux um 22:00 und 44.5 lux nach Mitternacht. Nach 00:30 wurden die meisten Lichter im hinteren, westlichen Teil der Promenade abgedreht. 22 Nester wurden entlang der Promenade gefunden, wobei die größte Anzahl sich im dunkleren nördlichen Ende befand. Um der Lichtverschmutzung in Çalış entgegenzuwirken, erfolgte eine Erarbeitung von Strategien und Lösungen zur Reduktion des künstlichen Lichtes.

ABSTRACT

The beach of Çalış is a Special Protected Area because it is an important nesting area of the endangered loggerhead sea turtle (*Caretta caretta*). In summer, many tourists spend their vacation here. To accommodate the tourists, the local community built hotels, bars and restaurants directly along the promenade. These shine light on the adjoining beach and can disrupt loggerhead sea turtle nesting and hatching. The light pollution in this area represents a well-known threat for the sea turtles. Therefore the artificial lights should be reduced and new management plans should be created to decrease the disturbance and disorientation problem for adult turtles and hatchlings. In the natural ecosystem the reflecting light of the moon and stars on the sea is the only light orientation for the sea turtles, but with human activities this situation has changed.

This study compares the light pollution situation from 2005 to 2013 and especially the light intensity compared to 2012. For this research all artificial light sources on the promenade of Çalış were counted and lux measurements were performed at different parts of the beach and at different times of the night. Moreover, I examine the artificial lights near the nests in front of the promenade. 946 lights were counted along the promenade, which means a decrease in light numbers compared to 2012, but the mean light intensity increased (15.4 lux at 22:00, and 12.4 lux at 00.30). The highest values were measured at a tourism stand (49.4 lux at 22:00 and 45.4 at 00:30). The brightest sections of the promenade were at the eastern end. There, most of the lights remained turned on until late at night. 22 nests were laid along the promenade part of the beach, whereby dark areas were preferred.

Several strategies are presented to decrease the light pollution in Çalış and improve the situation of the loggerhead turtles.

INTRODUCTION

In the past century artificial night lighting has increased drastically. Artificial night lighting affects the biology and ecology of wild animals. Two terms are available to describe light pollution. The first has its origins in astronomy, where it is described as the light which shades the view of night sky. The second is the ecological light pollution, which depicts the alteration of natural lighting due to anthropogenic influences such as artificial light sources (Longcare and Rich 2004).

The monitored area in Çalış is extremely light polluted. The coastal development in Çalış has led to an increasing beach development combined with light pollution due to rising tourism. Çalış Beach and especially the beach promenade are highly frequented by tourists in summer. A wide range of hotels, bars and shops are present which are highly illuminated and irradiate the 1.5-km-long section of the beach. This area is a Special Protected Area based on its role as an important nesting rookery of the loggerhead sea turtle (*Caretta caretta*). Female nesting turtles here face negative impacts such as light pollution and disruptions due to passing tourists. Artificial light sources at night affect the choice of nesting sites and hatchling orientation (Salmon 2006). Generally, nest densities are lower at beaches that are highly illuminated with artificial light (Salmon 2006).

In 1992 a group of scientists around Witherington performed experiments with loggerhead sea turtles in Florida and green turtles in Costa Rica. There they irradiated a beach with mercury vapour lights. Normally the monitored beach is an attractive nesting site for sea turtles. The

numbers of nesting success and nesting attempts decline when the light was turned on. Next they illuminated the beach with yellow light from low pressure sodium vapour lamps. In this situation the nesting efforts and nesting results changed to normal conditions (Salmon 2006). Loggerhead turtles, similar to most of the other sea turtle species, deposit their eggs in the sand at night. The females nest at night due to lower sand temperatures and lower risks of being attacked by terrestrial predators (Witherington 1996). Witherington (1996) suggested that artificial lighting hinder female sea turtles from entering the beach for egg deposition. The exact reason for this is not known. One explanation is that artificial light sources could indicate "daylight" and subdue nocturnal behaviour. If the turtle enters the beach it selects an adequate location for laying its eggs into the sand. An appropriate nesting site should fulfil the following criteria (Wood and Björndal 2000): low sand temperatures, specific substrate content and specific slope conditions. When finishing egg deposition an adult sea turtle has serious problems with strong artificial light sources because after egg deposition the turtle orients itself to sea and returns there. Various experiments have been conducted with blindfolded adult green turtles (Ehrenfeld and Corr 1967, Ehrenfeld 1968) and with immature green turtles (Caldwell and Cadwell 1962). They all indicate that sea turtles use visual cues to find their way back to the ocean (Salmon 2006). Moreover, lighted-beach experiments by Witherington (1992) showed that sea turtles were disorientated by artificial lighting. But not all turtles wandered for hours along the beach to find the sea.

Importantly, artificial light at night disturbs not only adult sea turtle but also the orientation of hatchlings emerging from the sand (Salmon 2006). That author distinguished 2 different types of hatchlings with such orientation problems. There exist two forms of misorientation along hatchlings. A "disorientated" hatchling crawls in circular paths away from the nest because it cannot detect the right direction to the sea. In contrast a "misorientated" hatchling moves straight in the direction of the closest artificial light source (Salmon 1995). "Disorientated" or "misorientated" hatchlings have reduced chances of survival (Witherington and Martin 1996). "Misorientated" hatchlings often die from exhaustion and dehydration or are eaten by predators. "Disorientated" hatchlings can ultimately find the sea but often lose much of their yolk energy, which is needed to swim offshore (Salmon 2006). Hatchlings are apparently even more influenced by artificial lighting than adults are (Salmon 2006). Furthermore, hatchlings orientate within the "cone of acceptance": it is about 180 ° wide horizontally and -10° up to 30° wide vertically (Lohmann et al. 1997). Normally, hatchlings move towards the brightest light source, which should be – without any anthropogenic stress factor – the bright horizon of the sea which reflects moon and stars (Witherington 1992).

After a wide range of experiments and documentations, Witherington and Martin (1996) presented some clever strategies to protect sea turtles from artificial lighting. The easiest alternative is reducing the light intensities by using lower wattage, or turning off the problem lights, during the nesting period. Also, low pressure sodium vapour lights show great potential: they irradiate long-wavelengths such as yellow light, which is indifferent for adult sea turtles, especially for loggerhead sea turtles. It turned out that sea turtles, especially hatchlings, are extremely attracted by artificial lights irradiating short wavelengths, such as violet, blue and green lights. Therefore scientists and sea turtle activists designed streetlight filters (Salmon 2006). These filters permit only the transmission of the less disturbing longer wavelengths. Salmon (2006) elaborated more strategies to decrease light pollution: planting higher dune vegetation or enhancing the vegetation. Accordingly, higher dune profiles should be constructed and beach promenade lights should be equipped with shields to restrict the irradiated area. Installing light timers and motion sensors would improve the situation for nesting turtles and emerging hatchlings. Generally, one should use BAT (better alternative technology), as Witherington noted in his paper of 1996.

The following study deals with the conservation and protection of the loggerhead sea turtle in the Mediterranean Sea. It reflects the strong tourism influence on the whole ecosystem. Importantly, tourists should be more informed about this serious issue. A small rethinking could save the lives of many endangered sea turtles.

MATERIALS AND METHODS

The monitored area was the extremely light-polluted beach promenade in Çalış. The light measurements started on the eastern end of the promenade and extended from the restaurant/bar Türkü Cadiri to Caretta Beach Club, which is the last section of the promenade. Altogether the monitored area is 1.5 km long. The measured values were allocated to a promenade section and each section corresponded with one building, e.g. a hotel, restaurant or bar. On 14 July 2013 the first documentation of light pollution in Çalış was performed and on 17 July 2013 the second measurements were made. The data collecting time was from 22:00 to 24:00 and from 00:30 to 2:30. The first measurement (22:00) represents the time when most of the lights were already turned on. The second measurement (00:30) is related to the time at which nearly all lights are turned off or reduced. To quantify the number of all artificial light sources and also the light intensity at each section, two different methods were used. To quantify the total number of light sources on the promenade, all visible lights which

irradiated the beach were counted. A lux-meter (Gossen Mavolux digital) was used to determine the light intensity on the beach promenade. The position of the nests along the promenade was detected by using the nest plan of 2013. Additional measurements in front of the nests were taken to identify potential correlations between light intensity and nesting locations. This evaluation was also made twice (measurement 1 about 22:00 and measurement 2 about 00:30). To determine the background light provided by the moon and stars, an evaluation on 22 July was made in Yaniklar, which is the neighbouring beach and also a *Caretta caretta* nesting site. For every section the illumination data were quantified in an about 6 m wide area measured from the promenade edge towards the restaurants.The numbers of lights and light intensity at each section of the beach promenade were compared with the data of 2011 and 2012. For this purpose, a photo catalogue from 2011 was used. A new catalogue was created by taking pictures of each building on the beach promenade. The photos were taken during the first data collection (22:00) (with Nikon Coolpix S210 camera).

2005 was the first year in which the numbers of artificial light sources along the promenade were quantified. 2012 was the first time when the lights were correlated with the light intensity as measured by a lux-meter. All collected light values were entered in Excel to create tables and graphics which portray the situation of Çalış light pollution over the years in detail. In general the numbers of lights do not optimally portray the total light intensity; for this reason lux-measurements are very important to correctly depict the situation. Moreover, to demonstrate some strategies to reduce the light pollution in Çalış, illustrations of sea turtle-friendly-lights were designed with the software Paint.

RESULTS

In 2013, 83 sections – corresponding to every building along the promenade – were counted (table 1) Compared to the last year a slight increase in the numbers of buildings was observed (+16). The measured lux data reached a maximum brightness at the Serkul Tourism stand (section 60) and its minimum of 2.5 lux at the Caretta Info desk. In the former, 49.9 lux (at 22:00) and 44.5 lux (at 00:30) were measured. Last year's maximum brightness (57 lux at ice cream p. simsek) exceeded this year's peak value. Furthermore the total number of lights declined from 1013 to 946 (fig. 1) but the mean value of the light intensity of all buildings increased (fig. 3).

Table1: Comparison of the total light numbers and lux measurements for each section at 22:00 and 00:30 along the promenade of Çalış from 2011 to 2013.(n.d. no data)

Tabelle1: Vergleich der gezählten Lichter und Lux-Werten um 22:00 und um 00:30, entlang der Strand Promenade in Çalış von 2011 bis 2013 (n.d..keine Daten vorhanden)

section	location	2013 lux 22:00	2013 lights 22:00	2013 lux 00:30	2013 lights 00:30	2012 lux 22:00	2012 lights 22:00	2011 lights
1	Türk Cadiri	12.4	14	8.6	14	n.d.	0	n.d.
2	ice cream palour	9.0	4	5.2	4	20	4	n.d
3	Haslam misir 1	11.4	3	9.2	3	11	3	n.d.
4	Locmaci pilav (corn)	9.5	2	2.4	0	0	0	n.d.
5	haslam misir 2	10.3	3	1.8	0	7	3	n.d.
6	Mutlu	15.5	8	8.8	0	11	0	n.d.
7	Rest.Mutlu	12.4	4	8.8	8	14	29	n.d
8	Mutlu air hockey	7.8	3	5.9	5	0	0	n.d.
9	House	4.0	4	2.0	1	3	4	n.d.
10	jewelry shop	6.0	4	1.6	0	5	5	3
11	Hamsi Cafe	3.5	16	1.9	7	2	18	n.d.
12	Manas Park	7.9	8	2.8	4	3	8	n.d.
13	Manas Park lounge	3.6	11	1.9	4	7	14	n.d.
14	Anna Bar	8.1	35	4.1	6	9	40	n.d.
15	ice cream p.2	30.0	8	6.1	3	52	8	n.d
16	Deniz Beach	21.0	10	2.4	4	16	6	n.d.
17	Hotel Simsek	12.5	13	7.5	0	20	16	n.d.
18	ice cream p.simsek	45.7	4	35.0	4	57	4	n.d.
19	Hotel Berlin	26.4	4	5.3	0	13	6	n.d
20	Hotel Eröz	10.5	15	1.5	0	9	16	n.d.
21	Gül Market	10.2	5	3.9	4	0	0	n.d.
22	Kassaba	12.8	11	2.0	0	6	20	n.d.
23	Bella Mama	10.4	22	1.4	1	10	25	n.d.
24	Turkish Chinese	13.3	22	2.9	0	12	27	n.d.
25	Vojo	18.9	9	15.0	10	14	11	n.d.
26	Eylül Optik	17.2	17	7.9	1	12	17	n.d.

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Tabelle1: Vergleich der gezählten Lichter und Lux-Werten um 22:00 und um 00:30, entlang der Strand Promenade in Çalış von 2011 bis 2013 (n.d..keine Daten vorhanden)

section	location	2013 lux 22:00	2013 lights 22:00	2013 lux 00:30	2013 lights 00:30	2012 lux 22:00	2012 lights 22:00	2011 lights
27	Orient Express	13.5	13	8.9	5	18	17	n.d.
28	Nil Restaurant	12.3	9	5.4	8	10	15	n.d.
29	Azurtek properties	9.7	10	3.0	2	0	0	n.d.
30	Bambu	8.8	11	6.2	1	13	15	n.d.
31	Bambu Rest./Bar	14.0	26	6.4	1	6	25	n.d
32	Cafe Soul	21.4	17	3.4	20	33	18	n.d.
33	Intersky Travel	11.2	4	2.0	1	41	11	8
34	La Casa	16.7	28	5.6	0	15	26	8
35	Red Tatoo	24.5	10	1.4	0	32	24	22
36	Souvenirs	33.3	22	1.6	0	26	22	22
37	Seaside Travel	35.1	22	2.9	1	26	18	18
38	Serkul 1	32.0	38	2.7	0	27	34	17
39	Serkul 2	34.0	38	18.1	2	18	33	21
40	Georges	23.6	22	9.0	2	14	18	16
41	Eyna	15.0	4	4.2	2	11	10	18
42	The Palms Beach	18.2	19	2.5	4	15	23	23
43	Turkish Bazar	41.5	9	4.8	n.d.	29	13	13
44	Focus Travel	40.3	16	33.5	7	21	13	17
45	Taxi Office	33.0	10	26.8	3	28	4	2
46	Cafe Green	21.5	7	5.0	0	20	10	n.d.
47	Çalış Bazar	20.9	5	2.1	0	19	15	17
48	Döner shop	23.3	4	1.3	0	0	0	n.d.
49	Lezzet Bahcesi	27.5	7	1.3	0	19	15	n.d.
50	Glassformer	10.0	3	0	0	5	2	n.d.
51	Mado	25.0	12	1.5	0	21	10	17
52	Painter	6.0	2	0	0	6	2	2
53	Sevda (corn)	23.3	4	0	0	0	0	n.d.
54	waffle shop	9.6	4	4.9	3	0	0	n.d.

Table1: Comparison of the total light numbers and lux measurements for each section at 22:00 and 00:30 along the promenade of Çalış from 2011 to 2013.(n.d. no data)

Tabelle1: Vergleich der gezählten Lichter und Lux-Werten um 22:00 und um 00:30, entlang der Strand Promenade in Çalış von 2011 bis 2013 (n.d..keine Daten vorhanden)

section	location	2013 lux 22:00	2013 lights 22:00	2013 lux 00:30	2013 lights 00:30	2012 lux 22:00	2012 lights 22:00	2011 lights
55	Lighthouse	6.8	17	6.1	5	3	15	15
56	Okyanus	6.7	5	4.6	4	5	15	15
57	Info Travel	18.5	8	16.8	4	12	7	7
58	1905 Pub	5.1	17	3.0	11	4	22	17
59	Rose Cafe&Rest.	8.2	23	2.0	0	6	19	19
60	Senkul Tourism	49.9	7	44.5	7	25	4	n.d.
61	la Testi	26.3	7	9.8	0	22	7	7
62	Merhaba	20.3	7	1.2	0	20	10	14
63	Clothing shop	16.9	20	1.2	0	16	20	20
64	Lilys Steak House	8.9	4	1.1	0	15	15	15
65	Çalış Beach Restaurant	21.4	7	1.5	0	6	12	n.d.
66	Günes Hotel &. Sunset Steakhouse	18.2	9	1.4	1	11	17	17
67	Günes Clothing	19.0	7	1.3	0	25	10	10
68	Günes Market	11.9	6	1.3	0	19	10	12
69	Tourist Info	13.5	6	1.3	0	0	0	n.d.
70	Sanat Kosesi	6.9	10	1.3	0	9	7	7
71	Sim Bar	5.9	10	1.4	0	4	23	23
72	Caretta Info Desk	2.5	2	1.2	0	1	2	3
73	Keyif Cafe	4.8	8	1.0	0	2	11	11
74	Paschas 1	4.6	8	1.0	0	0	8	11
75	Maya	3.3	8	1.2	0	0	11	8
76	Lees	4.1	6	1.2	4	1	8	n.d.
77	Hotel Ceren	7.5	15	1.5	0	2	16	25
78	Turkuaz Market	4.5	6	1.3	0	3	6	7
79	Hotel Yasmin	5.0	4	1.9	2	8	10	11
80	Bahame	8.2	4	3.6	7	8	13	8
81	Malhun Hotel	6.6	5	1.0	0	5	8	17

Table1: Comparison of the total light numbers and lux measurements for each section at 22:00 and 00:30 along the promenade of Çalış from 2011 to 2013.(n.d. no data)

Tabelle1: Vergleich der gezählten Lichter und Lux-Werten um 22:00 und um 00:30, entlang der Strand Promenade in Çalış von 2011 bis 2013 (n.d..keine Daten vorhanden)

section	location	2013 lux 22:00	2013 lights 22:00	2013 lux 00:30	2013 lights 00:30	2012 lux 22:00	2012 lights 22:00	2011 lights
82	Hotel Letoon	6.1	25	1.7	1	6	44	32
83	Caretta Beach Club	5.2	50	1.2	0	8	61	n.d.

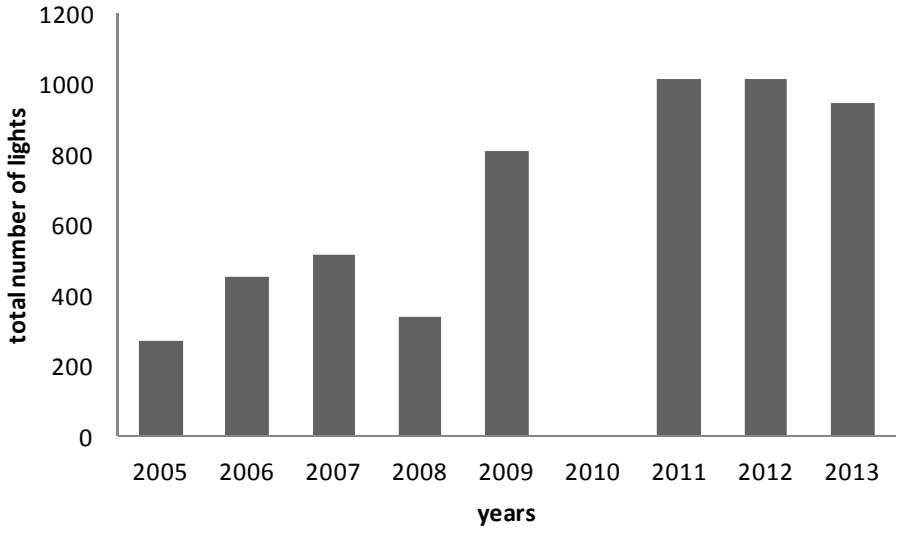

Figure 1: Trend in the total numbers of lights from 2005 to 2013 (2010, no data).

Abbildung 1: Verlauf der gezählten Lichter von 2005 bis 2013. (2010 keine Daten vorhanden)

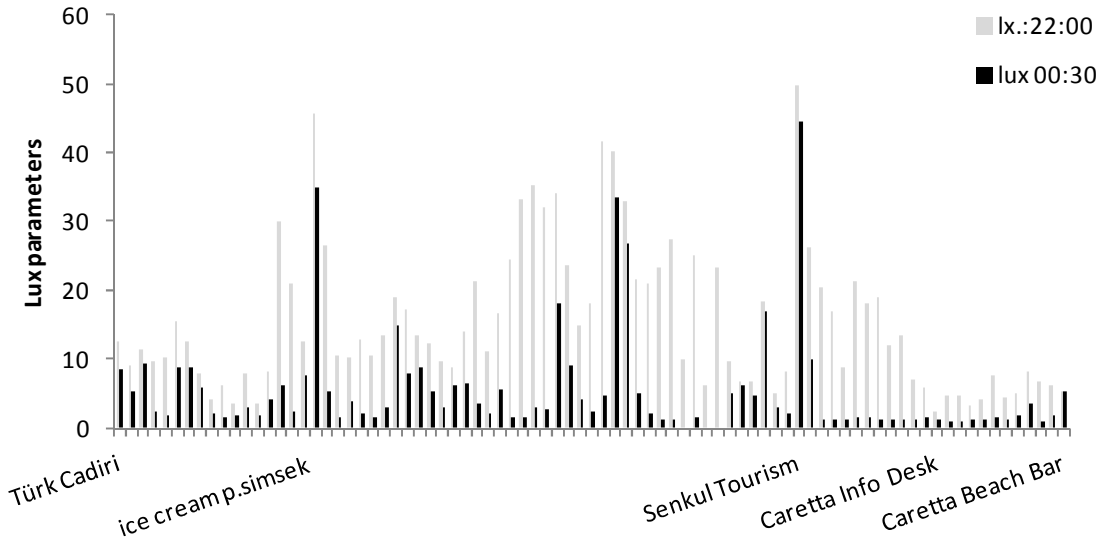

Figure 2: Lux values for each section of the promenade (from the east to the west) starting at Türkü Cadiri on the left and ending with Caretta Beach Club on the right. Grey bars: lux measured at 22:00; Black bars: lux measured at 00:30.

Abbildung 2: Gemessene Lux- Werte entlang der Promenade (vom östlichen bis zum westlichen Punkt). Anfangspunkt bei Türkü Cadiri (links), Endpunkt bei Caretta Beach Club (rechts). Graue Säulen: Lux Werte um 22:00, Schwarze Säulen, Lux Werte um 00:30

Figure 2 shows the situation of the light intensity along the Çalış promenade from the east (left) starting with Türkü Cadiri to the west (right). In the middle of the graph, the overall light intensity is higher, whereas at the left and right parts the light intensity decreases. Generally the values sink after 00:30, which correlates with the fact that most of the lights are turned off after midnight. Under natural conditions without any influence of artificial light, the irradiation of moonlight (full moon) is 0.2 lux (Posch et al 2009).In contrast the light intensity of full moon measured in Yaniklar at 22:45 (22 July 2013) was 0.5 lux, which exceeds the natural irradiation of the moon about more than double.

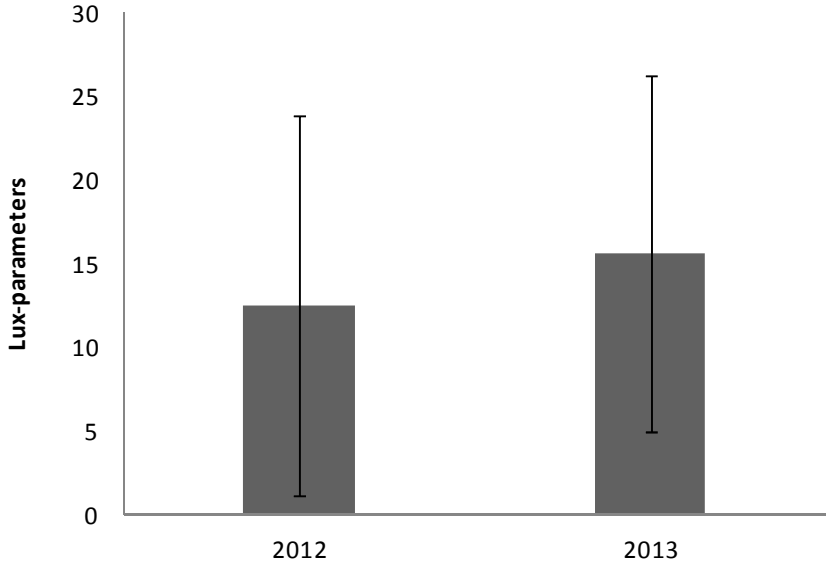

Figure 3: Mean value and standard deviation (SD), of the lux measurements at 22:00 from 2012(n=74) and 2013(n=83).

Abbildung 3: Durchschnittswert und Standardabweichung(SD), der Lux Messungen um 22:00 von 2012 (n=74) und 2013(n=83).

Table 2: Lux values at 22:00 and 00:30 at the nests along the promenade in Çalış vs. the data of 2012. (n.d.: no data)

Tabelle 2: Lux Werte, um 22:00 und 00:30 der Nestern, entlang der Promenade von Çalış.(n.d.: keine Daten)

Location	**nests 2013**	**Lux 22:00**	**Lux 00:30**
Türk Cadiri	C17	5.6	4
Hamsi Cafe	C10	3.8	1.8
Eylül Optik	C8	5.4	2.3
Bamboo Rest.	C2	5.5	2.8
Eynya	C5	7.1	1.8
Cafe Green	C13	7.6	1.9
Lezzet Bahcesi	C3	6.3	1.2
Çalış Beach Rest.	C6	6.9	1.1
Lily's Steakhouse	C7	3.8	1.3
Günes Market	C9	5.7	1.1
Sanat Koseci	C18	6.9	1.5
Sanat Koseci	C4	3.9	1.3
Sanat Koseci	C1	3.5	1.1
Sim Bar	C27	n.d.	n.d.

Table 2: Lux values at 22:00 and 00:30 at the nests along the promenade in Çalış vs. the data of 2012. (n.d.: no data)

Tabelle 2: Lux Werte, um 22:00 und 00:30 der Nestern, entlang der Promenade von Çalış.(n.d.: keine Daten)

Location	nests	2013	Lux 22:00	Lux 00:30
Hotel Ceren	C11		3.0	1.0
Hotel Letoon	C20		1.9	1.1
Hotel Letoon	C12		1.3	0.9
Caretta Beach Club	C21		1.3	0.9
Caretta Beach Club	C23		1.9	0.8
Caretta Beach Club	C19		1.1	3.6
Caretta Beach Club	C26		1.3	1.3
Caretta Beach Club	C16		2.1	0.6

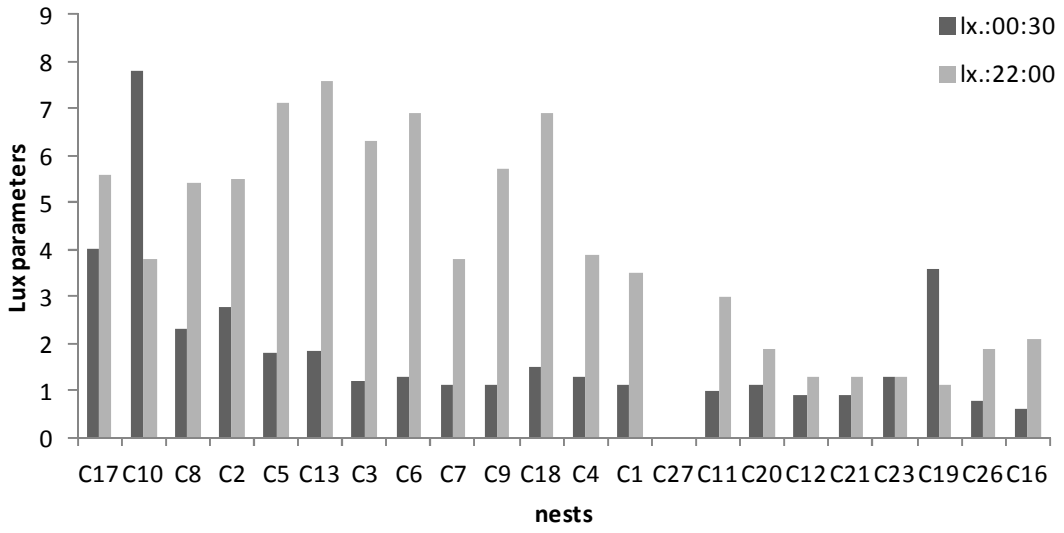

Figure 4: lux values at 22:00 and 00:30 at 21 nests along the promenade. Bars show order from Türkü Cadiri (C17) to Caretta Beach Club (C16).

Abbildung 4: Lux Werter um 22:00 und 00:30; 21 Nester wurden entlang der Promenade gefunden. Balken: Reihenfolge von Türkü Cadiri (C17) bis zu Caretta Beach Club (C16) .

Altogether 22 nests were found along the beach promenade in Çalış. The distribution of the nests correlates to the light intensity along the beach at 22:00 and 00:30 (fig.10). At the beginning and in the middle of the promenade, the buildings had the highest illumination values. At the eastern end of the promenade (Türkü Cadiri) to the middle of the promenade (Café Green), only one nest was found, whereas after Café Green the numbers of nests

increased. At Lezzet Bahcesi and Caretta Beach Club the nest densities appeared to be aggregated. This correlates with the low light intensity at the end of the promenade (fig. 5). After 00:30 the lux values in front of the nest ranged from a maximum of 7.5 lux to a minimum of 0.6 lux. The building with the highest illumination rate after 00:30 was Türkü Cadiri (14 lux). The light intensity at the promenade itself is associated with the measured intensity at the nests at 22:00 and 00:30. Late at night the most strongly illuminated part of the promenade switched from the middle to the beginning at the eastern end of the promenade (fig. 6).

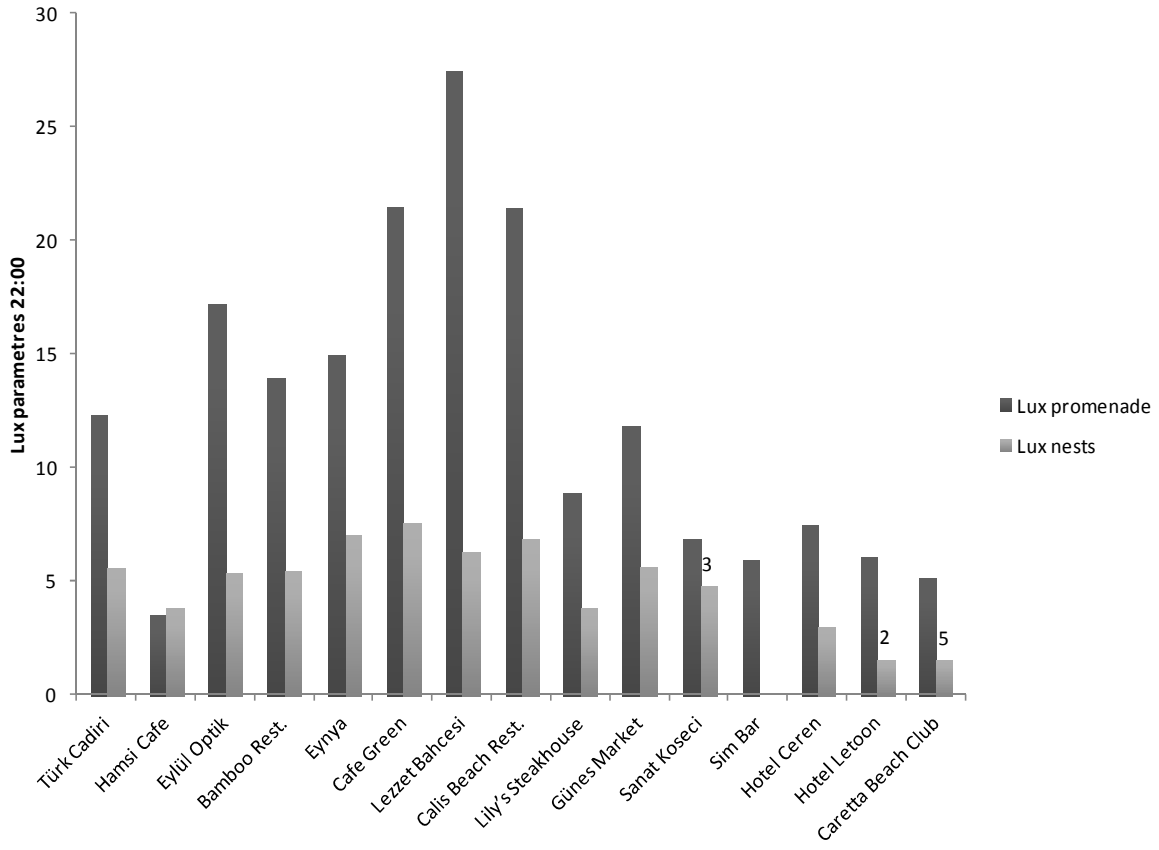

Figure 5: Lux values measured at the buildings and nests at 22:00. Black bars: lux values at a building and Grey bars: lux values at the nests. Figures (3, 2, 5): numbers of nests

Abbildung 5: Lux Messungen um 22:00 der Gebäude und Nester. Schwarze Balken: Lux Werte der Promenade; graue Balken Lux Werte der Nester.Nummern (3, 2,5): Anzahl der Nester.

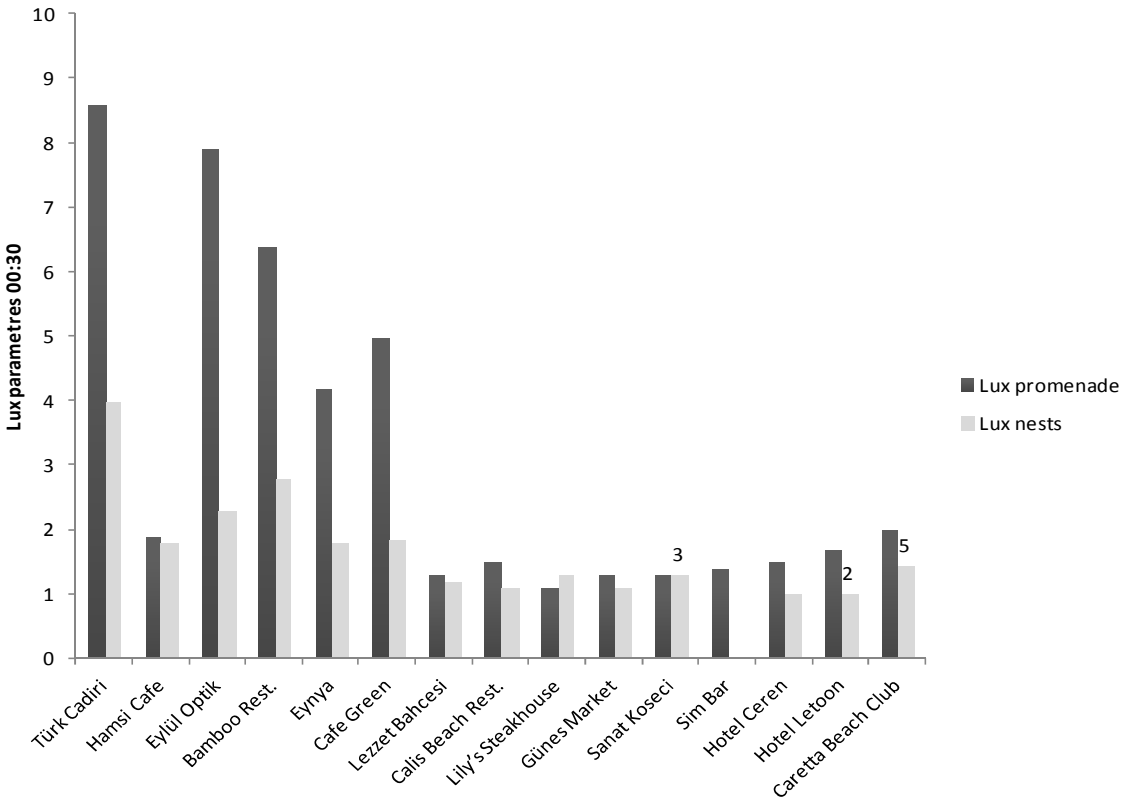

Figure 6; Lux measurements at the buildings and nests at 00:30; Black bars: lux values at each building; Grey bars: lux values at the nests; Figures (3,2,5) numbers of the nests

Abbildung 6: Gemessene Lux Messungen um 00:30 der Gebäude und Nester. Schwarze Balken: Gemessene Lux Werte der Gebäude, Graue Balken Lux Werte der Nester. Nummer (2,3,5):Anzahl der Nester

Also this year a photo catalogue was created (Appendix). This catalogue lists all shops, bars restaurants and hotels from the eastern to the western end of the beach promenade. The photographs with lux values in each section at 22:00 and 00:30 provide an overview of all buildings along the promenade which illuminate the beach. Also a map which presents the position of all nests at the promenade was created (Appendix).

DISCUSSION

This year, 22 nests were found along the beach promenade, which is a strong increase compared to 2012, where only 7 nests were documented. The overall number of nests in Çalış was 35, also a record. Is this value attributable to improved light conditions? The clear answer is no: the high light pollution in Çalış did not improve. The total light intensity even increased with a mean value of 15.4 lux at 22:00 and 12.4 lux at 00:30 (fig. 2). The counted lights along the promenade did decrease (fig. 1). This, however, may reflect the counting method: lights are present on the promenade itself, in the open-air part of restaurants, and inside the

buildings themselves, often making it difficult to decide which lamps to include. Moreover, there is no correlation between the number of artificial light sources and the light intensity. This can be explained by the very different nature and illumination power of the respective light sources (see below).

For example at Caretta Beach Club the highest number of lights was counted at 22:00 (table 1). Despite this high number, the lights illuminated the beach with an intensity of 5.2 lux, which is relatively low. In contrast, at Serkul Tourism, only 7 lights produced a light intensity of 49.7 lux (table 1). The 7 lights, which included 6 big info signs, illuminated the beach until 2:00. At this late time only few tourists walk along the promenade. This raises the question whether such a strong, ecologically damaging illumination at this late time is necessary. In conclusion, the decrease of artificial light sources along the promenade did not lead to a decrease in light intensity.

Moreover, not the quantity of lights but the type (intensity, brightness) of artificial light sources is a crucial factor. Along the promenade many localities used HPS (high pressure sodium vapour lamps) with an extremely high wattage. This type of artificial light source has at least one negative effect. The high wattage leads to a very bright light and high lux values. Sea turtles are very sensitive to high light intensities with short wavelengths. This type of artificial light influences the behaviour of nesting turtles as well as emerging hatchlings (Witherington 1996). The use of amber and red light would be the most efficient artificial light sources; these seem to be mostly indifferent for sea turtles, especially for the loggerheads (Salmon 2006). The use of lower pressure sodium lamps would be enough to illuminate the whole promenade and would reduce the impact on the turtles (Salmon 2006). Especially at the southern end of the promenade the usage of strongly illuminated signs and bright neon lamps was common. At 22:00 the high values from Türkü Cadiri (starting point of the promenade) till Cafe Green (section in the middle of the promenade) reflect the strong usage of illuminated signs. (table 1 and fig.2). At 00:30 many lights between the sections Türkü Cadiri and Cafe Green still illuminated the beach; although the lux values decreased here, they still remained high compared at other sites along the promenade (fig. 2).

Clearly, such extremely bright signs and decorative lightings are designed to attract the attention of passing tourists, but the needs of the endangered loggerhead sea turtle, which requires beaches like Çalış, should not be neglected. The relevant laws to protect the sea turtles should be strengthened and improved to get the serious problem of light pollution under control. Moreover, dialogue between the local residents and sea turtle workers should

be strengthened: only when the local shop and restaurant owners realise the light pollution problem in Çalış first positive steps can be achieved. Finally, one should not forget that the area around Çalış is an SPA (Special Protected Area) the whole attitude of the tourists and locals who live or visit this region should comply with the guidelines for such areas. This is all the more so because the loggerhead sea turtles which inhabit the area actually attract visitors. The habitants should be proud of their natural resources and protect the vulnerable animals which help make this an area worth visiting. Generally, eco-tourism here should be enhanced, which would help improve the situation of *Caretta caretta* in Çalış.

The general nest distribution of the 22 nests correlated with the measured lux values (figs.5 and 6). Sea turtles need dark nesting sites with specific substrate conditions (Bjorndal and Wood 2000). At section Sanat Koseci and Caretta Beach Club the nest density aggregated, i.e. more than one nest was found at these sections (fig. 4). This may be due to fewer lights and less brightness than at other locations along the promenade. Mainly the area at Gül Market till Caretta Beach Club was preferred nesting site. After half past one most of the lights in this area were turned off or at least dampened, this leads to some nearly dark sections along the promenade. Compared to the eastern end and the middle section of the promenade there the lights remained turned on until late at night, but also in this sections some sea turtles still deposited their eggs Even though at higher illuminated locations the risk of getting spotted and get disturbed by loud tourists is clear. If a sea turtle nested at these highly illuminated sections, then only shadowed sites were selected. Specifically, objects such as umbrellas, staircases and plants provided shadow. A case in point is Nest 16 at Caretta Beach Club, which was situated directly under a permanent umbrella. Or sea turtles deposited their eggs late at night when most of the strong light sources were turned off. Another reason for such high nest densities at the western end of the promenade could be specific substrate conditions at these sites. At Sanat Koseci and Caretta Beach Club grain size of the sand seems to be more suitable for nesting turtles. Generally, the whole beach along the promenade offered quite good substrate conditions compared to the substrate offside the promenade, which was often very stony. This complicated egg deposition offside the promenade, even though the sea turtles were subjected to fewer lights. This could be the reason why 22 nests of 35 were located along the extremely light-polluted promenade (fig.10). Furthermore, light pollution also exists offside the promenade, for example by people who picnicked and celebrated there or by cars which entered the beach and kept their lights on. To reduce such unnecessary light pollution, public education and signs which refer to the light pollution problem would help. Of course, policing efforts and controls are ultimately necessary.

The light pollution along Çalış could be ameliorated with little effort. Witherington and Salmon (1996 and 2006), for example, demonstrated several strategies and solutions to reduce the light pollution in urban regions. Some of these could be considered in Çalış.

For instance the use of special streetlamps equipped with shields that regulate the direction of the light. This modification has already been elaborated to some extent along the promenade in Çalış, but most of the lamps still illuminated the beach with high intensity and were still positioned too close to the beach. To make this approach more efficient, native vegetation could be enhanced in combination with a low wall equipped with light sources that shine away from the beach and only up to the buildings. Moreover, planting vegetation along the promenade would improve the aesthetic value and shield the nesting turtles, also making it harder for tourists to spot them. Combining all these strategies could help secure the future of the loggerhead turtles along Çalış beach.

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APPENDIX

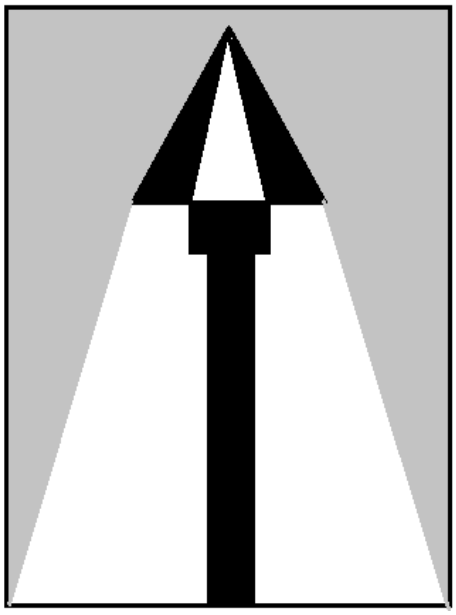

Figure 7: Sea turtle friendly street lamp

Abb.7: Schildkröten-freundliche-Straßenlampe

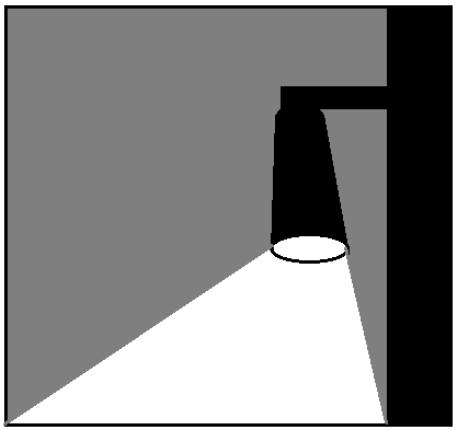

Figure 8: Wall-mounted down light

Abb.:8:An der Wand befestigte Lampe; Lichtsrahl nach unten fokussiert

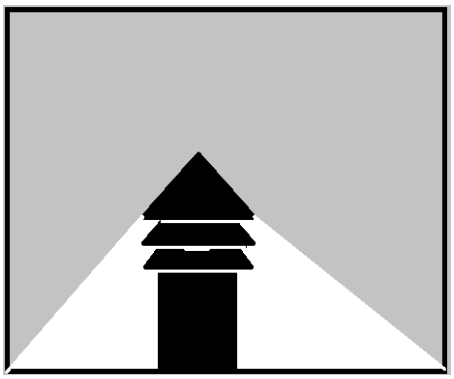

Figure 9: Sea turtle friendly lightning bollard

Abb.9: Meereschildkröten -freundliche -Lichtsäule

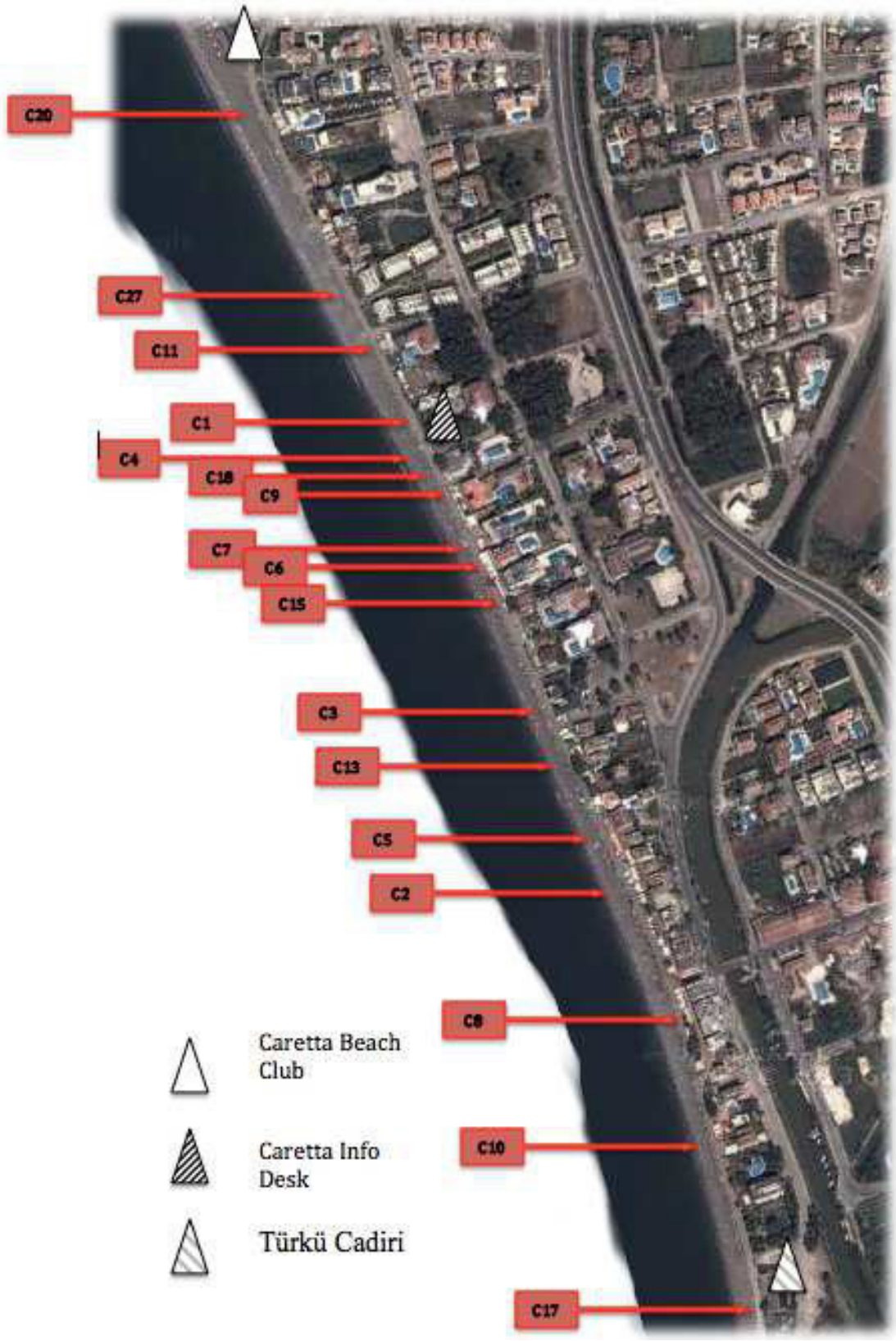

Figure 10: Location of the nests on Çalış Beach during the nesting season 2013 (maps.google.at)

Abb. 10 :Standorte der Nester in Çalış, während der Nistsaison 2013. (maps.google.at)

Figure 11: ice cream palour simsek lux: 22:00: 45.7

Abb.11: ice cream plaour simsek lux:22:00: 45.7

Figure 12: Caretta Info Desk lux: 22:00: 2.5

Abb.12: Caretta Info Desk lux: 22:00: 2.5

Fig. 13: Senkul Tourism lux 22:00: 49.9

Abb.:13: Senkul Tourism lux 22:00: 49.9

Bachelor Thesis

Tourism activity on a Turkish nesting beach hotspot of the loggerhead sea turtle (*Caretta caretta)*

Tourismus-Aktivität an einem türkischen Niststrand der Unechten Karettschildkröte (*Caretta caretta)*

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Aspired academic title
Bachelor of Science (BSc.)

Vienna, October 2013

Studies number/ Studienkennzahl: A033 630
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ABSTRACT

The Mediterranean coast of Turkey is an important nesting area for the endangered loggerhead sea turtle (*Caretta caretta).* There are 14 major nesting regions on the Mediterranean coast of Turkey and Fethiye is one of them. Fethiye is divided into three parts: Çalış, Yanıklar and Akgöl. Although Akgöl is the shortest part and only 1.5 km long, it is a very important nesting beach, because normally about 22% of all nests in Fethiye are located there. In 2013 there were 20 nests. Although tourism does not play the same crucial role as in Çalış, it has an increasing negative impact on the sea turtles here. Especially the western part of the beach, a 50-m-long section with fine sand (Anh. 1, Abb. 1), is very popular among the local people and a hotspot for sea turtle nests. Every year it has a very high nest density. During the observed timeframe (7 days) I counted 296 people on and around the beach and divided them into four categories: singles, couples, small families (≤ 4 people) and extended families (≥ 5 people). Most of the people recorded were in the category small families. 55% of the people visited the beach on the weekend (Friday and Saturday) and normally there were more people at midday than in the evening. In 2013 a little wooden hut (Anh. 2, Abb. 9) was built where drinks are sold. Since this year there are also 20 sunbeds and 10 sunshades which are serviced from the hut. The sunbeds and sunshades are an obstacle for the adult female turtles, which attempt to dig their nests on the beach, and a threat to baby turtles. Sunshades without umbrella stands (Anh. 2, Abb. 6) can destroy whole clutches and the shade itself can alter the development of the embryos. Artificial light, like the lamp which illuminates the wooden hut, is also a problem for the hatchlings and the adult females: the females may avoid coming on the beach to lay their eggs and the hatchlings can get disorientated. People who are on the beach until the late night hours, although it is forbidden between 8 p.m. and 8 a.m., can step on the hatchlings, disorient them with artificial lights like bonfires or disturb the female turtles. The new parking area, where I counted 65 vehicles in seven days, has positive as well as negative effects on the turtles. The beach visitors no longer park their cars directly on the beach, reducing the risk of driving over turtles or nests. The negative effect is that the natural barrier for vehicles, the streambed of Akgöl Lake, between the small sandy beach and the rest of the beach has been leveled. The water no longer runs along the narrow streambed but may diffuse through more extensive areas of the beach, potentially impacting nearby nests. These are only a few examples for the negative effects that increasing tourism has on sea turtles.

To ensure the protection of this very important nesting beach for the loggerhead sea turtle in Fethiye, I make suggestions as to when, how and to what extent people should use the beach.

KURZFASSUNG

Die Mittelmeerküste der Türkei zählt zu den wichtigsten Nistregionen der als gefährdet eingestuften Unechten Karettschildkröte (*Caretta caretta).* Fethiye ist einer von 14 Niststränden der türkischen Mittelmeerküste und in drei Bereiche unterteilt: Çalış, Yanıklar und Akgöl. Akgöl ist mit 1,5 km Länge zwar der kürzeste, aber dennoch ein sehr wichtiger Strandabschnitt, da sich dort in der Regel 22% aller Nester in Fethiye befinden. 2013 wurden in Akgöl 20 Nester gezählt. Auch wenn der Tourismus in diesem Abschnitt nicht dieselben Probleme wie in Çalış verursacht, so ist eindeutig ein stetig zunehmender negativer anthropogener Einfluss erkennbar. Vor allem der westlichste Strandabschnitt Akgöls, ein 50m langer Bereich der mit feinem Sand bedeckt ist, gilt als "nesting hot spot". In diesem 50 m langen Abschnitt wurden 2013 14 Nester gezählt und ist jedoch auch bei Einheimischen als Badestrand sehr beliebt. Während des untersuchten Zeitraums (7 Tage) wurden 296 Besucher am und um den Strand gezählt, wobei die Besucheranzahl am Wochenende ansteigend ist. Seit diesem Jahr gibt es dort auch eine ca. 3m x 3m umfassende Holzhütte (Anh. 2, Abb. 9) bei der Getränke verkauft werden, sowie eine Reihe von 20 Liegen und 10 Sonnenschirmen, die ebenfalls vom Betreiber der Buffethütte betreut werden. Die Liegen und Sonnenschirme stellen nicht nur eine Barriere für die adulten Weibchen dar, die auf diesem Teil des Strandes ihre Eier ablegen möchten, sondern haben auch negative Effekte auf die Jungtiere. So können achtlos in den Sand gesteckte Sonnenschirme (Anh. 2, Abb. 6) ganze Gelege zerstören und die Beschattung durch die Schirme hat Einfluss auf die Bedingungen im Nest. Weiters können sich die Weibchen durch die Besucher, die sich trotz Verbots oft bis in die späten Nachtstunden am Strand aufhalten, gestört fühlen und den Nistvorgang abbrechen oder erst gar nicht zur Eiablage an den Strand kommen. Eine weitere Gefahr stellt das Zertreten der frisch geschlüpften Jungtiere durch nächtliche Strandbesucher dar. Die künstliche Beleuchtung des Strandes durch Straßenlaternen, die Beleuchtung der Holzhütte oder Lagerfeuer stellt sowohl für die adulten Tiere als auch für die Hatchlinge ein großes Problem dar. Die Jungtiere, welche sich am hellsten Punkt orientieren, werden durch diese künstlichen Lichtquellen fehlgeleitet und finden so überhaupt nicht oder erst nach einem sehr langen Umweg den Weg Richtung Meer. Auch die Schaffung einer Parkmöglichkeit für die Badegäste durch das Aufschütten des Flussbetts des Akgöl Sees bringt Probleme für die Schildkröten mit sich. Hierdurch wurde die natürliche Barriere zerstört, die den sandigen Strandabschnitt vom Rest des Strandes trennte. Das Zubaggern des Flussbetts kann auch zur Folge haben, dass das Wasser nun durch einen großen Abschnitt des "Nesting Hot Spots" sickert. Dies kann sich durch Abkühlung ungünstig auf Gelege auswirken. Durch die kommerzielle Nutzung des Strandes geht ein unberührter Abschnitt und da-

durch so wichtig für *Caretta caretta* verloren, und sollte unterbunden werden. Im Zuge dieser Arbeit wurde untersucht, wann und in welchem Ausmaß der Strand genutzt wird.

EINFÜHRUNG

Einst waren die Meeresschildkröten eine sehr formenreiche Gruppe. Vor ca. 140 Millionen Jahren umfassten sie noch vier Familien, von denen heute weltweit nur noch zwei Familien, die sieben Arten umfassen, existieren. Von diesen sieben Arten kommen drei im Mittelmeer vor: die Unechte Karettschildkröte (*Caretta caretta)*, die Grüne Meeresschildkröte (*Chelonia mydas)* sowie die Lederschildkröte (*Dermochelys coriacea).* Lediglich die Grüne Meeresschildkröte und die Unechte Karettschildkröte pflanzen sich auch im Mittelmeer fort (Casale & Margaritoulis 2010).

Die Unechte Karettschildkröte ist im Mittelmeerraum die häufigste dieser drei Arten, dennoch wird sie auf der Roten Liste der International Union for Conservation of Nature and Natural Resources (IUCN) als gefährdete Art angeführt (Margaritoulis et al 2003). Obwohl die Unechte Karettschildkröte auch in der Türkei durch eine Reihe von internationalen und nationalen Gesetzen und Abkommen, wie beispielsweise CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora), CBD (Convention on Biological Diversity) sowie der Berner Konvention und der Barcelona Konvention, in der Theorie umfassend geschützt wird, ist sie in der Praxis einigen Bedrohungen durch den Menschen ausgesetzt.

Die Hauptprobleme im Mittelmeerraum stellen die Fischerei und die Zerstörung der Niststrände dar. Die größten Gefahren, denen die Niststrände heutzutage ausgesetzt sind, sind: die Erschließung der Strände für den Tourismus, Sandentnahme, unkontrollierte Strandnutzung, Fahrzeuge am Strand sowie die künstliche Beleuchtung der Strände (Casale & Margaritoulis 2010).

Im Zuge dieser Arbeit wurde ein für die Meeresschildkröten sehr wichtiger Strandabschnitt, welcher jedes Jahr eine sehr hohe Nestdichte aufweist, hinsichtlich seiner touristischen Nutzung untersucht. Die Erschließung dieses Strandabschnitts für den Badetourismus stellt unweigerlich ein Problem für die dort nistende Unechte Karettschildkröte dar. Obwohl Fethiye, sowie auch zwei weitere türkische Niststrände (Dalyan und Patara), nach einem Zusatzprotokoll der Barcelona Konvention als Specially Protected Areas deklariert sind, verschlechtern sich die Bedingungen für die Schildkröten in Fethiye zugunsten des Badetourismus von Jahr zu Jahr.

So auch beim untersuchten Strandabschnitt:

- Neu plazierte Liegen und Sonnenschirme stellen eine Barriere für die adulten Weibchen dar, wodurch es ihnen erschwert wird am Strand ihre Eier abzulegen.
- Der durch die Sonnenschirme und andere typische Strandutensilien, wie beispielsweise Liegetücher, verursachte Schatten verändert die Bedingungen im Nest für die Embryonen, wodurch sich diese schlechter entwickeln können und das natürliche Geschlechterverhältnis verschoben werden kann.
- Ist kein Schirmständer vorhanden, so können achtlos in den Sand gesteckte Sonnenschirme ganze Gelege zerstören.
- Trotz bestehenden Verbots (von 20:00 bis 8:00 darf der Strand nicht betreten werden) halten sich regelmäßig Besucher bis in die späten Nachtstunden am Strand auf, was mehrmals bei nächtlichen Kontrollgängen beobachtet wurde. Zudem kommt es auch vor, dass Besucher direkt am Strand auf den Sonnenliegen oder in den Pavillons nächtigen. Dies konnte mehrmals bei den morgendlichen Kontrollgängen um ca. 6 Uhr beobachtet werden. Dadurch können sich adulte Weibchen gestört fühlen und den Nistvorgang abbrechen oder erst gar nicht zum Legen der Eier an den Strand kommen. Jeder missglückte Eilegeversuch kostet den Weibchen viel Energie. Weiters können frisch geschlüpfte Hatchlinge von Menschen zertreten oder durch künstliche Beleuchtung wie beispielsweise Lagerfeuer fehlgeleitet werden.
- Von Fahrzeugen am Strand gehen eine Vielzahl von Gefahren aus, so können nistende Weibchen oder Jungtiere überfahren werden, Weibchen können sich beim Nistvorgang durch vorbeifahrende Autos gestört fühlen und diesen abbrechen und Jungtiere können durch Fahrzeugspuren sowie künstliches Licht fehlgeleitet werden.
- Straßenbeleuchtungen, Beleuchtungen von Parkplätzen und Lokalen können nicht nur Weibchen dazu veranlassen diesen Strand zu meiden, sondern auch Jungtiere fehlleiten.
- Sowohl Fahrzeuge als auch ein großer Menschenandrang können zu einer Kompaktierung des Sandes führen, wodurch das Graben des Nestes und der Schlupf der Jungtiere erschwert werden.
- Hatchlinge können durch Erschütterungen in unmittelbarer Nähe des Nestes dazu veranlasst werden, es noch vor Einbruch der Nacht zu verlassen, was für sie letale Folgen haben kann, da die Temperatur des Sandes zumeist noch zu hoch ist und auch das Prädationsrisiko ein höheres ist (Arianoutsou 1988)

Dies sind nur einige Beispiele für Gefahren, die eine zeitgleiche Nutzung eines Niststrandes von Meeresschildkröten als Badestrand mit sich bringen. Ziel dieser Arbeit war es zu untersuchen, wann, in welchem Ausmaß und von wem der Strand genutzt wird. Es wurde dokumentiert, wie viele und welche Leute sich am Strand aufhalten und welche Effekte sie auf die Schildkröten beziehungsweise deren Nester haben könnten. Weiters wurden zweimal am Tag die geparkten Fahrzeuge gezählt sowie die Besucher in dem nahegelegenen Strandrestaurant „Karaot Cafe“ (Anh. 2, Abb. 4). Der untersuchte Strandabschnitt wurde auch vermessen, um einen Managementplan erstellen zu können, der die negativen Auswirkungen auf die Meeresschildkröten in Zukunft so gering wie möglich halten sollte.

METHODEN UND MATERIAL

Das Untersuchungsgebiet befindet sich auf dem 1,5 km langen Strand von Akgöl. Am westlichen Ende von Akgöl befindet sich ein 50 m langer Strandabschnitt, der im Norden und Westen von einer Felswand begrenzt wird, im Süden grenzt das Meer an und im Osten erstreckt sich der Strand von Akgöl Richtung Yanıklar (Anh. 2, Abb. 1,2). Die Besonderheit dieses kleinen Areals besteht darin, dass der gesamte Bereich aus feinem Sand besteht, wohingegen auf dem restlichen Strand nur sehr kleine Bereiche mit feinem Sand bedeckt sind. Der Großteil des restlichen Strandes ist mit größeren und kleineren Steinen bedeckt und somit kaum als Niststrand geeignet.

Im Norden hinter der Felswand befindet sich seit diesem Jahr ein Parkplatz (Anh. 2, Abb. 3). Davor befand sich dort ein Flussbett, das vermutlich im Winter 2012 beziehungsweise Frühjahr 2013 zugebaggert wurde, um den Badegästen des vor allem bei Einheimischen sehr beliebten Strandabschnitts eine Parkmöglichkeit bieten zu können. Zu diesem Parkplatz führt eine Straße, die mit einem Schranken geschlossen werden kann und während der Nacht (20:00 bis 8:00) auch geschlossen sein sollte. Während des gesamten untersuchten Zeitraums war der Schranken allerdings nie geschlossen. Der Schranken gehört zum Strandrestaurant „Karaot Restaurant“, das seit Sommer 2013 um 12 Hütten, 20 Liegen, 12 Sonnenschirme sowie eine ca. 30m x 3m umfassende überdachte Terrasse erweitert wurde. Die Besucherzahl dieses Restaurants wurde ebenfalls dokumentiert um feststellen zu können, ob die Besucherzahl des kleinen Sandstrandes und des Restaurants miteinander korrelieren. Aufgrund nicht aktueller Google Earth Aufnahmen sind der Parkplatz sowie weitere Neuerungen auf den Abbildungen 1 und 2 im Anhang 1 leider noch nicht sichtbar.

Die Datenaufnahme erfolgte von Freitag 6.9.2013 bis Freitag 13.9.2013 (Ausnahme: Sonntag 8.9.2013).

Folgende Daten wurden zweimal am Tag, um ca. 12:30 Uhr und um ca. 18:30 Uhr, erhoben:

- Anzahl der Personen am und um den Sandstrand sowie deren Einteilung in folgende Kategorien: Einzelpersonen, Paare, Kleinfamilien (bis zu 4 Personen), Großfamilien (5 und mehr Personen)
- Position der Personen am Strand: hierzu wurde der Strand durch eine zuvor vermessene und mit Steinen markierte Linie in zwei Zonen (Anh. 1, Abb. 1) eingeteilt:
  Liegezone: 0 m-10 m von der Wasserlinie
  Nistzone: 10 m-30 m von der Wasserlinie
  Die Trennung zwischen diesen beiden Zonen beruht darauf, dass 10 m von der Wasserlinie entfernt die Liegenreihe Richtung Strand endete und der Sand hier nicht mehr feucht, sondern trocken war. In diesem Jahr betrug die kürzeste Distanz zwischen einem Nest und dem Meer in diesem Strandabschnitt 12,9 m.
- Anzahl der Personen im „Karaot Cafe“ (inkludiert Personen auf den Sonnenliegen und in den Pavillons)
- Anzahl sowie Kennzeichen (Land) der am Parkplatz abgestellten Fahrzeuge

Bis auf Abbildung 9 im Anhang 2 (Foto: Michael Stachowitsch) wurden alle Fotos von mir mit einer Olympus VR-320 aufgenommen. Die Abbildungen 1 und 2 im Anhang 1 stammen von Google Earth (25.10.2013) und wurden am 9.9.2011 aufgenommen. Neuerungen wie der Parkplatz oder die Strandhütte sind auf diesen beiden Abbildungen noch nicht enthalten.

ERGEBNISSE

Während des untersuchten Zeitraumes (7 Tage) wurden 296 Besucher am und um den Strand sowie 65 am Parkplatz abgestellte Fahrzeuge gezählt. 55% der Menschen (160 Personen) suchten den Strand am Wochenende auf. Während der Woche hielten sich weniger Menschen am Strand auf (Abb. 2)

Um die Mittagszeit (ca. 12:30) befanden sich insgesamt mehr Menschen am Strand (58%) als bei der abendlichen Aufnahme um ca. 18:30. Dieser Effekt ist vor allem an den Wochenendtagen deutlich erkennbar (Abb. 1).

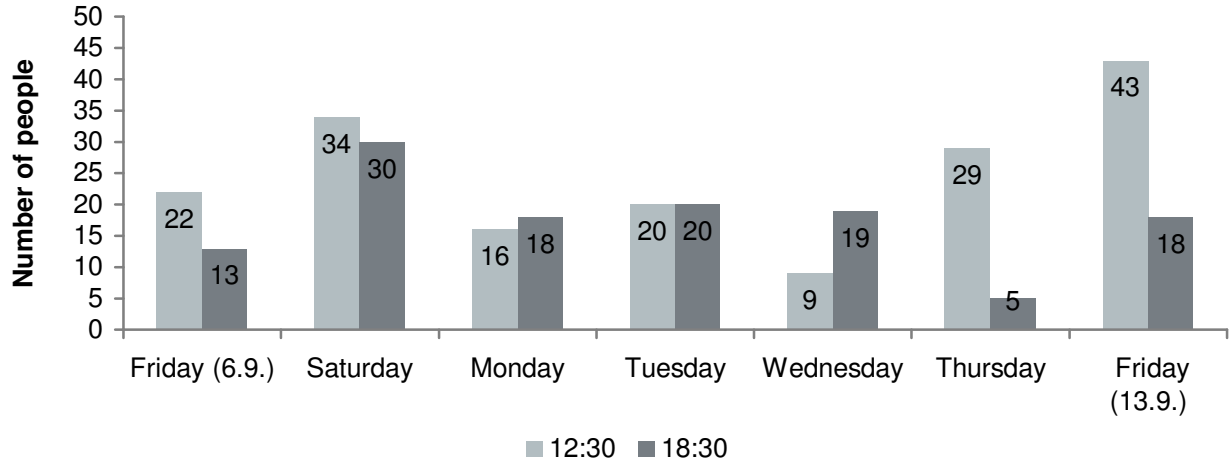

Abbildung 1: Anzahl der Personen am Strand im Laufe des untersuchten Zeitraums.
Figure 1: Number of people on the beach during the observed time frame.

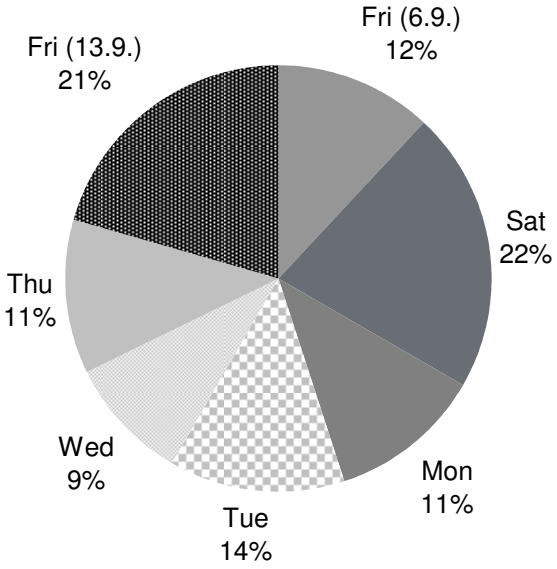

Abbildung 2: Anteile der einzelnen Tage an der Gesamtpersonenzahl.
Figure 2: Percentage of each day based on the total number of people.

Die Personen am Strand wurden nach der Zählung in Einzelpersonen, Paare, Klein- und Großfamilien unterteilt. Viele Leute kommen mit ihren Familien an den Strand. Die Zahl der Kleinfamilien mit bis zu vier Personen war am höchsten, die zweithäufigste Kategorie stellten die Großfamilien dar. Die Anzahl der Einzelpersonen war stets am geringsten (Abb.3). Auch hier ist gut zu erkennen, dass bei der Datenerhebung zu Mittag sich zumeist mehr Personen am Strand aufhielten als bei der Erhebung um Abend.

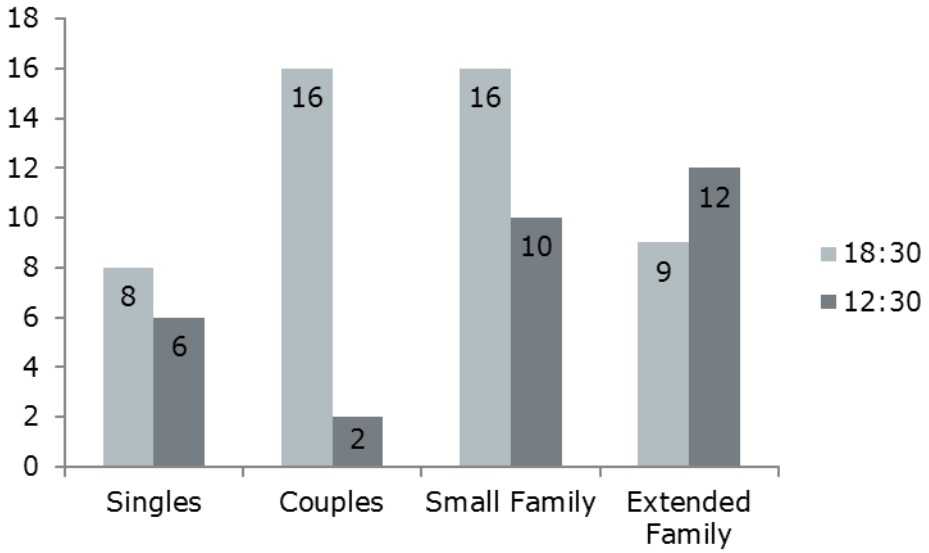

Abbildung 3: Anzahl der Singles, Paare, Kleinfamilien und Großfamilien zu Mittag und am Abend.
Figure 3: Number of singles, couples, small families and extended families at midday and in the evening.

Die Personen am Strand wurden nicht nur in Kategorien eingeteilt, sondern es wurde auch ermittelt, in welchem Bereich des Strandes sie sich vorwiegend aufhalten. Hierzu wurde der Strand in zwei Zonen unterteilt: die Liegezone und die Nistzone. Die Liegezone reicht von der Wasserlinie bis 10 m landeinwärts, die Nistzone reicht von 10 m bis 30 m landeinwärts (Anh. 1, Abb. 1). 24% der Besucher nutzten nicht die Sonnenliegen sondern lagen weiter landeinwärts in der Nistzone. Insgesamt wurden 12-mal Sonnenschirme, sowohl selbst mitgebrachte als auch die zur Verfügung gestellten Schirme, in der Nistzone aufgestellt, wo sie eine Gefahr für die Jungtiere darstellen können.

Um festzustellen ob die Zahl der Restaurantbesucher mit der Zahl der Strandbesucher korreliert, wurden bei den Datenerhebungen auch die Personen im und um das Restaurant „Karaot Restaurant“ gezählt (Anh. 2, Abb. 4). Scheinen die Besucherzahlen in den ersten Tagen der Untersuchung noch einem gemeinsamen Trend zu folgen, so schwanken sie ab Dienstag unabhängig voneinander (Abb. 4). Um Aussagen darüber zu machen, ob an Tagen mit vielen Badegästen auch die Besucherzahl des Strandrestaurants erhöht ist, wäre ein längerer Untersuchungszeitraum notwendig.

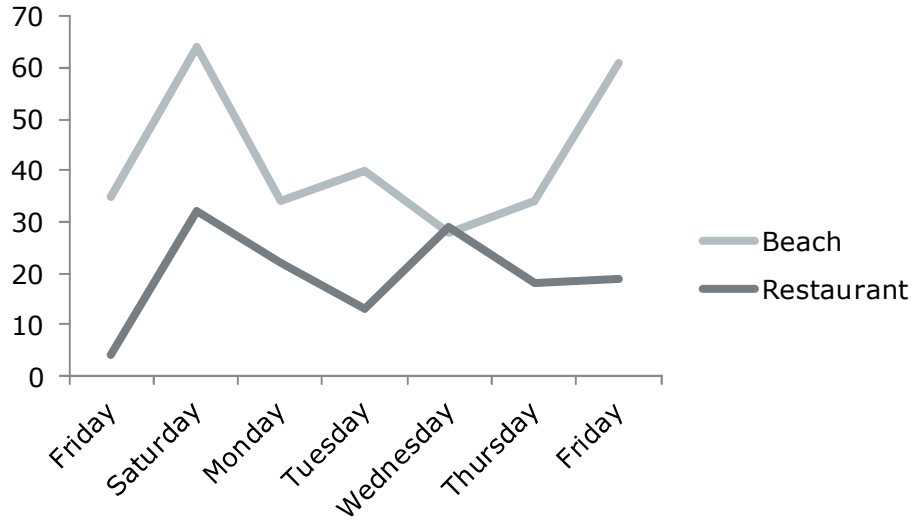

Abbildung 4: Anzahl der Strandbesucher und der Restaurantbesucher.
Figure 4: Number of people at the beach and in the restaurant.

Innerhalb des untersuchten Zeitraums wurden 65 am Parkplatz abgestellte Fahrzeuge dokumentiert (Anh. 2, Abb. 3). Hierbei handelte es sich bei 86% um Autos. 9% der geparkten Fahrzeuge waren Motorräder, 5% Fahrräder. Alle Fahrzeuge hatten türkische Kennzeichen. An 5 von 7 Untersuchungstagen wurden am Abend mehr Fahrzeuge gezählt als zu Mittag.

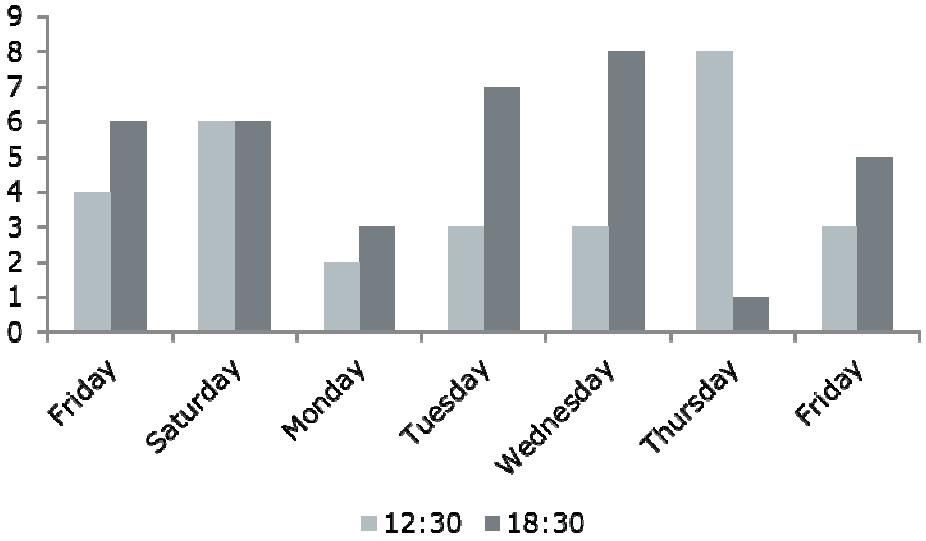

Abbildung 5: Fahrzeuge am Parkplatz.
Figure 5: Vehicles on the parking area.

DISKUSSION

Der kleine Sandstrand am westlichen Ende von Akgöl ist vor allem bei türkischen Familien als Badestrand sehr beliebt. Die Anzahl der Klein-und Großfamilien war deutlich höher als die der Paare und Singles. Die durchwegs türkischen Kennzeichen der am Parkplatz abgestellten Kraftfahrzeuge weisen darauf hin, dass vor allem Einheimische den Strand aufsuchen. Es könnte sich bei den Autos allerdings auch um Mietwagen von Touristen mit türkischem Kennzeichen handeln, jedoch waren nur wenige ausländische Touristen am Strand anzutreffen.

Zudem waren die Besucherzahlen in der Regel zu Mittag höher als am Abend. Die Zahl der Fahrzeuge war hingegen in 5 von 7 Fällen am Abend höher. Die Strandbesucher scheinen zu Mittag eher zu Fuß oder in größeren Fahrgemeinschaften zum Strand zu gelangen, wohingegen am Nachmittag bis Abend eher eine Anfahrt mit dem Auto bevorzugt wird.

Nur dieser 50m lange Strandabschnitt ist vollständig mit Sand bedeckt. Auf dem restlichen Strand überwiegt ein steiniger Untergrund. Dies ist der ausschlaggebende Faktor, weswegen dieser Strandabschnitt von den Besuchern bevorzugt wird. So verteilen sich die Menschen nicht auf den gesamten Strand, sondern konzentrieren sich auf diesen kleinen Bereich, der jedoch auch ein sehr wichtiger Niststrand der Unechten Karettschildkröte ist und jedes Jahr eine sehr hohe Nestdichte aufweist.

Die Nutzung dieses Strandabschnitts während der Nistsaison bringt einige Probleme mit sich. Zudem erfuhren wir durch Gespräche mit den Strandbesuchern, dass vor allem ausländische Touristen nicht wissen dass dies ein Niststrand der Unechten Karettschildkröte ist beziehungsweise wie man sich auf solchem verhalten sollte. Es sind zwar Tafeln vorhanden die auf den Niststrand und die damit verbundenen Regelungen hinweisen, doch ist die Platzierung der Tafeln nicht optimal. Nur wenige Leute kommen an diesen vorbei. Es wird eine Hinweistafel beim Parkplatz benötigt, die die Besucher auf den Niststrand und die damit einhergehenden Verbote aufmerksam macht (Anh. 2, Abb. 7).

Der neu geschaffene Parkplatz hat insofern einen positiven Effekt auf die Schildkröten, als dass die Autos nicht mehr direkt am Strand geparkt werden, wie es in den letzten Jahren der Fall war (Anh. 2, Abb. 3). Während der 5-wöchigen Projektdauer wurden keine Autos direkt auf dem Strand abgestellt. Jedoch wurde für die Schaffung des Parkplatzes ein großer Eingriff in die Natur vorgenommen. Das Flussbett des Akgöl Sees musste dem Parkplatz weichen und wurde zugebaggert. Dass es sich bei dem Parkplatz früher um ein Flussbett handelte ist in Abbildung 1 im Anhang 1 gut ersichtlich. Somit wurde nicht nur die natürliche Barriere, die den kleinen Sandstrand vom Rest des Strandes trennte, zerstört, sondern die Aufschüttung des

Flussbetts kann auch zur Folge haben, dass sich das Wasser über den Niststrand ausbreitet, was sich wiederum ungünstig auf die Gelege auswirken kann. Beim Aufgraben der Nester vier Tage nach dem Schlupf konnte bei mehreren Nestern in diesem Strandabschnitt beobachtet werden, dass die Wände der Ei-Kammer viel feuchter und somit kompakter und härter sind, als in anderen Strandabschnitten. Den Jungtieren wird der Schlupf dadurch erschwert und in verschiedenen Nestern desselben Strandabschnitts schafften es mehrmals bis zu 20 Hatchlinge nicht, ohne anthropogene Hilfe das Nest zu verlassen, da sie im feuchten und kompakten Sand feststeckten. Auch ein breiter Teil des Schilfgürtels, der eine Barriere zwischen Straße und Strand darstellte wurde zugunsten des Parkplatzes gerodet.

Das größte Problem stellt die voranschreitende Erschließung des Strandes für den Badetourismus dar. Die ca. 3m x 3m große Holzhütte (Anh. 2, Abb. 9), die als Strandbuffet fungiert und von deren Betreiber auch die Sonnenliegen und Sonnenschirme betreut werden, ist vermutlich nur der erste Schritt der Umwandlung des Niststrandes in einen touristischen Badestrand. Nicht nur die Holzhütte wurde neu errichtet, es gibt auch eine Dusche für die Badegäste sowie eine Beleuchtung für die Hütte, eine Satellitenschüssel und ein Zelt, wobei nicht bekannt ist von wem dieses Zelt benutzt wird. Leider wird es vermutlich nicht allzu lange dauern, bis die ersten Pavillons aufgestellt werden und die jetzt noch kleine Strandhütte durch zusätzliche Liegen und Esstische immer mehr Platz einnimmt. Bereits diese eine Reihe von 20 Liegen und 10 Sonnenschirmen, wobei je nach Bedarf weitere hinzugefügt werden, steht im Konflikt mit dem Schutz der Schildkröten.

Wie bereits in der Einführung erörtert, stellen die Sonnenliegen eine Barriere für die adulten Weibchen dar. Im Laufe der Untersuchungswoche wurden die Schirme und Sonnenliegen weiter Richtung Osten verschoben. Warum die Liegen versetzt wurden entzieht sich allerdings unserer Kenntnis. Am 1. Tag der Untersuchung begann die Liegenreihe noch direkt bei der Felswand. Am letzten Tag der Untersuchung stand sie bereits 23m von der Felswand entfernt. Eine mögliche Managementmaßnahme wäre, den Beginn der Liegenreihe noch weiter nach Osten zu verschieben, also ca. 50 m von der westlichen Felswand entfernt. Somit würden sie den Weibchen nicht mehr den Zugang zum sandigen Strandteil versperren. Auch das Substrat dort, eine Mischung aus Sand und Kies, ist für die Badenden ein noch immer geeigneter Untergrund. Die Liegen sollten immer paarweise mit einem Abstand von 2 m bis 4 m zum nächsten Paar stehen (Anh. 1, Abb. 2), damit adulte Schildkröten ungehindert passieren können.

Nicht nur die Sonnenliegen, sondern auch die Sonnenschirme stellen ein Problem dar (Anh. 2, Abb. 5,6). Während des untersuchten Zeitraumes wurden 12 mal Sonnenschirme, sowohl zur

Verfügung gestellte als auch selbst mitgebrachte, in der Nistzone in den Sand gesteckt. Durch das Eingraben der Schirme können ganze Gelege zerstört werden. Selbst wenn der Sonnenschirm neben einem Schildkrötennest in den Sand gesteckt wird, beeinflusst der entstehende Schatten die Temperatur im Nest, wodurch sich die Umweltbedingungen für die Embryonen verändern und das Geschlechterverhältnis verändert werden kann (Mrosovsky & Yntema 1980). Denselben Effekt haben andere typische Strandutensilien wie Sonnenzelte oder auf dem Boden ausgebreitete Liegetücher. Nicht alle Nester werden vor dem Schlüpfen der Jungtiere gefunden. Diese Nester, die erst durch die Spuren der Hatchlinge gefunden werden, werden auch „secret nests" genannt. Theoretisch könnte somit jeder achtlos in den Sand gesteckte Schirm ein solches „secret nest" negativ beeinflussen beziehungsweise zerstören. Auf jeden Fall sollten die Schirme mit Schirmständern versehen werden und gemeinsam mit den Sonnenliegen weiter Richtung Osten versetzt werden (Anh. 1, Abb. 2)

Auch die die künstliche Beleuchtung in Akgöl wird zu einem zunehmenden Problem. Die kleine Strandhütte verfügte über eine sehr hell leuchtende Laterne, die bis spät in die Nacht hinein brannte. Einige Hatchlingspuren führten in Richtung der Laterne und wurden vermutlich durch diese fehlgeleitet. Durch den dort steinigen Untergrund konnten die Spuren allerdings nicht weiter verfolgt werden. Während der Nistsaison sollte diese Laterne abgeschaltet beziehungsweise so präpariert werden, dass das Licht vom Strand aus nicht sichtbar ist und die Hatchlinge nicht fehlleiten kann. Diese künstliche Lichtquelle beeinflusst nicht nur die Hatchlinge, sondern kann auch die Weibchen dazu bringen den Strand zu meiden.

Trotz bestehenden Verbotes hielten sich auch häufig nach 20:00 Uhr Leute am Strand auf und nächtigten zeitweise auch dort. Der Schranken, der beim Strandrestaurant positioniert ist und bisher auch die einzige Möglichkeit darstellt die Straße zum Parkplatz zu sperren, sollte nach 20:00 Uhr geschlossen werden. Jedoch war dies während meiner 5 wöchigen Projektzeit nie der Fall. Um dieses Problem zu lösen, sollte ein Ranger damit beauftragt werden sowohl den Schranken als auch den Strand nach 20:00 Uhr zu kontrollieren. Es wäre einfach in der Nacht eine Kontrolle durchzuführen ohne dabei die Schildkröten zu stören. Diese Kontrollen sollten jede Nacht und nicht nur an bestimmten Tagen oder am Wochenende erfolgen. Auch wenn, wie die Untersuchung zeigte, am Wochenende mehr Leute den Strand besuchen als während der Woche, so war doch ein ständiger Besucherstrom vorhanden.

Der kleine Sandstrand ist nur ein kleiner Teil Akgöls, jedoch ist er als Niststrand-Hotspot in Fethiye für die Unechte Karettschildkröte von großer Bedeutung (Anh. 2, Abb. 1,2). Es muss bedacht werden, dass die Aufnahmen in der Nachsaison und ohne den vermutlich besucherstärksten Tag, (Sonntag, 8.9.2013) durchgeführt wurden. Dennoch wurde selbst innerhalb

dieser kurzen Zeit ersichtlich, dass ein Management des kleinen Sandstrandes dringend von Nöten ist, um den Strandabschnitt mit der größten Nestdichte ausreichend schützen zu können. Der kleine Sandstrand misst in der Länge 50m und in der Breite 30 m.

Am effektivsten wäre es, diesen kleinen Bereich während der Nistsaison vollständig zu schließen. Der restliche Strand bietet für Badegäste mehr als genug Platz und ist als Niststrand von geringerer Bedeutung. Bereits eine Verschiebung der Liegen und Sonnenschirme um 50m Richtung Osten würde den Schildkröten helfen (Anh. 1, Abb. 2). Zudem sollte eine andere Art der Nestmarkierung verwendet werden, da die zurzeit praktizierte Art der Markierungsweise (Halbkreis aus Steinen mit einem Schild, das in 3 Sprachen (Deutsch, Englisch, Türkisch) die Leute darauf hinweist, dass sich hier ein Meeresschildkrötennest befindet) von den Besucher oft nicht nur ignoriert, sondern regelmäßig zerstört wurde (Anh. 2, Abb. 8). Beinahe jeden Tag mussten Nester wieder neu trianguliert werden, da die Markierungen entfernt oder versetzt wurden. An einem anderen Strandabschnitt (Karatas Strand) wurden die einzigen beiden Nester an diesem Strandabschnitt zerstört, da Autos mehrmals direkt über die Nester fuhren. Obwohl dies bei meiner fünfwöchigen Projektzeit nie der Fall war, besteht dennoch auch beim untersuchten sandigen Strandabschnitt in Akgöl die Gefahr, dass die Nester von Autos überfahren werden könnten. An solch kritischen Stellen wie dem kleinen Sandstrand oder Karatas Strand wäre der Einsatz von stabilen Schutzkäfigen sinnvoll.

MANAGEMENTPLAN

Folgende Managementmaßnahmen, die in der Diskussion ausführlich erörtert wurden, sollten gesetzt werden, um den Schutz dieses Hotspots für Nester der Unechten Karettschildkröte in Fethiye zu gewährleisten:

- Abriegelung des sandigen Strandabschnitts (östliches Ende: Felswand, westliches Ende: 50 m von der Felswand entfernt) während der gesamten Nistsaison (Juni bis September).
- Versetzung der bestehenden Sonnenliegen und Schirme nach Osten; die Liegenreihe sollte ca. 50 m von der Felswand entfernt beginnen.
- Paarweise Aufstellung der Sonnenliegen mit einem Abstand von 2-4 m zum nächsten Paar.
- Verwendung von Schirmständern für die Sonnenschirme.
- Aufstellen von Hinweistafeln an gut sichtbaren Stellen (z.B. Parkplatz).
- Abschalten der Straßen- und Hüttenbeleuchtung während der Nistsaison oder Präparation der Beleuchtung, sodass das Licht vom Strand aus nicht mehr sichtbar ist.

- Schließen des Schrankens zwischen 20 Uhr und 8 Uhr.
- Nächtliche Kontrollen des Strandes und des Schrankens durch Ranger.
- Verwendung von stabilen Schutzkäfigen an besonders kritischen Stellen (wo die Gefahr droht, dass die Nester von Autos überfahren werden könnten).
- Sensibilisierung der Besucher durch Hinweistafeln und Ranger.

Es muss noch viel getan werden, um den sandigen Strandabschnitt am westlichen Ende von Akgöl als Niststrand für die Unechte Karettschildkröte (*Caretta caretta)* zu erhalten. Leider geht der Trend durch die fortschreitende touristische Erschließung in eine andere Richtung. Die oben genannten Managementmaßnahmen sollten unbedingt und so bald wie möglich umgesetzt werden, um die negativen Effekte, die der Tourismus zurzeit in diesem Bereich auf den Schildkröten ausübt, so gering wie möglich zu halten.

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ANHANG 1

Abbildung 1: Strand von Akgöl mit Liege- und Nistzone (über und unter roter Linie), Parkfläche (blauer Kreis) und Strandhütte (gelbes Viereck).
Figure 1: Akgöl beach with the nesting zone (above red line) and sunbeds (under red line), parking area (blue circle) and location of booth (yellow rectangle).

Abbildung 2: Abmessungen des kleinen Sandstrands am Ende von Akgöl (blau: 50 m, rot: 30 m), empfohlene Versetzung der Sonnenliegen Richtung Osten (gelber Pfeil)
Figure 2: Dimensions of the small sandy beach (blue: 50 m, red: 30 m), recommended relocation of the sunbeds in an eastward direction (yellow arrow)

ANHANG 2

Abbildung 1: Kleiner Sandstrand am Ende von Akgöl, Blick Richtung Osten
Figure 1: Small sandy beach at the end of Akgöl; view towards east

Abbildung 2: Kleiner Sandstrand mit Personen in Nistzone, Blick Richtung Westen
Figure 2: Small sandy beach with people in nesting zone; view towards west

Abbildung 3: Parkplatz, Nistzone links im Hintergrund
Figure 3: Parking area; nesting area in left background

Abbildung 4: Restaurant mit Hinweistafel über Meeresschildkröten
Figure 4: Restaurant with information board about sea turtles

Abbildung 5: Nest (weißer Pfeil)mit Leuten, Sonnenschirmen und Liegetüchern rundherum
Figure 5: Nest (white arrow) with people, umbrellas and beach towels around it

Abbildung 6: Sonnenschirm in Nistzone; weißer Pfeil: Nest
Figure 6: Umbrella in nesting zone; white arrow: nest

Abbildung 7: Hinweistafel über Verhaltensregeln am Niststrand
Figure 7: Information board about the dos and dont's on a nesting beach

Abbildung 8: Markiertes Nest in Akgöl
Figure 8: Marked Nest in Akgöl

Abbildung 9: 2013 aus Holz neu gebautes Strandbüffet am westlichen Ende von Akgöl.
Figure 9: In 2013 erected wooden hut used as a bufet at the western end of Akgöl.

Bachelor Thesis

Environmental education and public relations on a sea-turtle nesting beach near Fethiye, Turkey: The effect of beach-front "edutainment" programmes on public awareness

Umweltbildung und Öffentlichkeitsarbeit an einem Meeresschildkröten-Niststrand bei Fethiye, Türkei: Sind „Edutainment"-Programme am Strand ein sinnvoller Beitrag zur Öffentlichkeitsarbeit?

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Environmental education and public relations on a sea-turtle nesting beach near Fethiye (Turkey): The effect of beach-front "edutainment" programmes on public awareness

Birgit Bühler

KURZFASSUNG

Wie in vielen anderen Regionen der Welt, so ist auch in der Gegend um Fethiye (Türkei) der Tourismus ein Hauptfaktor für negative ökologische Entwicklungen im Allgemeinen und für eine negative Populationsentwicklung bei Meeresschildkröten, im Speziellen. Im Mittelpunkt dieser interdisziplinären Studie (Umweltpädagogik – Ökologie – Naturschutz) steht die Erstellung eines Umweltbildungsprogramms zum Thema Meeresschildkröten, sowie dessen mehrfache Erprobung tagsüber am Strand von Çalış im August 2013. Das komplette Umweltbildungsprogramm („Sea Turtle Quest") besteht aus 10 Stationen zu unterschiedlichen Aspekten des Themas Meeresschildkröten (Stationen 1, 2a, 2b, 2c, 3, 4a, 4b, 5, 6 und 7) und insgesamt 14 Aktivitäten. Das Programm kann jedoch nach Bedarf gekürzt und adaptiert werden (zum Beispiel für verschiedene Altersgruppen). Die „Sea Turtle Quest" wurde im Zeitraum 23.-27. August insgesamt fünfmal – an drei verschiedenen Orten am Strand von Çalış– erprobt. Insgesamt nahmen 134 Personen (Kinder und Erwachsene) aus fünf Nationen (Türkei, Großbritannien, Deutschland, Russland und Holland) teil. Das ergibt eine durchschnittliche Teilnehmerzahl von 27 Personen pro Durchgang. Im Zuge dieser Erprobung konnte auch ermittelt werden, inwiefern Touristen über die Präsenz von unechten Karettschildkröten (*Caretta caretta*) an diesem Strand informiert sind, inwiefern sie dieses Thema interessiert und ob ein solches Umweltbildungsprogramm einen sinnvollen Beitrag zur Öffentlichkeitsarbeit an einem Meeresschildkröten-Niststrand darstellen könnte. Das Ziel war, Informationen zu gewinnen und somit Empfehlungen bezüglich zukünftiger Aktivitäten im Bereich Öffentlichkeitsarbeit und Umweltbildung an Meeresschildkröten-Niststränden aussprechen zu können. Wie im Rahmen dieser Studie gezeigt werden konnte, ist das Programm „Sea Turtle Quest" ein vielseitig einsetzbares, flexibles Werkzeug für die Umweltbildung, das sich zum Einsatz auf jedem Meeresschildkröten-Niststrand eignet und somit zur Verbesserung der Koexistenz von Menschen und Meeresschildkröten – in Fethiye und anderswo – beitragen kann.

ABSTRACT

In the Fethiye region (Turkey), like in many other parts of the world, tourism is a major factor for negative ecological developments in general, and for declining sea-turtle populations in particular. This interdisciplinary study (educational science – ecology – conservation biology) is focused on creating an original, sea-turtle related environmental education programme and testing it on Çalış beach in several daytime sessions in August 2013. The full environmental education programme ("Sea Turtle Quest") consists of 10 thematic stations (Stations 1, 2a, 2b, 2c, 3, 4a, 4b, 5, 6 and 7) and a total of 14 activities. However, it can be shortened and adapted as needed (for example, for different age-groups). The "Sea Turtle Quest" was tested five times, at three different locations, on Çalış beach between 23 and 27 August. A total of 134 participants (children and adults) from 5 different nations (Turkey, Great Britain, Germany, Russia and the Netherlands) took part. This is equivalent to an average of 27 participants per session. These sessions also facilitated a preliminary investigation concerning the extent to which tourists and locals were informed about and interested in loggerhead sea turtles (*Caretta caretta*) and to determine whether such environmental education programmes would be effective in promoting public awareness of environmental and sea turtle issues. The aim was to obtain information which will be helpful in making recommendations for future, sea turtle-related, environmental education programmes and public relations strategies. As this study has shown, the "Sea Turtle Quest" is a versatile and adaptable tool for environmental education. It can be used on any sea turtle nesting beach, thereby contributing to a better co-existence of humans and sea turtles on the nesting beaches in the Fethiye region and elsewhere.

INTRODUCTION

In many parts of the world, tourism is a major factor behind negative ecological developments in general, and for declining sea-turtle populations in particular (Spotila 2004 and 2011).

The nesting data for loggerhead turtles at the beaches near Fethiye clearly show a negative population trend (Ilgaz et al. 2007; Casale & Margaritoulis 2010): This has been a cause for concern in recent decades and is certainly related to the gradual loss of nesting habitat as a result of tourism (Fellhofer & Stachowitsch 2005). The Fethiye beaches are more than 8 km long, consisting of three sections: Çalış , Yanıklar and Akgöl. Although they are major sea turtle nesting beaches – in particular for loggerhead turtles (*Caretta caretta*) – and were declared a Special Protected Area (SPA) in 1988, they are still threatened, especially by sand extraction, poorly controlled construction and tourism development (Casale & Margaritoulis

2010; MEDASSET 2012). As this situation is incompatible with the Fethiye beaches' status as a Special Protected Area, the non-governmental organisation "Mediterranean Association to Save the Sea Turtles" (MEDASSET) submitted a complaint to the Bern Convention in August 2009 and has been monitoring and assessing the situation closely ever since (most recent update: MEDASSET 2012; http://www.medasset.org).

Previous studies (for example: Rößler 2011; MEDASSET 2012) have demonstrated that the majority of tourists interviewed on the beaches near Fethiye are concerned about environmental issues in general, are interested in sea turtles and supportive of conservative efforts for this species. However, these studies also show that there is a general lack of basic information regarding "best-practice" conduct on sea-turtle nesting beaches (for example: an inadequate number and ineffective placement of notice boards, which are frequently damaged or removed within one or two seasons). On the positive side, the role of the information desk on the promenade at Çalış beach appears to be important in raising awareness and providing information for holiday-makers, at least for that particular nesting beach (Rößler 2011).

Nevertheless, my impression was that several passers-by are reluctant to stop at the information desk. While the reasons for this can be quite diverse, some observations may be relevant for future public relations strategies: For example, conversations with passers-by who were at first reluctant to stop at the information desk revealed that many of them thought that we were in fact selling "sea turtle excursions" to Dalyan. Also, it seems that many of the tourists who do visit the information desk – some of them on more than one occasion – have an above-average interest in animals, as well as in environmental and/ or animal protection issues. Although it will be impossible to interest everyone in sea turtle issues, the high number of people unaware of the presence of loggerhead sea turtles on Çalış beach shows that there is still room for improvement. But how can we attract those tourists who have no previous knowledge of sea turtle issues and are initially perhaps not even particularly interested in the topic? Modern teaching methods (for example: Gugel 2007; Michl 2009) used in environmental education may provide an answer.

A range of sea turtle related educational games and activities are available for download on the homepage of non-governmental associations such as ARCHELON (http://www.archelon.gr), ARKIVE (http://www.arkive.org), EUROTURTLE (http://www.euroturtle.org) and MEDASSET (http://www.medasset.org): These were collected in the preparation process for this contribution and they served as an inspiration while planning and writing the original programme "Sea Turtle Quest" presented here (APPENDIX I-III, with Fig. 1-16).

The main aim of this study was to create a programme of daytime, "beachfront" environmental education and public relation activities (see MATERIAL AND METHODS and APPENDIX I-III with Fig. 1-16 for details) and to test the working hypothesis that such activities will be helpful in increasing public awareness of sea turtle issues on Çalış beach. In this context, "testing" does not refer to any kind of formal, quantitative research. The numbers and percentages included in MATERIAL AND METHODS (Tab. 1) and the RESULTS (Tab. 2-3) were obtained by recording the number of participants and the relevant observations directly after each session of environmental education and public relations. Also included in the RESULTS and DISCUSSION are conclusions drawn from numerous conversations held with tourists and local residents on a variety of occasions: during the beachfront public relations programmes, at the information desk, after the evening talk given on July 7th at the "Sunset terrace" – a central location on the Çalış promenade – but also on a variety of other, informal occasions in shops, bars or on the beach.

The conclusions drawn from my fieldwork in Çalış during July and August 2013 are intended to assist in making recommendations for future, sea turtle-related, environmental education programmes and public relations strategies. The ultimate goal is to help improve the co-existence of humans and sea-turtles at the nesting beaches in Fethiye and elsewhere.

MATERIAL AND METHODS

The first step in the research process was to create an original programme of daytime, "beachfront" environmental education and public relation activities suitable for Çalış beach. One of the main requirements for such a programme was that it should be versatile and effective for attracting and informing a multi-age group (preferably both children and adults), multi-lingual audience as well as being mobile, inexpensive, fast and easy to transport, set up and carry out – preferably even by only one person. A key concept, both in modern museum studies and educational science, is that objects and pictures are crucial in transporting meaning. Therefore, a well-chosen assemblage of objects and/ or images can "say" more than many words (Gugel 2007). Educational trails are an established outdoor teaching method (Arnberger & Eder 2007) for transporting a variety of topics (for example: biology, ecology, history and cultural aspects). In Austria, there are a multitude of educational trails (http://www.lebensministerium.at/umwelt/natur-artenschutz/lehrpfade), focusing almost exclusively on biological and ecological topics. Recently, the concept of educational trails has also been applied to marine biology, for instance for teaching divers about coral reefs (http://www.blue-water-dive.de/de/reefeducation_de.php). Per definition, educational trails

are permanent installations, but I have attempted to adapt the concept for the purposes outlined above, by creating a mobile, inexpensive version.

With this concept in mind and drawing on my previous experience in environmental education and museum studies, I created the "Sea Turtle Quest" (APPENDIX I-III, with Fig. 1-16) – an interactive and mobile "educational trail" consisting of 10 stations, with 14 matching activities. The creative process and preparations (such as: choosing, acquiring and making equipment, writing multi-lingual texts and signs in English, German and Turkish) took place between May and August 2013. I have written all the texts in APPENDIX I-II. The total costs for the equipment were approximately 80 Euro. The "Sea Turtle Quest" was tested five times, at three different locations, on Çalış beach between 23 and 27 August (see Tab. 1, below). Due to the hot weather at this time of year, these activities were held in the late mornings. While sessions 1 and 2 were pre-announced (by a sign at the information desk, several days in advance), sessions 3 to 5 were "spontaneous" events.

Tab.1: Basic Data regarding participation in the Sea Turtle Quest Sessions on Çalış beach
Tab. 1: Sea Turtle Quest Sessions: Daten bezüglich Teilnahme (Prozentwerte abgerundet)

Session Nr.	Date	Time	Place	Total Nr. Participants	Children Nr. (%)	Adults Nr. (%)
1 (pre-announced)	23.08.	10:15-12:45	CME	17	7 (41 %)	10 (59 %)
2 (pre-announced)	24.08.	10:30-12:00	CME	32	8 (25 %)	24 (75 %)
3 (spontaneous)	26.08.	10:45-11:45	CBC	6	2 (33 %)	4 (67 %)
4 (spontaneous)	26.08.	12:00-13:15	CME	37	20 (54 %)	17 (46 %)
5 (spontaneous)	27.08.	10:45-12:45	CT	42	10 (24 %)	32 (76 %)
Total	-	-	-	134	47 (35 %)	87 (65 %)

The "Sea Turtle Quest" (detailed description in APPENDIX I-III and Fig. 1-16) consists of a set of 10 thematic stations (= Stations 1, 2a-c, 3, 4a&b, 5, 6 and 7) with 14 matching activities. The stations and activities are intended to be suitable for a variety of age-groups, although it is aimed mainly at children between the ages of about 8-12 years. These activities can be strung together to form a complete environmental education programme, which can be carried out with a group of children and accompanying adults. The full programme (see Fig.

14) takes about 20-30 minutes (for the age-group 8-12 years), although it can be shortened for younger participants (see Fig. 15) or expanded if more time is available. The programme provides basic information on sea turtles and their life cycle, as well as addresses general environmental issues and the problems associated with tourism on a sea turtle beach. Participants follow the sea turtle life cycle, from the moment the adult female arrives on the beach looking for a suitable place to nest, via the nesting process and the adults' return to the sea, the incubation period, to the hatching process and the hatchlings' perilous journey to the sea. The activities included in the "Sea Turtle Quest" employ a variety of modern teaching methods, such as the "empathic" (http://www.parentmap.com/article/compassion-changing-the-world-through-empathy-and-education) and "investigative" approaches (http://investigating-science.wikispaces.com/Theory), as well as games and creative activities. For example, stations 1 (= activity 1; "Message in a Bottle", Fig. 3), stations 3 (= activity 5a; "The Sea Turtle's Eye View", Fig. 6) and activity 5c ("Making a Nest") encourage the participants to empathize with the adult sea turtle in its desperate search for a suitable nesting place in a changed environment. The program begins with the "Message in a bottle" (APPENDIX II), written by a turtle who wanted to nest on her native beach for the first time, but turned around because she was shocked by the changes that had taken place and is now asking for the children's help. In the course of this "quest", through messages, activities and games, the participants will discover the "Do's and Don'ts" of a sea-turtle nesting beach. They will also obtain some basic information on sea turtles and on marine biology and ecology in general. In contrast, station 4a (= activity 5b; "Sea Turtle Nest", Fig. 7-8) and station 5 (= activity 6; "Where's the Sea, please?"; Fig. 10) are good examples of the "investigative method", permitting participants to solve an object-based puzzle, using a number of simple clues. The programme can be adapted to suit different age-groups and to fit the time available, for example by selecting only some of the activities or by allowing more time for the creative activities or games.

Importantly, the beach-front exhibits are also aimed at "casual" visitors, who may stop to have a look while walking on the beach. This is particularly challenging, because the key message transported by the individual "stations" should be understandable at a glance – at least for adults and older children – but still intrigue passers-by, making them want to know more about the topic. Ideally, they will then ask the environmental educator for more information. This can be followed by a conversation (in English, German or Turkish) about sea turtles or even a short "guided tour" of selected stations of the "Sea Turtle Quest" (see Fig. 16). The most frequently asked questions are summarised in RESULTS. Information material (in Eng-

lish, German, Turkish and Russian) was also distributed on such occasions and all participants were given a "souvenir turtle" made from pebbles found on Çalış beach.

RESULTS

The "Sea Turtle Quest" (see MATERIAL AND METHODS and APPENDIX I-III) was carried out five times, at three different locations on Çalış beach, between 23 and 27 August, in the late morning until around noon. Sessions 1, 2 and 4 took place on the beach near Çalış beach main entrance (= CME; Fig. 1), where the sign with sea turtle information is located, near the information desk. Session 5 took place on Çalış beach just below the "Sunset Terrace" (= CT; Fig. 13), and session 3 took place on the beach between the Caretta Beach Club and Letoon Hotel (= CBC).

The results are divided into three parts: Participation, Feedback about the Sea Turtle Quest and Frequently Asked Questions.

Participation (see also Tab. 1, above):

Tab. 2: Participants' Awareness that Çalış Beach is a Sea Turtle Nesting Beach (= STNB), prior to taking part in the Sea Turtle Quest (= STQ).
Tab. 2: Anteil der Teilnehmer, die bereits vor dem Programm wussten, dass Çalış ein Meeresschildkröten-Niststrand ist.

Session Nr.	Total Nr. Participants	Aware that Çalış is a sea turtle nesting beach (before STQ)	% STNB Awareness before STQ
1	17	8	47 %
2	32	23	73 %
3	6	3	50 %
4	37	22	61 %
5	42	7	18 %
Total	134	63	47 %

Tab. 3: Nationality of Participants.
Tab. 3: Nationalität der Teilnehmer.

Session Nr.	Total Nr. of Participants	Turkey	Great Britain	Germany	Russia	Netherlands
1	17	5 (29 %)	-	5 (29 %)	5 (29 %)	2 (12 %)
2	32	11 (34 %)	13 (41 %)	8 (25 %)	-	-
3	6	3 (50 %)	-	3 (50 %)	-	-
4	37	15 (41 %)	6 (16 %)	10 (27 %)	4 (11 %)	2 (6 %)
5	42	35 (83 %)	4 (10 %)	3 (7 %)	-	-
Total	134	69 (52 %)	23 (17 %)	29 (22 %)	9 (7 %)	4 (3 %)

A total of 134 participants (children and adults) took part in the 5 sessions, yielding an average of 27 participants per session. However, the number of participants was quite variable (6-42 persons), also due to the variable duration and location. The results in Tab. 1 suggest that the beach near Çalış beach main entrance (= CME; Fig. 1) and just below the "Sunset Ter-

race" (= CT; Fig. 13) are more suitable locations than the section of beach near the Caretta Beach Club (= CBC). Also, the number of participants in the pre-announced Sessions 1 and 2 was not significantly higher than in the "spontaneous" Sessions 3 and 4.

With the exception of Session 4, there were always more adult participants than children, which may be because it was already the final week of summer holidays in many countries, including Turkey. However, this provided a good opportunity for testing whether the stations were also interesting for adult participants and the results were encouraging.

The average percentage of people who were aware (prior to the programme) that Çalış beach is a sea turtle nesting beach is 47 %, considerably lower than the number given by Rößler in 2011 (62 %). However, this value varied considerably between sessions and the extremely low value for Session 5 suggests that there may be a difference between national and international tourists (see DISCUSSION).

The participants of the "Sea Turtle Quest" came from 5 nations: Turkey, Great Britain, Germany, the Netherlands and Russia. This fits well with the results obtained by Rößler (2011), which show that most tourists on Çalış beach come from one of these 5 countries. The "Sea Turtle Quest" was held in the languages of 3 of these 5 countries (English, German and Turkish). The adult participants from the Netherlands and Russia all spoke either fluent English or German and translated for their children.

Feedback:

The feedback for the beach-front environmental education program was very good. Many passers-by and participants gave positive feedback and, in every session, at least some of the participants expressed their appreciation – not only of this activity, but of the Sea Turtle Project as a whole.

The test-runs carried out on Çalış beach in August 2013 have demonstrated that the "Sea Turtle Quest" is indeed a versatile and adaptable tool for environmental education on a sea turtle nesting beach. Although this course of mobile beach-front sea-turtle stations and activities was developed initially as an environmental education programme for children of different ages, the test-runs showed that it is at the same time an effective public relations strategy: it can be used to catch the attention of adults with little previous knowledge and/ or interest in sea turtle issues. Therefore, it is also a mobile and interactive source of information which appears to reach even an audience which might just walk by the evening information desk without stopping. Therefore, the day-time beach-front program complements the evening information desk and is presumably more effective than expanding the opening hours of the

information desk, firstly, because the majority of holiday-makers are on the beach during the day and secondly, because it is more interactive. In addition to this, my impression is that the most effective strategy is to inform the public about sea turtles right "on site" – on the nesting beach itself. "Real" sea turtle nests with protective cages, as well as actual obstacles and dangers present "on site" (for example: beach furniture, umbrellas, holes in the sand and garbage) are incorporated spontaneously into the environmental education programme.

Also, selected stations of the Sea Turtle Quest can be taken to and arranged around the information desk on the Çalışpromenade in the evening: Stations 2 a-c, 4a, 5 and the creative activity (making souvenir turtles from pebbles) are particularly suitable and the life-size turtle from station 3 can be "embellished" with multi-lingual information. I tried this out on two evenings (19 and 21 August) and it attracted numerous children (and their parents) to the information desk. One problem, however, is the lack of space around the information desk and also that the stations look more attractive on the beach, in daylight.

Elements of surprise and humour are crucial in provoking interest. This is an important aspect in any educational programme and was also taken into consideration when creating the "Sea Turtle Quest": A number of people present on the beach or the promenade said that they were reluctant at first to get up and look at the stations of the "Sea Turtle Quest", but did so eventually because they became curious. Stations 4a ("Sea Turtle Nest"; Fig. 7-8), 4b ("S.O.S"; Fig. 9) and 5 ("Where's the Sea, please?"; Fig. 10) illustrate this point (see Appendix I-III for details): They attracted a high number of adult passers-by, many could not figure out the "puzzle" about the role of temperature immediately (Fig. 7), thus became curious and asked for information. At the same time, the fake "sea-turtle" eggs (= ping-pong balls) and sand toy "hatchlings" at Station 4a were extremely attractive for (small) children (Fig. 8). Similarly, Stations 2a ("Life in the Sea") and 2b ("The Food Chain") are suitable even for very young children, but several parents said that they learnt new things here, such as the differences between tortoises and sea turtles, what sea turtles eat, or other interesting facts about sea turtles. Also, many adults were not aware – prior to participating in the "Sea Turtle Quest" – that there is actually a real sea turtle nest in the sand below the protective cages.

<u>Top-Ten Frequently Asked Questions:</u>

- Do the adult sea turtles come here now? When do they usually come (time of year, day/ night)?
- When do the young sea turtles hatch (time of year, day/ night)?
- Is it the same species of sea turtle as in Dalyan?

- Various questions about the project, such as: Do you work here alone? How big is the group? Where are you from? How long are you here? How is the project financed?
- How do you know when the young turtles will hatch? How long does it take until they hatch (incubation time)?
- Can we see the turtles? Where? When?
- What are the cages on the beach for?
- How many eggs are there in a nest?
- How big are the (adult/ young) sea turtles?
- What do sea turtles eat?

The results fit well with those obtained by Rößler in 2011. Also, most topics included in this list are included in the topics covered by the "Sea Turtle Quest" (see APPENDIX I-III).

DISCUSSION

My working hypothesis at the beginning of this study was that the effectiveness of the information desk of the Sea Turtle Project on Çalışpromenade could be enhanced by offering a number of additional, sea turtle-related activities – especially interactive beach-front "edutainment" programmes, carried out during the daytime and aimed primarily, although not exclusively, at children. As the RESULTS show, this hypothesis was verified.

Due to the positive result regarding the beach-front programme, I would suggest continuing day-time environmental education activities on Çalış beach, on a regular basis, throughout July and August. The high temperatures in July and August are a limiting factor for the timing and duration of day-time environmental education activities on Çalış beach. However, my fieldwork has shown that the late mornings are quite suitable, with bearable temperatures until about noon and a sufficient number of potential participants already present on the beach. And although the final week of August was perhaps not the ideal time to test an environmental education programme, because it was already at the end of the school holidays and there were fewer schoolchildren present on Çalış beach than before, the number of participants (Tab. 1) was more than satisfactory. Announcements in local hotels and bars, several days ahead of time, could further increase the number of participants. The "Sea Turtle Quest" could also be held – as a "pre-arranged event" – at individual hotels as part of their children's animation programme, perhaps in combination with a lecture on sea turtles for the adults. In this context, it may be worthwhile expanding the programme to include more educational games and activities: Ample educational resources are available on the homepages of non-

governmental associations like ARCHELON (http://www.archelon.gr), ARKIVE (http://www.arkive.org), EUROTURTLE (http://www.euroturtle.org) and MEDASSET (http://www.medasset.org).

Nevertheless, I would strongly recommend also continuing to carry out the "Sea Turtle Quest" on Çalış beach "spontaneously" several times a week in July and August, by choosing a place on the beach where there are a lot of people. For example, although Sessions 4 and 5 (see Tab. 1-3) were "spontaneous events", participation, interest and feedback were very good. Session 4 was "international" (5 different nationalities took part), with a quite high level of pre-informed participants (60.5 %). However, in Session 5, where the majority of participants were Turkish, the level of awareness about sea turtle issues before the programme was surprisingly low (17.7 %). A possible explanation could be that at least some international tour operators are now informing their customers about the presence of sea turtles on the beaches near Fethiye, while perhaps the national tourists – many of them from big cities in Turkey – did not have this source of information: Quite a few international tourists (British, German, Russian, Dutch) told me that they had heard about sea turtles from their tour operators – but not a single Turkish tourist said this. For those Turkish tourists who were in fact already aware of sea turtle issues prior to the programme, the media, the Sea Turtle Project information desk or friends and relatives from Fethiye appear to have been the major sources of information. In the study by Rößler (2011), 62 % of the tourists interviewed were aware of the presence of sea turtles on Çalış beach: I determined a somewhat lower value, an average of 47 %. However, as can be seen in Tab. 2, the results varied between the different sessions and – as discussed above – seem to be much higher for international than for national tourists. However, in contrast to Rößler (2011), I did not carry out a formal quantitative study with questionnaires, but only a preliminary inquiry. Therefore, it may be worthwhile doing formal quantitative research with questionnaires – in combination with the "Sea Turtle Quest" – in the years to come: In this context, the environmental education programme could be helpful in motivating people to participate in such a survey – for example, while their children are still busy making souvenir turtles from pebbles on the beach (= Station 7 of the "Sea Turtle Quest").

In any case, these results, once again, demonstrate the importance of informing tourists on the Fethiye beaches about sea turtle issues and about appropriate behaviour on a sea turtle nesting beach. Generally speaking, there is enormous potential for environmental education in Turkey. In a recent on-line paper (Neel 2011; http://www.todayszaman.com/news-257839-environmental-groups-work-to-raise-turkeys-ecological-iq.html), environmental issues are

referred to as an "invisible problem" in Turkey, to which the answer must be more education, preferably starting from an early age. In this context, *Caretta caretta* may also serve as a "flagship species" for furthering public awareness of environmental issues in Turkey. The problem of huge amounts of plastic garbage in the marine environment is a good example. An alarming number of people feel – incorrectly, of course – that this is an "abstract" problem, which does not concern them. Drawing attention to the fact that sea turtles frequently confuse plastic bags floating in the water with jellyfish and may die as a result, can be extremely helpful in increasing public awareness of marine pollution because a concrete, "real-life" example is given. This example is particularly effective because it causes people to empathize with marine fauna suffering from (plastic) pollution.

In conclusion, the "Sea Turtle Quest" is a versatile and adaptable tool for environmental education on a sea turtle nesting beach. It is suitable both for groups and for individual participants and can be used on any sea turtle nesting beach, in Turkey and elsewhere. An extended version of the programme – with additional activities and information – would also be suitable for schools, for example as part of a school outing to the beach on "World Oceans Day" (8 June), or "World Turtle Day" (23 May).

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APPENDIX I

"Sea Turtle Quest" (Environmental education programme for group aged about 8-12 years; created by B. Bühler) – Basic Outline (Fig. 2 and 14):

The full programme should start and end on the upper part of the beach, near one of the beach entrances, and follow an approximately s-loop-shaped route, alternating between the upper and lower part of beach. However, the arrangement of the stations is flexible and can easily be adapted to the situation on the beach (for example: amount of space available, location of objects already present on the beach and included in the programme, such as "protective cages" and beach furniture) and to the age, interest and previous knowledge of the participants. Subject to demand, I was able to present the programme in three languages: English, German and Turkish.

The individual stations and activities are described below, with reference to necessary equipment and the main topics covered. For some of the stations and activities, examples of what the educator could say (in inverted commas) are also given. These are, however, only suggestions and must be adapted to the actual audience of the session (age, previous knowledge/ interest, time available).

Preliminary Activity (for group programme): "True/ False Game 1"

This activity leads the group from the upper part of the beach to the pebble zone, where they find the message in a bottle. The game is played as follows: The group leader makes a statement about sea turtles (for example: "Sea turtles lay eggs. True or false?"). Each participant decides whether the statement is true or not and responds either by putting both arms up in the air (= true) or by crossing their arms, with one hand on each shoulder (= false). The answer is then announced and all participants who have given the correct answer may take one step forward. The game can be played until all participants have reached the "finish line", where the "message in a bottle" is located. Alternatively, the game can end when the first participant finds the "message in a bottle" (see below). In any case, the number of steps needed from start to finish line is a good indicator of the participants' previous knowledge about sea turtles.

Sea Turtle Quest Station 1 (= Activity 1): "Message in a Bottle" (Fig. 3)

Topics and key statements: Introduction to the problems associated with tourism on a sea turtle beach and basic information on the sea turtles' life cycle; introduction to the issues of plas-

tic waste and recycling ("Let's put the bottle in the bin – no, in fact it would be much better if we use it again!").

Equipment: Plastic bottle with message (see APPENDIX II) and photo of sea turtle, attached to "turtle messenger" (= small plastic turtle) using a ribbon.

Sea Turtle Quest Station 2a (= Activity 2): "Life in the Sea" (Fig. 4 and 8)

Topics and key statements: Why are sea turtles special? Where/ how do they live? Why/ when/ how often do they visit the beach? Which animal lives where?

Compare tortoise – sea turtle with help of toy figures: Adaptations to life on land (= can hide in shell, limbs adapted to walking) vs. adaptations to life in the sea (= cannot hide in shell, limbs adapted to swimming).

Equipment: Toy animals (sea/ land – sea turtles, tortoises, dolphin, shark, seal, penguin, sea star etc.); plastic image depicting sea and land (to simulate habitats).

Activity: Children place toy animals in correct habitat and compare sea turtles with tortoises. Optional "Sea Turtle Quiz" with quiz cards in sea shells, for example: Maximum turtle speed in the water vs. on land; other "turtle" records (size, weight, deep diving).

Sea Turtle Quest Station 2b (= Activity 3): "The Food Chain" (Fig. 4)

Topics and key statements: What do sea turtles eat? Who likes to eat sea turtles or their eggs? Why are sea turtles important in this world?

Equipment: Toy animals plus "turtle food" (examples: real sea-grass, pictures of jelly-fish and crabs, sand toys shaped like clams and sea-stars, etc.); plastic image sea and land (to simulate habitats).

Activity: Children identify "turtle food" and "turtle predators" and arrange the relevant objects accordingly; concept of food chain may be introduced (if suitable for the group).

Sea Turtle Quest Station 2c (= Activity 4): "Dangers in the Sea" (Fig. 5)

Topics and key statements: What other dangers are there for sea turtles in the sea and on land? Why are their numbers decreasing?

For example: "Most sea turtles love to eat jellyfish. There is an object here which looks a little bit like a jellyfish but is actually rubbish: Can you find it? Yes, sea turtles often confuse plastic bags with jellyfish and this is very dangerous for them because the plastic blocks their stomach and they often die as a result".

“Please never just leave your rubbish lying around – always put it in the rubbish bin! And when you go shopping, don’t take a new plastic bag every time – try to re-use them as often as possible. Or even better: Use a basket or a textile shopping bag instead of plastic bags!”

Equipment: Toy animals and danger pictures (examples: jellyfish – plastic bag, commercial fishery, speedboat/ jet-ski)

Activity: Children identify and discuss dangers for sea turtles; introduce concept of “endangered species” if suitable for the group.

Sea Turtle Quest Station 3 (= Activity 5a): “The Sea Turtle’s Eye-View” (Fig. 6)

Activity: One child lies down on the large plastic turtle and/ or airbed and plays the role of a mother sea turtle. Assisted by the group, “mother sea turtle” crawls up the beach in search of an ideal place to nest, starting in the pebble zone and, past several man-made obstacles (sunbeds, umbrellas, holes in the sand, rubbish etc.) – imitating the movements, observing the ground and looking for soft sand, avoiding obstacles and so on.

Equipment: “Life-size” plastic sea turtle (plus airbed).

Topics and key statements: “Imagine you are a grown-up sea turtle – you are 30 years old, your shell is about 70 cm long and you weigh about 100 kg! You are an excellent swimmer, using your long front flippers to fly through the water like birds fly through the air”.

Swimming: “Try swimming like a sea turtle.”

Crawling up the beach:

“Imagine that you are a mother sea turtle which has just arrived at Çalışbeach. Where would you dig your nest?”

“Yes, definitely not among the stones at the sea-front, but in soft sand and far enough from the water to avoid the nest being flooded. So let’s crawl up the beach and look for a suitable place! Can you see how difficult it is to crawl up the beach?”

The group identifies and helps the “sea turtle” avoid man-made obstacles on the beach (sunbeds, tables, umbrellas etc.):

“Unfortunately, the beach is full of obstacles for our mother turtle...what are these obstacles...why are they here...how could we make mother sea-turtle’s journey up the beach easier?”

“Many sea-turtle nests are about 20 m away from the water. Mother sea turtles need a dry place with soft sand to dig their nests – but crawling with flippers on land is not easy!”

“Sea turtles like: soft, dry sand. Sea turtles don’t like...stones, hard sand, sunbeds, umbrellas etc. Because sea turtles have flippers instead of feet, it is much easier for them to swim than to move on land!”

“The whole process of crawling up the beach in search of a suitable place, digging the nest, laying the eggs, covering them with sand and returning to the sea may take a sea turtle up to 2 hours”.

Sea Turtle Quest Station 4a (= Activity 5b): “Sea Turtle Nest” (Fig. 7 and 8)

Topics and key statements: Appearance of sea turtle tracks, nests and eggs; incubation; temperature-dependent sex determination.

Equipment: Photo of adult turtle tracks and nest; ping-pong balls, thermometer, postcard of hatchling with additional clues regarding temperature-dependent sex determination; toy turtles and/ or stone turtle.

Activity: Attempting to solve the puzzle: Why is temperature important for sea turtle eggs?

Activity 5c: “Making a Nest”

Topics and key statements: The nesting process, return to the sea, incubation, hatching.

“Congratulations! You have found a suitable place – now our sea turtle can start digging a nest! Mother turtle first clears away the sand on the surface with her front flippers. Then she digs a nest about half a metre deep with her hind flippers. Try clearing away sand with your front flippers and then digging a hole with your hind flippers! Let’s all try digging with our feet! Hard work, isn’t it? After laying her eggs into the nest (average number 80 eggs per nest), she covers the eggs with sand”.

“Mother sea turtle then returns to the sea and leaves the nest on its own. The sand warms the eggs. After about 45-60 days the young turtles hatch from their eggs and try to reach the sea as fast as they can”.

Clue for finding Station 4b: “Normally, sea turtle nests are hard to spot. But there is one near here which is easy to recognize because it is protected by a man-made object. Can you find it?”

Equipment: “Life-size” plastic sea turtle (plus airbed); ping-pong balls.

Activity: One child lies down on the large plastic turtle and/ or airbed and plays the role of a mother sea turtle.

Sea Turtle Quest Station 4b (= Activity 5d): "S.O.S. = Save Our Sea-Turtles" (Fig. 9)

Topics and key statements: How to recognise a sea turtle nest; role of the protective cage.

"This cage is here to protect the sea turtle nest from damage by people or animals. We (= volunteers who are trying to help the turtles) have put one over each (known) sea turtle nest on this beach. But there is another reason why we are using these cages and this has something to do with the way young sea turtles see the world".

Clue for finding Station 5: "Look for a young turtle which seems to have problems finding its way to the sea".

Equipment: A "real" sea-turtle nest with a protective cage; picture of nest with hatchling tracks; stone turtle.

Activity: Finding a "real" nest and understanding what the cage is for.

Sea Turtle Quest Station 5 (= Activity 6): "Where is the sea, please?" (Fig. 10)

Topics and key statements: Introduce problem of hatchling disorientation caused by artificial lights; role of the protective cage (continued from Station 4b).

Clue: "Young turtles (hatchlings) find the sea by running towards the brightest place they can see. If the moon is the only light over the beach, this place is the sea. Have you been on the promenade at night? Can you figure out why this young turtle did not find the sea?"

Equipment: Toy turtles plus sign.

Activity: Finding the "disorientated hatchlings" (toy turtles) located just below a lamp on the promenade and figure out why they came here instead of running towards the sea.

Sea Turtle Quest Station 6 (= Activity 7): "Hatchlings in Danger" (Fig. 11)

Topics and key statements: Dangers in the sea: "Natural" predators (fish etc.); humans (and their motor boats, jet-skis, fishing nets and hooks, garbage etc.); dangers and obstacles on the beach (beach-furniture, umbrellas, rubbish, holes in the sand), loud noise, fire/ bright lights, people on the beach at night.

"Imagine you are a young turtle which has just left its nest (hatchling). Your shell is only about 4 cm long. You need to run to the sea as fast as you can! Are there any obstacles in your way? And why do you need to run and swim so fast? What / who must you be afraid of if you are a sea turtle on land / in the sea? How can we help make the beach a better place for sea turtles? Do you have any ideas?"

Equipment: Real obstacles on the beach; "danger" pictures; "symbolic man-made dangers" (small shovel and tiny umbrella).

Activity: Viewing the beach with a sea turtle hatchling's eyes; considering dangers for sea turtles (continued from Station 2c).

Activity 8: "Race to the Sea"

Topics and key statements: "Now let's imagine it is dark and we are taking our hatchlings to the sea. It is important that they walk at least a few metres on this beach, so that they can remember what it feels like once they return to it as adults, 20-30 years later. They also need to prepare their bodies for swimming away from the beach as fast as they can."

Equipment: Toy turtles from Stations 4a and 5; dice.

Activity: Children simulate the hatchlings' race to the sea with toy turtles found earlier (at Stations 4a and 5), by playing a game: Casting a dice and taking steps forward.

Sea Turtle Station 7 (= Activity 9): Creative Activities (using pebbles; Fig. 12)

Make own "souvenir turtle" by gluing together pebbles collected on the beach; or ready-made "souvenir turtle" for participants (together with information material for parents).

Additional/ alternative activity: Use pebbles to write a message for mother sea turtles ("Sea Turtles Welcome!" etc.).

Concluding Activity: "True/ False Game 2"

Repeat "True/ False Game" as above ("Preliminary activity"), but from the pebble zone to the upper part of the beach (Optional: Find "treasure" – small prizes, such as buttons, for participants – at finish line, near promenade wall).

APPENDIX II

Message in a Bottle (Text created by B. Bühler; the text fits on a single A4 page):

Welcome to my native beach, children! Yes, I hatched from an egg, about the size of a ping-pong ball, right here on this beach about 30 years ago!! I cannot say exactly when I was born – unfortunately, we sea turtles don't have birth certificates…

Since then, I have travelled far, I have swum thousands of kilometres through the seas of the world, I have grown and grown…my shell is now about 75cm long! I am now finally an adult sea turtle and must start to lay eggs. According to sea turtle law, this should be on the same beach where I myself hatched, like my mother, my grandmother, my great-grandmother and all my other ancestors before me!

You know what? We sea turtles have lived on Earth much longer than you humans have – about 150 million years! That is a long time!!! We lived at the same time as the dinosaurs, can you imagine that? But the dinosaurs died out, eventually, and we survived – I hope you're impressed?!

Well anyway…This beach here – I think you humans call it "Çalış beach", don't you? Just 30 years ago, it was a perfect place for sea turtles to lay their eggs: Lots of soft, warm sand…perfect for digging a nest! And nice and quiet, too!! The only light I saw when I hatched from my egg was the moonlight reflected by the water and this light told me where to go – to the sea, as fast as I could, before seagulls, crabs, dogs or other hungry animals could catch me!

So, what a shock for me when I arrived here last night: There were bright lights everywhere, lots of noise and so many humans!!! How confusing! What are they all doing on the beach at night?? I thought you humans normally sleep at night? Don't you sleep anymore at night??

I swam up and down along the shore of Çalış beach last night for hours, but I couldn't find a quiet, dark place where I could crawl out, dig a nest and lay my eggs. So I turned around and swam back out to the place which you humans call "Fethiye bay": Out there, I met lots of other mother sea turtles who were all looking for a quiet beach to lay their eggs. Some of them were much older than me – 40, 50 years, perhaps even much older – and they told me: "It seems to get worse every year – have the humans gone crazy? Why are there so many of them on our nesting beaches at night? And all these awful lights…scary…so confusing! Where should we go? What can we do??"

So we decided to send you humans this message: Please help us! We have to lay our eggs on this beach as soon as possible, or we will lose them. And if we lose our eggs, we will have no

children and no future and eventually, sea turtles will disappear from this planet, just like the dinosaurs…Do you want to help us?? Yes?? Then please stay away from the beach at night and please turn off these horrible lights and all this noise! It's ok for you to use our beach during the day but please be careful, because some mother turtles may already have buried their eggs in the soft sand. And please tell your friends and family what you have learnt today.
We have left some more messages for you on this beach…if you follow the clues, you will find out more about us sea turtles!

APPENDIX III (Figures)

Fig. 1: Çalış Beach Main Entrance (CME)
Abb. 1: Çalış Haupteingang zum Strand (CME)

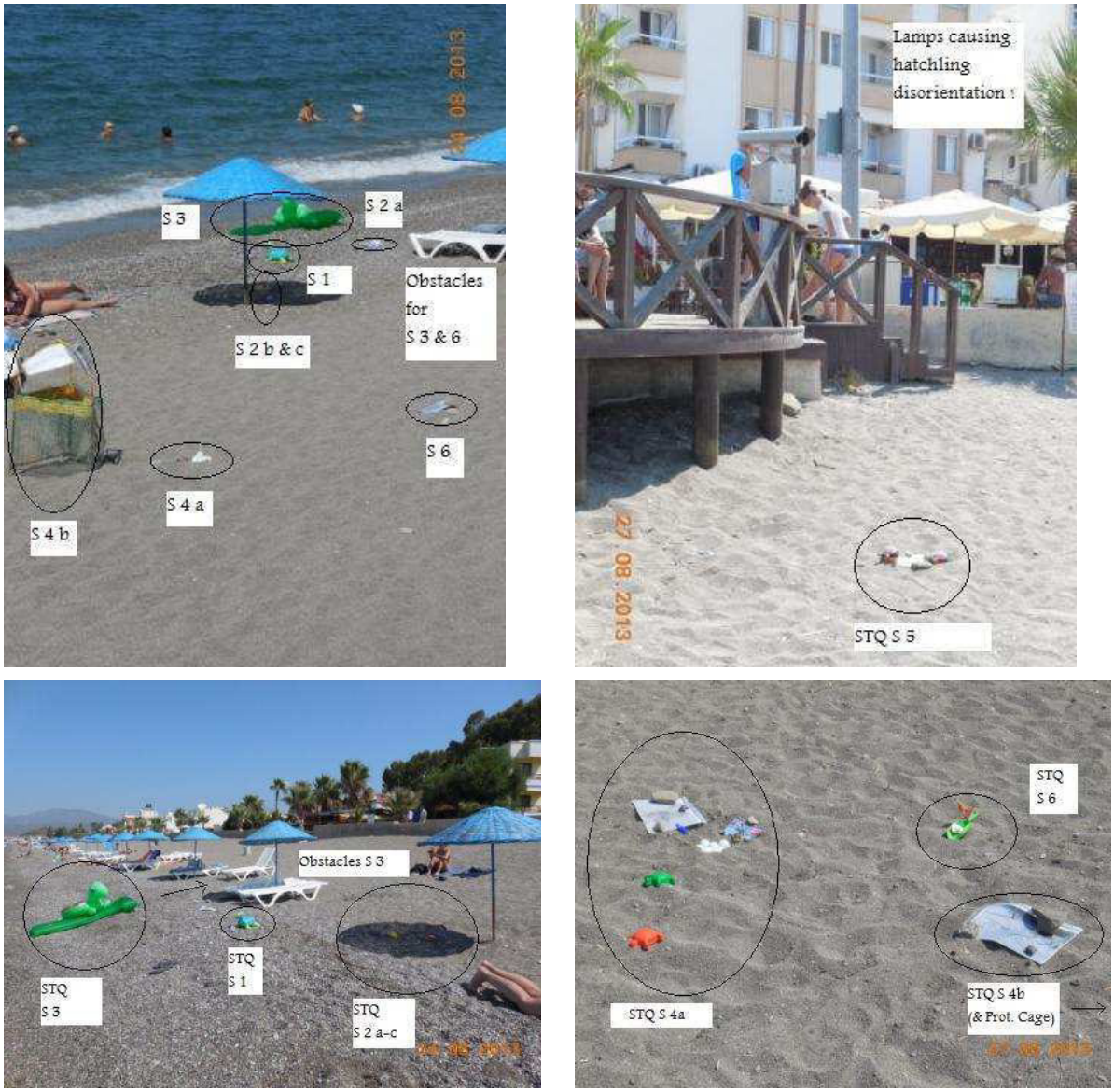

Fig. 2: Sea Turtle Quest Stations (STQ S) 1-6, Overview
Abb. 2: Sea Turtle Quest Stationen (STQ S) 1-6, Überblick

Fig. 3: Sea Turtle Quest Station 1: “Message in a Bottle”
Abb. 3: Sea Turtle Quest Station 1: “Flaschenpost”

Fig. 4: Sea Turtle Quest Station 2a (“Life in the Sea”) and 2b (“The Food Chain”)
Abb. 4: Sea Turtle Quest Station 2a (“Leben im Meer”) und 2b (“Nahrungskette”)

Fig. 5: Sea Turtle Quest Station 2c: “Dangers in the Sea” (Speedboats, commercial fishery, rubbish)
Abb. 5: Sea Turtle Quest Station 2c: “Gefahren im Meer” (Motorboote, Fischerei, Müll)

Fig. 6: Sea Turtle Quest Station 3: “The Sea Turtle’s Eye View”
Abb. 6: Sea Turtle Quest Station 3: “Aus der Sicht der Meeresschildkröte”

Fig. 7: Sea Turtle Quest Station 4a: „Sea Turtle Nest“
Abb. 7: Sea Turtle Quest Station 4a: “Meeresschildkrötennest”

Fig. 8: Sea Turtle Quest in Action (Stations 4a and 2a)
Abb. 8: Sea Turtle Quest in Aktion (Stationen 4a und 2a)

Fig. 9: Sea Turtle Quest Station 4b: “S. O. S.” (left = protective cage and multi-lingual information; right = photo of nest & hatchling tracks & “hatchling” made from pebbles)
Abb. 9: Sea Turtle Quest Station 4b: “S. O. S.” (links = Schutzkäfig und mehrsprachige Information; Rechts = Foto v. Nest mit Hatchling Spuren & „Hatchling“ aus Kieselsteinen)

Fig. 10: Sea Turtle Quest Station 5: “Where is the sea, please?” (Solution of the puzzle: Lamp causes hatchling disorientation)
Abb. 10: Sea Turtle Quest Station 5: “Wo ist das Meer, bitte?“ (Auflösung des Rätsels: Wegen der Lampe laufen die Hatchlinge in die falsche Richtung)

Fig. 11: Sea Turtle Quest Station 6: “Hatchlings in Danger”
Abb. 11: Sea Turtle Quest Station 6: “Junge Meeresschildkröten in Gefahr”

Fig. 12: Sea Turtle Quest Station 7: Creative Activity (souvenir turtles made from pebbles)
Abb. 12: Sea Turtle Quest Station 7: Meeresschildkröten aus Kieselsteinen basteln

Fig. 13: Meeting Point for Sea Turtle Quest on Çalış Beach “Sunset Terrace: “CT” = Çalış Terrace.
Abb. 13: Treffpunkt für Sea Turtle Quest am Çalış Beach, „Sunset Terrace“ („CT“ = Çalış Terrace)

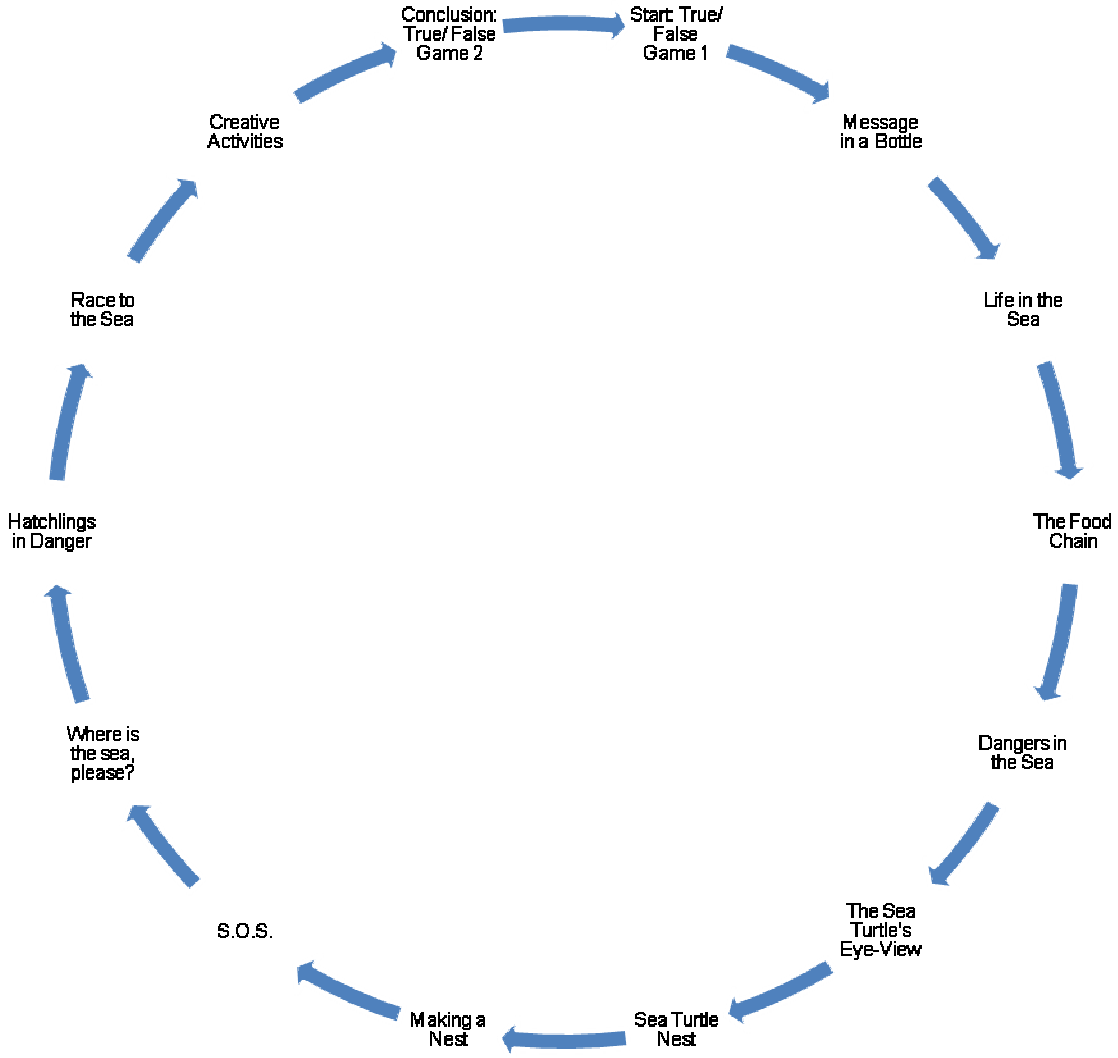

Fig. 14: Sea Turtle Quest (created by B. Bühler), summary of full version (for children aged around 8-12 years and their parents)
Abb. 14: Sea Turtle Quest (von B. Bühler), Zusammenfassung der Gesamtversion (für Kinder ca. 8-12 Jahre und ihre Eltern)

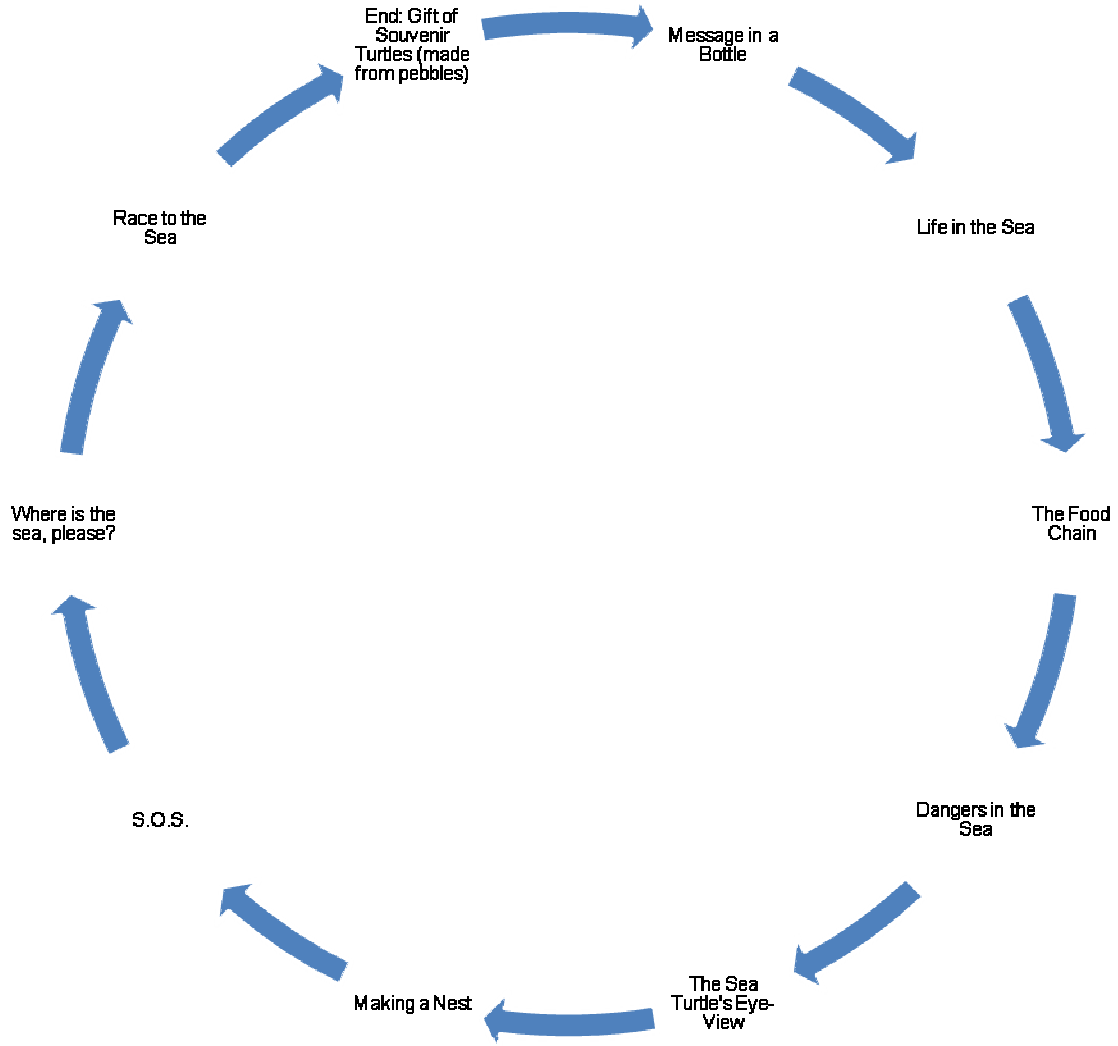

Fig. 15: Sea Turtle Quest (created by B. Bühler), summary of a (suggested) shortened version which is particularly suitable for younger children (below 8 years) and their parents
Abb. 15: Sea Turtle Quest (von B. Bühler), Vorschlag für eine Kurzversion, die besonders für jüngere Teilnehmer (Kinder unter 8 Jahren) geeignet ist

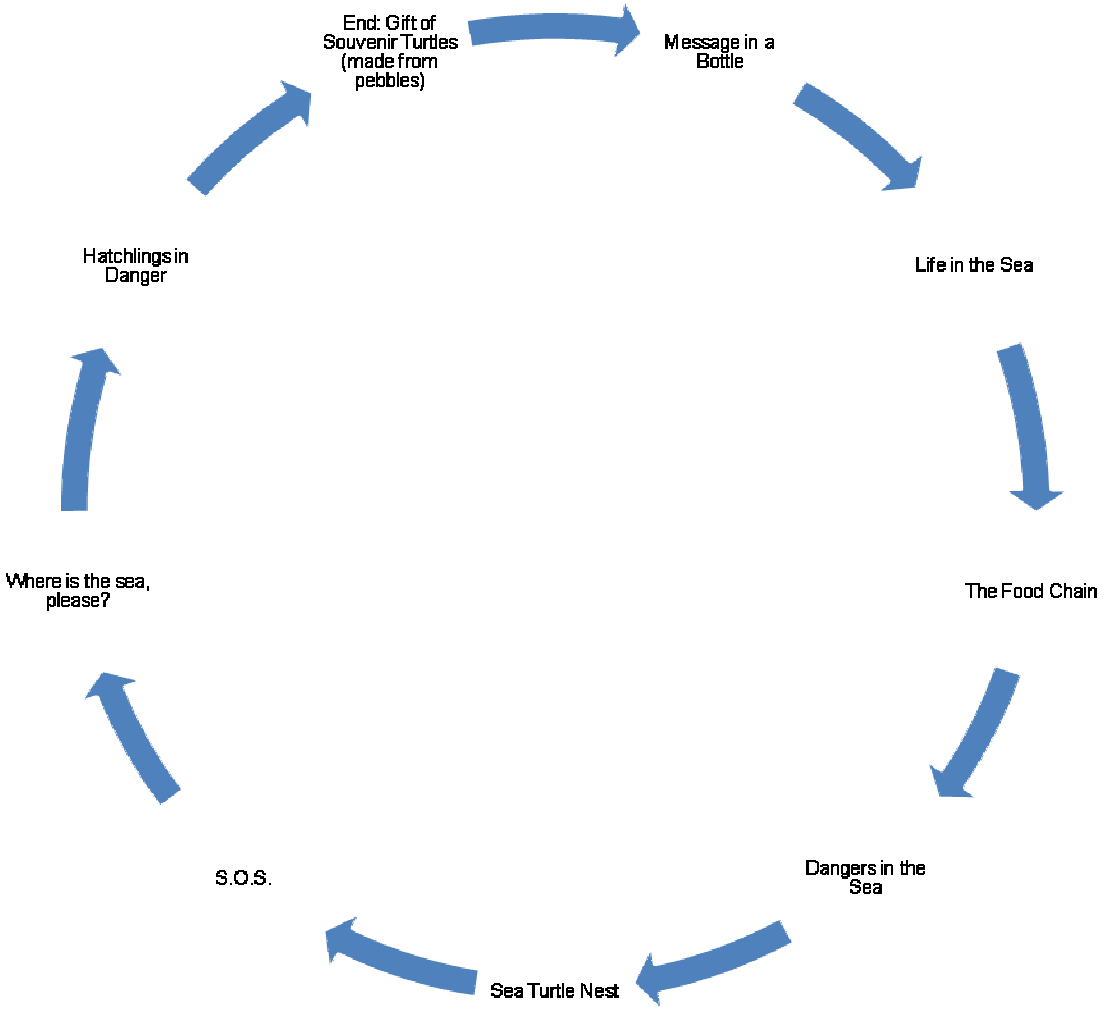

Fig. 16: Sea Turtle Quest (created by B. Bühler), summary of a (suggested) shortened version which is particularly suitable for “casual” visitors (children and adults)
Abb. 16: Sea Turtle Quest (von B. Bühler), Kurzversion für “Spontanbesucher” (Kinder und Erwachsene)

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In Fethiye, a series of hotels and restaurants in Calis provided us with free dinners every evening: Rebin Beach Hotel, Pelin Hotel, Golden Moon Hotel, Günes Hotel, Idee Hotel, Orient Restaurant, Delta Hotel, Cenk Bey Hotel, Mutlu Hotel, Eröz Hotel, Aymes Hotel, Canikom Köfte, Sevi Hotel, Nil Restaurant, Dolphin Hotel, Mendos Hotel, Malhun Hotel, Orient Hotel, Bahar Hotel, Area Hotel & Ceren Hotel. Thanks to Mrs. Sevim for arranging!
In Yaniklar, Majesty Club Tuana (Mr.Nurkaya Gondogdu and Mr. Yilmaz Donmez) provided us with pick-up meals every evening. Thank you for the delicious meals!

Last but not least, we sincerely thank Orhan and Fatma Karatas, owners of Onur campground in Yaniklar, for their hospitality, and Yunus Emre for welcoming our Calis team to a small camping site behind the beach promenade. Carola Gürtekin and her family provided electricity for the camp in Calis and helped in daily-life-questions!

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Isabella Beinhauer
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Marina Fischer
Bettina Kliespiess
Andrea Hauswirth
Raffaela Lesch
Kilian Egger-Peitler
Iason Pifeas
Agnes Preinfalk

……..2013 Observer:……

ADULT/NEST/TRACK

Date:……. Time:……..	Nest Nr.:……..	Track Nr.: ……..
Tag Nr.: L R Straight measurements: SCL ……. SCW …… Curved measurements: CCL ……. CCW ……. Epibionts …….. Deformations……..	Shape of track dry zone(1) moist zone(2) wet zone(3)	Total track length:…….. Track width:…… Nr. of body pits: …….. Nest Dist. to sea: …….. Beach zones 1:……m (dry) 2:...…….....m (moist) 3:…….m (wet) Hatchery Yes No

Exact position of the nest:

Notes: vegetation, substrate type (sand, pebbles > 2mm, cobbles > 64 mm)

.....2013
HATCHING-DATA

Nest Nr:..... Nest Date:…… Incubation Time:…….. Observer:……

Emerging days	1	2	3	4	5	6	7	8	Total
Hatch date									
Hatch time (start)									
Number of tracks									
Hatchlings reaching the sea									
Predated hatchlings									
Predated eggs									
Dead due to sun/heat									

Other observations and remarks:

Nest excavation: Date:.....…….. Time :……..…….… Observer:……

Empty shells	
Hatchlings still living inside nest	
Dead hatchlings in nest	
Unfertilized eggs	
Total Nr. of fertilized eggs:	

Early-embryonic stage (<1 cm)	
Mid.-embryonic stage (>1 cm <2cm)	
Late-embryonic stag (> 2cm)	

Total Nr. of eggs	
Total Nr. of empty shells	
Total Nr. of hatchlings reaching the sea	

Depth: top eggs	
Bottom of chamber	
Diam. of chamber	
Nest dist. to sea	

Insects ets. in nest:

Dead or injured sea turtles 2013

Observer: …….. Stranding date and time: …….

Species: *Caretta caretta*- loggerhead turtle □
Chelonia mydas- Green turtle □
Trionyx triunguis – Nile softshell turtle □
Other:…….

Stranding location: Offshore (beach) □ Inshore (sea, lake, river) □
Descriptive Location:…….

Sex: undetermined □ Male □ Female □

How was sex determined: necropsy □ tail length (adult only) □

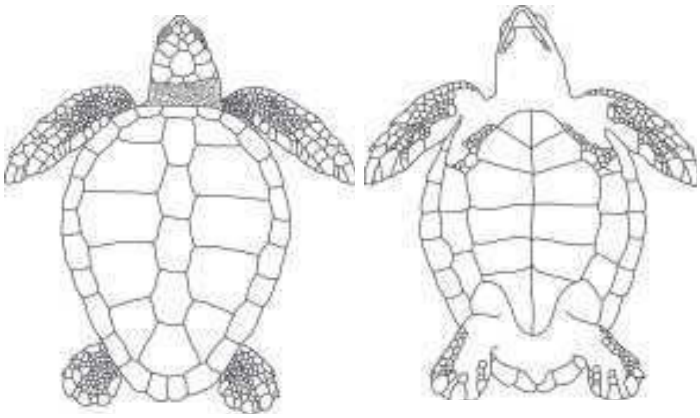
Condition: 1 alive □
2 fresh dead □
3 decomposed □
4 dried carcass □
5 skeleton bones only □

Tags: Checked for tags? Yes □ no □ Tagnumber:……...
Tag location:…….....
Return adress:…….

Carapace measurements: SCL …….. SCW…….
CCL …… CCW…….

Photos taken? Yes□ no□
Nr. of photos:

Mark wounds/abnormalities on diagrams and describe. Please also note if no wounds or abnormalities are found.



□ holes/ wounds made by gun
□ deformations
□ cuttings
□ missing parts
□ gear or debris entanglement
□ propeller damage
□ others:

Notes: