Nature conservation field course: Protection of sea turtles (*Caretta caretta*) in Turkey 2014

Projektpraktikum: Schutz von Meeresschildkröten (*Caretta caretta*) in der Türkei 2014

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Executive Summary

Die Bucht von Fethiye liegt an der türkischen Mittelmeerküste und ist ein Nistgebiet für die Unechte Karettschildkörte (*Caretta caretta*). Seit 1994 arbeitet dort jeden Sommer die Universität Wien mit verschiedenen türkischen Universitäten (2014: Hacettepe Universität, Ankara) an einem Artenschutz- und Forschungsprojekt. In der Feldarbeit werden Daten von Adulten, Jungtiere, Nester, Schlüpferfolg und anthropologische Einflüsse mit negativen Auswirkungen auf das Nistgebiet (Tourismus, Verbauung des Strandes, Verschmutzung) gesammelt.

Alle sieben Meeresschildkrötenarten stehen auf der Roten Liste Gefährdeter Arten der Internationalen Union zum Schutz der Natur (IUCN). Im Mittelmeer kommen zwei nistende Arten vor; die Unechte Karettschildkröte (*Caretta caretta*) und die Grüne Meeresschildkröte (*Chelonia mydas*). Beide Spezies nisten ausschließlich im östlichen Mittelmeerbecken. Nistgebiete der Unechten Karettschildkröte findet man in Griechenland, Türkei, Zypern, Lybien und in Israel.

Um effiziente Feldarbeit leisten zu können, wird der ca. 8 km lange Niststrand in zwei Abschnitte geteilt: Çaliş und Yaniklar/Akgöl. 2014 wurden insgesamt 99 Nester gefunden: 38 in Çaliş und 61 in Yaniklar (41 Yaniklar, 20 Akgöl). Im Vergleich zu den Vorjahren kann man unterschiedliche Entwicklungen erkennen: in Çaliş wurde 2014 die höchste Nestzahl seit Beginn des Projektes in 1994 gezählt (1994: 36, 2012:10, 2013: 35). In Yaniklar/Akögl hingegen sinkt die Anzahl der Nester (1995: 169, 2004: 37, 2012: 76, 2013: 69)(Fig.1).

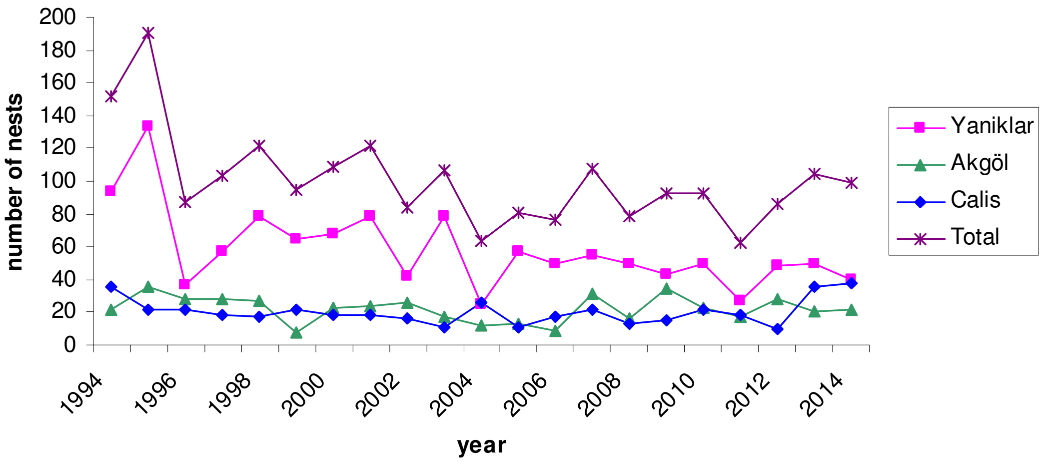

Fig. 1: Anzahl der Nester von 1994 – 2014.

In der Zeit von 30 Juni bis 26 Juli wurden 12 adulte Weibchen am Strand von Çaliş gesichtet. Keines der Tiere war oder wurde von uns markiert. Von den 39 Nestern wurden 19 entlang einer ca. 1-km-langen betonierten Promenade gelegt. Dieses Gebiet ist touristisch sehr frequentiert, und Lichtverschmutzung ist offensichtlich. 19 weitere Nester wurden außerhalb des Promenadenabschnitts gelegt. Die Entfernung zum Meer betrug bei diesen Nestern durchschnittlich 20.8 m, hingegen betrug die Entfernung zum Meer bei den Nestern innerhalb der Promenade durchschnittlich nur 14.5 m. 2638 Eier wurden insgesamt gelegt, 89.1% davon waren befruchtet, 10.8% der befruchteten Eier sind nicht geschlüpft. Von diesen nicht geschlüpften Eiern waren 38.1% in einem frühen abgestorbenen Embryonenstadium, 10.1% in einen mittleren und 51.8% in einen späten Embryonenstadium. Durchschnittlich wurden 72 Eier pro Nest gezählt und die durchschnittliche Inkubationszeit betrug 48 Tage. 1861 Schlüpflinge, das sind 70.6 % der Eier insgesamt oder 79.2 % der befruchteten Eier, haben das Meer erreicht. 2014 wurden entlang der Promenade 570 Sonnenliegen und 302 Sonnenschirme gezählt. Das ist im Vergleich zu einer Zählung in 2012 ein Anstieg von 13% bei Sonnenliegen und 11% bei Sonnenschirme. Am Strandabschnitt in Çaliş außerhalb der Promenade weiten sich Bars auf den Strand aus, Teppiche werden immer noch am Strand ausgelegt, ebenso wurden es neue Baumbepflanzungen am Strand sowie neue Duschanlagen und Volleyballfelder fotodokumentiert.

In Yaniklar/Akgöl wurden 4 adulte weibliche Unechte Karettschildkröten gesichtet. Die durchschnittliche Distanz vom Nest zum Meer betrug 22.5 m in Yaniklar (n=41) und 17.5 m in Akgöl (n=20). Insgesamt wurden 4886 Eier gelegt, 3886 (79.5%) davon waren befruchtet, 850 (17.4%) waren unbefruchtet. Die durchschnittliche Ei-Anzahl in einem Nest betrug 83. 565 (11.6%) der befruchteten Eier starben bereits als Embryo ab. 150 (3.1%) Eier wurden von Predatoren gefressen. 18 (0.3%) Schlüpflinge wurden während der Nestausgrabungen in tot noch halb in den Eierschalen steckend gefunden. 142 (2.9%) tote kleine Schildkröten wurden tot in den Nestern gezählt. 23 (0.5%) starben am Weg zum Meer und 30 (0.6%) Jungtiere wurden auf dem Weg zum Meer getötet. Insgesamt erreichten 3121 (63.9%) Jungtiere das Meer, was einen Schlüpferfolg von 63.1±28.5% ergibt. Die durchschnittliche Inkubationszeit betrug 46 ± 4.5 Tag. 2014 kam es zu einer Zunahme an Strandliegen und –schirmen. Eine großflächige Baustelle für ein Hotel (Barut Hotel) führte durch intensive Lichtverschmutzung zu Desorientierung bei Schlüpflingen am weg ins Meer. Außerdem wurden weitläufige Sumpflandschaften, sowie Feuchtgebiete entlang des Strandes gerodet und Sandentnahmestellen wurden fotodokumentiert.

Vier Bachelorarbeiten wurden während der Feldarbeiten ausgearbeitet:

Strandungen von toten Meeresschildkröten in Fethiye wurden dokumentiert während der Feldarbeit 2014 und mit den Daten der Vorjahre verglichen. Sechs tote Schildkröten wurden angeschwemmt, 4 Unechte Karettschildkröten, 1 Grüne Meeresschildkröte und eine Brackwasserschildkröte der Art *Trionyx triunguis* (Nilweichschildkröte). Diese weibliche Schildkröte wurde eingegraben im Spülsaum gefunden. Eine der vier toten *Caretta caretta* war ein männliches adultes Tier, die anderen drei Individuen waren weiblich. Zwei on ihnen hatten in Fischernetze um ihren Hals, ein Tier wies Einschusslöcher auf. Ein weiteres Tier hatte tiefe Verletzungen am Carapax - vermutlich durch einen Schiffspropeller verursacht. Die weibliche *Chelonia mydas* wies Blutungen im Mundbereich und in den Augen auf. In den letzten 14 Jahren stiegen die Funde toter angeschwemmter Schildkröten erheblich.

Eine andere Bachelorarbeit beschäftigte sich mit dem wissen der Besucher über Meeresschildkröten an unserem Informationsstand an der Promenade in Çaliş. Ein Fragebogen wurde ausgearbeitet und 5 verschiedene Informationsblätter wurden verglichen. Der Fragebogen war in 3 abschnitte gegliedert: 1)generelle Daten über den Befragten, 2) Informationsmaterial über Meeresschildkröten, 3) spezifische Fragen über *Caretta caretta*. Insgesamt 76 Personen nahmen an der Befragung teil. 54 von 76 Personen befanden das Informationsblatt mit den meisten Bildern am Ansprechendsten. 91% Ortsansässige, 46% der türkischen Urlauber und 52% ausländische Touristen wussten, dass Çaliş ein Niststrand für *Caretta caretta* ist. Interessanterweise wussten 100% der türkischen Gäste, dass diese Meeresschildkröte vom Aussterben bedroht ist.

Lichtverschmutzung ist eine große Bedrohung für Meeresschildkröten, im speziellen Jungtiere können durch künstliche Lichter auf ihren Weg ins Meer desorientiert werden. Entlang der Strandpromenade in Çaliş wurden in 99 Sektionen die Anzahl verschiedene Lichtquellen gezählt vor 24 Uhr und nach 24 Uhr gemessen. Im Vergleich zu 2013 wurden mehr Lichtquellen gezählt (946 in 2013, 1206 in 2014). Die Luxmessungen um 22 Uhr zeigten allerdings eine geringe Abnahme von 15:44lx in 2013 auf 11.75lx in 2014. auch die Messung um 24 Uhr zeigte eine geringe Abnahme im Vergleich zu 2013 (5.34lx in 2013 auf 3.70lx in 2014). Keine signifikante Korrelation konnte zwischen Lichtintensität und Nestplatz gefunden werden.

Eine weitere Arbeit befasste sich mit dem derzeitigen Status der Specially Protected Area Fethiye-Göcek. In der Türkei unterstehen die SPAs dem Ministerium für Umwelt und Stadtplanung. Anhand der über 20 Jahren gesammelten Daten des Meeresschildkrötenprojektes kann man erkennen, dass die Strände von Fethiye unter der Nichteinhaltung der Gesetze leiden. Die derzeitige Gesetzgebung sollte soweit strukturiert werden, dass es keine Unklarheiten bzw. Missverständnisse oder verschiedene Auslegungen geben kann. Des Weiteren sollten Bewohner der SPAs über die Besonderheiten des Gebietes, sowie über ihre Rechte und Pflichten aufgeklärt werden. Außerdem wären regelmäßige Besichtungen des Gebietes von Vorteil, um auf Veränderungen sofort reagieren zu können.

Zusammenfassend ist zu sagen, dass die Nestanzahl in Fethiye den abnehmenden Langzeittrend bestätigt. Allerdings zeigt es sich, dass obwohl von den Meeresschildkröten als ein Niststrand gesehen, die einzelnen Strandabschnitte insbesondere gesehen werden müssen. Obwohl ein Anstieg der Nester in Çaliş zu verzeichnen ist, sehen wir einen Abstieg der Nester in Yaniklar. Sandentnahmen und große Baustellen für riesige Clubanlagen verändern die Strände nachhaltig und stellen eine große Bedrohung für die Meeresschildkröten dar. Diese negativen Entwicklungen müssen weiterhin von den Universitäten, den lokalen Schutzgruppen und die zuständigen Behörden der SPAs genau beobachtet und gestoppt werden, um den Niststrand für *Caretta caretta* zu erhalten.

The beaches around Fethiye Bay on the Turkish Mediterranean coast are nesting areas for loggerhead sea turtles (*Caretta caretta*). Since 1994 the University of Vienna together with different Turkish universities (2014: Hacettepe University, Ankara) has held a conservation course and conducted joint research on *Caretta caretta* every summer. During this period, data on adult turtles, nests, hatchling success, and anthropogenic disturbances were collected daily in morning and night shifts. In 2014, the data were collected by Austrian and Turkish students between 30 June and 11 September. Although this long-term study is being conducted in a SPA (Specially Protected Area), the beaches suffer from strong anthropogenic impact (e.g. tourism, construction, pollution).
All seven sea turtle species are listed in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species. In the Mediterranean, two species are known to nest, *Caretta caretta* (loggerhead turtle) and *Chelonia mydas* (green turtle). Other Mediterranean nesting beaches of *Caretta caretta* are in Greece, Cyprus, Israel and Libya.
For better monitoring the nesting area is split into two sections: Çaliş and Yaniklar. In 2014 a total of 99 nests were documented: 38 at Çaliş and 61 at Yaniklar (41 Yaniklar, 20 Akgöl) nesting areas. In comparison to former years, several developments are visible: with 38 nests, Çaliş has reached the highest number since monitoring started in this area (1994: 36, 2012:10,

2013: 35). At Yaniklar/Akgöl (61 nests) the nest numbers decreased (1995: 169, 2004: 37, 2012: 76, 2013: 69)(Fig.1).

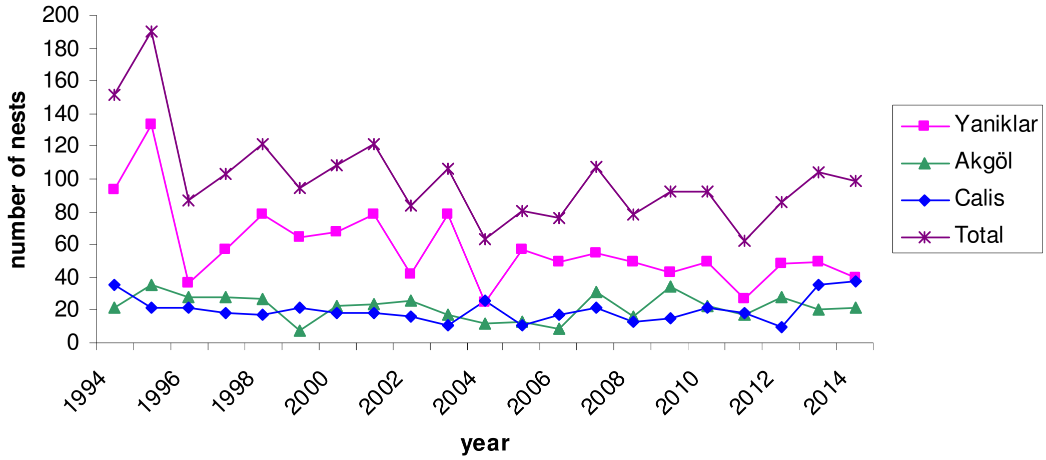

Fig.1: Number of nests from 1994 until 2014.

At the Çaliş nesting area, 12 adult females were spotted on the beach, between 30 June and 26 July. None of these animals bore tags or were tagged by us. Of the 38 nests, nineteen were laid in front of a ca. 1-km-lomg concrete promenade. This area suffers from light pollution and tourism activities. The other 19 nests were found off the promenade. A difference is evident between the nests laid in front of versus offside the promenade. The mean distance to the sea of the "promenade" nests was 14.5 m, whereas that of nests offside the promenade was 20.8 m. In total 2638 eggs were laid, 89.1 % of them were fertilized. 10.8 % of the fertilized eggs did not hatch. The latter can be further distinguished into 38.1 % early, 10.1 % mid- and 51.8 % late embryonic stage. In average, 72 eggs were laid per nest and the average incubation time was 48 days. 1861 hatchlings, i.e. 70.6 % of the total number of eggs or 79.2 % of the total number of fertilized eggs, reached the sea.
In 2014, 570 sunbeds and 302 parasols were counted along the promenade. Compared to the data from 2012 (Fig. 1; 528 sunbeds in total), the value increased by 42 (13%). Parasols changed from 274 to 302, an increase of 28 (11%). Off the promenade, bars continued their expansion onto the beach area through extensive carpeting, planting new trees or through installation of beach showers and a volleyball court.
At Yaniklar/Akgöl area, 4 female loggerhead sea turtles were spotted. The average distance of a nest to the sea was about 22.5 m in Yaniklar (n=41) and 17.5 m in Akgöl (n=20). In total, 4886 eggs were laid here, 3886 (79.5%) of those were fertilized and 850 (17.4%) unfertilized. The average clutch size was 82.8. 565 (11.6%) of the fertilized eggs died as embryos, 150 (3.1%) were predated. In addition, 18 (0.3%) hatchlings were found dead stuck in their eggs

and 142 (2.9%) dead inside the nest. 23 (0.5%) hatchlings died on their way to the sea and 30 (0.6%) were killed by predators on the beach. 3121 (63.9%) hatchlings reached the sea. This yields a hatching success rate of 63.1 ± 28.5%. The average incubation time was 46 ± 4.5 days. This year the numbers of sunroofs and sunbeds increased again, leading to an expansion of the area used by tourists. Additionally, another hotel complex (Barut Hotel) has been under construction since early 2014. A huge area of wetlands behind the beach has already been bulldozed and in the near future a large stretch of the beach is expected to be used for hotel guest activities. Yaniklar beach is under threat of losing important sandy nesting areas due to sand extraction, constructions and pollution.

Four bachelor theses were written in the framework of the field course:

Sea turtle strandings were documented in Fethiye (Turkey) in summer 2014: from 30 June until 11 September, six stranded turtles were found: four were *Caretta caretta* (loggerhead turtle), one was a *Chelonia mydas* (green turtle) and one was the species *Trionyx triunguis* (Nile soft-shell turtle). The female Nile soft-shell turtle was found buried at Yaniklar beach. One of the four dead loggerhead sea turtles was a male the other three animals were female. Two of these individuals were found with fishing net around their necks, one was found with probable gunshot holes in the carapace and another had deep cuts on the carapace caused by ship propellers. The *Chelonia mydas* was female and showed blood in mouth and eyes. In the past 14 years, the number of found dead sea turtles has risen considerably.

Another bachelor thesis concentrated on the information booth on the Çaliş promenade, focusing on a survey about sea turtles in general and on *Caretta caretta* in particular. A questionnaire and five different types of sea turtle information materials were presented. The questionnaire included three sections concerning: 1) basic data about the participants, 2) the information material on sea turtles and 3) specific questions about *Caretta caretta*. A total of 76 persons participated in the survey. Most participants chose their favorite information material based on visual appearance, and most thought that environmental pollution is the greatest threat for sea turtles in general and *Caretta caretta* in particular. The survey also showed that the information materials were mostly chosen based on their visual appearance (54 of 76), and that residents far more often knew (91%) that *Caretta caretta* is nesting on Çaliş beach than did Turkish (46%) and foreign tourists (52%). Conversely, Turkish guests better knew that this turtle is an endangered species (100%).

Light pollution from restaurants, bars and shops along the beach promenade in Çaliş negatively impact the seaward orientation of hatchlings after they have emerged from the nest. The number and types of lights on 99 sections of the promenade were counted, and the light intensity was measured both before and after midnight (on the promenade, at nest sites, and at the waterline). The comparison of the data with the values of previous years showed an increase in the number of lights from 946 in 2013 to 1206 in 2014. The lux-values between 22:00 and 00:00 decreased slightly from 15.44 in 2013 to 11.75 in 2014 and those after 00:30 from 5.34 (2013) to 3.70 (2014). Using this approach, no significant correlation was found between light intensity and the placement and distribution of the nests.

One bachelor thesis reveals the current state of the Specially Protected Area Fethiye-Göcek. In Turkey, SPAs are under governance of the Ministry of Environment and Urban Planning. As seen on data of sea turtle monitoring over 20 years, the beaches of Fethiye suffers from noncompliance with regulations. The relevant legislation should be structured so that it leaves no vagueness and no open room for misconception regarding the SPAs and all the other protection areas that the international agreements cover. Futhermore, local residents should be informed and educated about the area they live in and what kind of responsibilities they should assume. Ultimately, supervision, inspection and reinforcement of the legal clauses is crucial.

Overall, the number of nests confirms the decades-long decline, bit the high values in the Çaliş section in the last two years show that the decline is not necessarily uniform and that individual beaches should be evaluated separately. The ongoing development of major new construction sites, coupled with the incessant expansion of individual beach bars and envisioned mega-projects pose a serious and increasing threat to nesting adult and hatching young sea turtles. This calls for continued vigilance by nature and species protection groups as well as university researchers, and clear action by the authorities to ensure that this Special Protected Area at least partially earns its name.

The nesting season of adult loggerhead turtles (*Caretta caretta*) on Çalış Beach (Fethiye, Turkey) in 2014

Angelina Ivkic, Elia Guariento

KURZFASSUNG

2014 fand in Fethiye, Türkei ein Projektpraktikum zum Schutz und Management der Unechten Karettschildkröte (*Caretta caretta*) statt.

Studenten der Universität Wien und Studenten der türkischen Hacetteppe Universität arbeiteten von 28. Juni bis 11. September zusammen um dieses Ziel zu erreichen.

Çalış Beach ist ein 3.5km langer, touristisch geprägter Strand der zur Hälfte durch eine kleine Mauer abgegrenzt ist. Hinter dieser Mauer befindet sich eine sehr belebte Strandpromenade mit zahlreichen angrenzenden Hotels, Bars und Restaurants.

Der Strand wurde jeden Morgen und jeden Abend kontrolliert. Sobald adulte Meeresschildkröten oder Schlüpflinge gesichtet wurden, war unsere oberste Priorität die Touristen fernzuhalten und den Schildkröten somit eine ungestörte Eiablage bzw. ein ungestörtes Erreichen des Meeres zu ermöglichen. Zusätzlich wurden Vermessungen der Tiere vorgenommen. Auch wurde ein Informationsstand an der besagten Strandpromenade betrieben, um die Touristen und Einheimischen über Meeresschildkröten im Allgemeinen und insbesondere die Situation der Unechten Karettschildkröte am Strand von Çalış zu informieren.

Im Jahr 2014 wurden 38 Nester am Strand von Çalış gelegt. Dies ist seit dem Beginn dieses Projektpraktikums 1994 der Höchstwert.

19 Nester wurden bei dem Strandabschnitt der durch die Mauer begrenzt ist gelegt. Die anderen 19 Nester befanden sich in der „unbegrenzten" Hälfte des Strandes. Bei diesen Nestern war die Entfernung zum Meer um 30% größer, als bei jenen die durch die Mauer begrenzt waren.

2014 wurden von unserem Team insgesamt 38 Spuren von adulten Meeresschildkröten gefunden, von denen 15 zu einem Nest führten (die übrigen 23 Nester wurden nicht anhand von Spuren entdeckt, sondern zum Beispiel erst beim Schlüpfen).

Die Ergebnisse 2013 und 2014 lassen auf einen positiven Trend der *Caretta caretta* Population am Strand von Çalış hoffen.

ABSTRACT

In 2014 a field course for the protection and conservation of sea turtles (*Caretta caretta*) took place in Fethiye, Turkey. Students from the University of Vienna and from the Hacetteppe University in Turkey worked together from 28 June to 11 September to achieve that goal.

Çalış Beach is 3.5-km-long and a touristic hotspot. Half of the beach is in front of a promenade and limited by a wall. The beach was patrolled in a morning and a night shift. Furthermore an information booth was operated.

Our aim was to allow the female sea turtles to dig their nests and the hatchlings to reach the sea without being disturbed, to inform the tourists and local residents about sea turtles and the dangers they face, and to collect data about adults and hatchlings.

During the 2014 nesting season we recorded the highest number of nests (38) since the beginning of the project in 1994.

Nineteen of those 38 nests were laid in front of the promenade; the other 19 were laid offside the promenade. The nests offside the promenade were 30% more distant to the sea.

In 2014, 38 adult turtle tracks were found at Çalış Beach, of which 15 led to a nest (the other 23 nests were not found with the help of tracks, but e.g.: when hatching).

Our aim to achieve an increase in the *Caretta caretta* population at Çalış Beach is a difficult task due to anthropogenic influences, but last year's and this year's results give reasons to hope.

INTRODUCTION

Today, only seven species of sea turtles inhabit the world's oceans. In the Mediterranean Sea, two of them nest: *Caretta caretta* (the Loggerhead Turtle) and *Chelonia mydas* (Green Turtle) (Groombridge 1990). Both species are on the IUCN (International Union for Conservation of Nature) Red List and are classified as "endangered" (Broderick & Godley 1996).

Caretta caretta can be found in the whole Mediterranean Sea, but nests mainly in Turkey, Greece, Cyprus and Libya (Margaritoulis et al. 2003). Based on annual numbers in Cyprus, Greece, Israel, Tunisia and Turkey, the number of Loggerhead Turtle nests per season ranges from 3375 to 7085 (Margaritoulis et al. 2003). Note that a single turtle lays two to three nests per season.

The main threats for sea turtles are human activities including: beach- and sea pollution, light pollution (Morandell 2014, chapter 12 this issue), disturbance of nesting adults (noise or flash photography), human exploitation (direct take of eggs) and damage to egg chambers with sun-

umbrellas.
Female sea turtles always return to the beach on which they hatched to lay their nest. This phenomenon is termed natal homing (Bowen et al. 2004). This fact underlines why it is important to protect every beach.
Due to the threats sea turtles are facing, the University of Vienna started a project in cooperation with Turkish universities to protect sea turtles in Fethiye, Turkey in 1994. Two beaches in Fethiye are being monitored: Çalış Beach (Fig.1, Fig.2) and Yaniklar/Akgöl. Both beaches are declared to be Specially Protected Areas (SPA) by the Barcelona Convention (Protection of the Marine Environment and the Coastal Region of the Mediterranean) (Türkozan & Kaska 2010).
Our team in Çalış worked this year from 28 June to 11 September with colleagues of Hacettepe University. The Turkish team arrived earlier on 5 June and their data had been taken over by our team. Çalış Beach is 3.5 km long and its composition varies between sand and gravel. Half of the beach is located in front of a promenade, which is frequented by tourists during summer. Students from both countries patrolled the beach together in two shifts (see Material & Methods). We collected data about adults and hatchlings, documented the temperature and also changes on and around the beach. Furthermore we were responsible to inform the tourists and local residents about the dangers sea turtles face and what could be done to support the species. To achieve that goal an information desk was operated on the promenade of Çalış Beach. Especially in Çalış this is very important because of the high density of tourists and local residents.

Fig. 1: Çalış Beach near Fethiye.
Promenade section in background

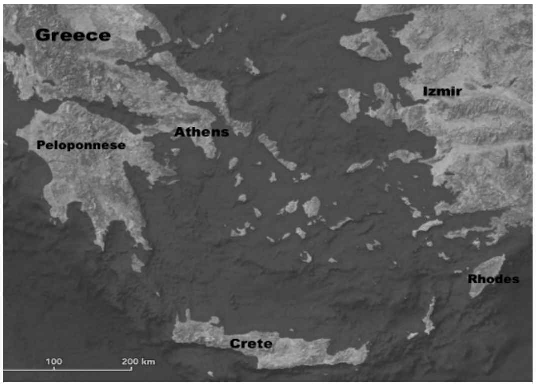

Fig. 2: Location of Fethiye in the Mediterranean
Abb. 2: Lage von Fethiye im Mediterranraum.

MATERIAL AND METHODS

The work consisted mainly in monitoring and collecting data on the activity of the sea turtles. A morning and a night shift were undertaken every day along the beach.

Night shift

The night shift began at 10 pm and took at least 4 hours. Three or four students walked on a straight line parallel to the sea in regular distances covering the whole beach. The night shift started at the "Restaurant "Çadiri" and ended at the "Spor Cafe" and was not extended further. The team walked four times from one end of the beach to the other, taking a 15-minute break between each walk.

The equipment of the team consisted of a wooden calliper to measure the turtles and a back-pack containing a thermometer to measure the temperature at the beginning of each shift, a field data book, two measuring tapes (2 m and 25 m), a flashlight, a metal rod ('shish'), walkie-talkies, a GPS tracking device (GARMIN), waterproof markers and ping-pong balls (to help mark the nest, see below). Later in the season, a bucket to collect hatchlings was also taken on the shifts.

If a turtle was spotted on the beach, the team first ensured that no tourist or dog was disturbing the turtle and then sat or kneeled down to observe its behaviour. After laying the eggs, the turtles closed the nest and hid it in a behaviour known as "camouflage", whereby sand is thrown with the front flipper over the carapace while the turtle moves slowly further. After that, the turtles made their way back to the sea. At this point the team started with measuring the animal. One student held the turtle by its carapace, allowing a second student to take the measurements. With the wooden calliper the straight carapace width (SCW) and straight carapace length (SCL) were measured; the curved measures – curved length (CCL) and curved

width (CCW) – were taken with a 2m tape. Before the turtle was released, the team checked if the animal was tagged and if epibionts were growing on the carapace. The collected data and the time the turtle spent on the beach were noted into the data field book.
No turtles were tagged this year.
After the turtle returned to the sea, and also in cases where the turtle emerged and returned without being seen and only the track was found, the team measured the track length, the track width and also the distance to the sea. Furthermore, we noted the number of "body pits" (Fig. 10), the total distance to the sea divided into dry, moist and wet zone of the beach (Fig. 3), and the team drew the shape of the track into the data field book.
If the team saw the turtle laying eggs or if the track led to a "camouflage" area, the exact position of the nest was localised. For this purpose a metal rod ('shish') was used to carefully penetrate the sand. Where it entered easily thanks to loosened sand it marked the egg chamber. To be able to relocate the exact position later on, the nest was triangulated using reliable landmarks (Fig. 3). Furthermore, GPS data were taken by a GPS tracking device to determine the position of each nest.

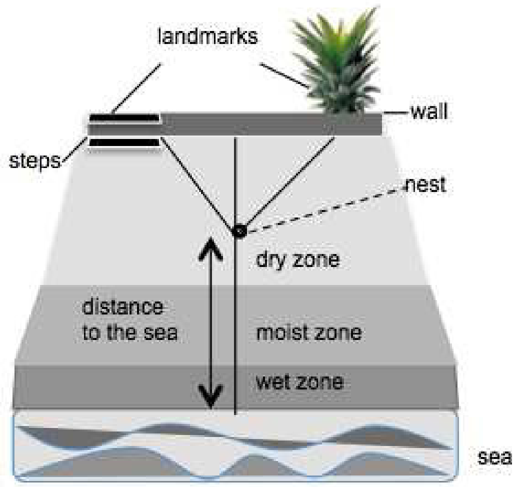

Fig. 3: Schematic illustration of a triangulation and the division of the beach in dry, moist and wet zone.
Abb. 3:Skizze einer Triangulation und die Aufteilung in nasse, feuchte und trockene Zone des Strandes.

Each nest received a number such as CY-22, whereby C stands for Çalış and Y for Yuvasi, which means nest in Turkish. The number was given successively to each nest found and does not correspond to the laying date of the nest itself.
Afterwards the team marked the nest with cages (Fig. 6 and Fig. 7), tripods (Fig. 8) or marked stones depending on the location, the availability of cages and on the expected date of hatching. On the cages and tripods, information sheets were attached to inform tourists about the nests and not to use the cages as trash bins. On some particularly exposed nests that had been laid in a position where the marks could be easily destroyed, a short rope with two sticks fixed at the ends was buried under the sand, enabling the team to relocate the exact position even without triangulation.
When the hatching season began, we also looked for hatchlings and their tiny tracks in the sand. Usually the date a nest was laid was known. The nets on the cages were put down when the eggs were expected to hatch. The net was put down before the nightshift to prevent the

hatchling from running in the direction of artificial lights (light pollution). These nets were then pulled up every morning to enable late-emerging hatchlings to reach the sea (see below). Our team arrived on June 30, but some nests were laid earlier. Those nests were called "secret nests" because we initially did not know where they were and when they were laid (detected based on first hatchling tracks).

Morning shift

The morning shift started at 6 am and lasted usually until 8 am. It was conducted by two to three students. On this shift the whole beach was patrolled starting from “Restaurant Çadiri“ until Çalış Teppe. The team took a bucket and the backpack filled with the same working materials as for night shift.

Each nest was triangulated to ensure that the cages or tripods have not been moved. The net was pulled up to allow hatchlings to reach the sea in case they emerged during the day. The morning shift also controlled the beach looking for tracks missed by the night shift. New nests found by the previous night shift team or on the morning shift were additionally marked by placing a ping-pong ball with the number of the nest and the laying date on top of the eggs. This ball is a back-up system that enables relating the hatching nest to its number during excavations and simplifies finding the exact location of the eggs. After the hatching season began, excavations of the nests were also done on these shifts.

RESULTS

Nests

At the nesting season 2014, 38 nests were found on Çalış Beach. This number was the highest ever recorded since the beginning of the project in 1994 (Fig. 4). The mean number of nests laid over 20 years on Çalış Beach (20) was nearly doubled in this season. The number of nests laid over the years (Fig. 3) fluctuate strongly: the peaks are 36 (1994), 26 (2004) and 35 (2013) nests, and the lows are only 11 (2003), 11 (2005), 13 (2008) and 10 (2012) nests. The number of nests laid this year did not differ considerably from the number laid in the last season (2013), i.e. an increase of only 3 nests.

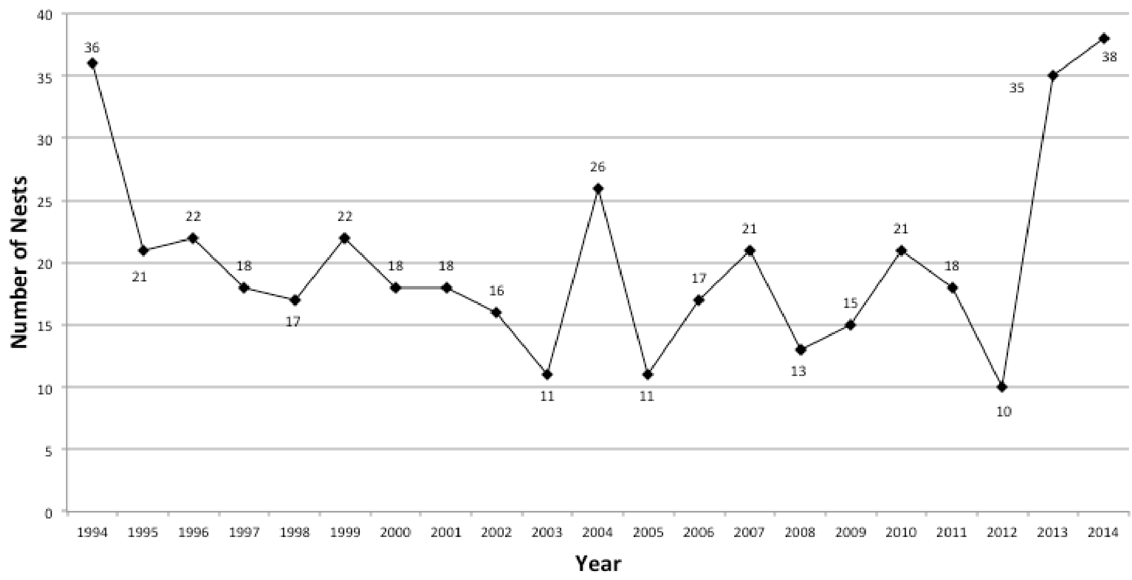

Fig. 4: The number of nests in the years 1994-2014 on Çalış Beach.
Abb. 4: Entwicklung der Nestanzahl in den Jahren 1994-2014 am Strand von Çalış.

The nests CY1-CY9 were found by the Turkish colleagues and were laid before the students of the University of Vienna arrived in Turkey. Also nest CY10 was laid before 29.06.2014, but was found on the first shift. Nests CY11-CY24 and CY28 and CY30 were laid between 30.06.2014 and the 26.07.2014 (Tab. 1). Twelve nests, CY25-CY27 and CY32-CY44, were not observed to have been laid, and the team found them when hatchlings started to emerge. These nests are called "secret nests" and are marked in the Tab.1 with an S instead of the date on which they have been laid. Nest CY15 proved not to have existed (an incorrectly interpreted body pit). Nest CY14 was seen to be laid, was lost over time, and no hatchlings emerged from it. The secret nest CY36 went lost after 16 hatchlings emerged and the team was unable to locate the nest position. Other nests were mistaken as secret nests because hatchlings managed to escape under the net. Accordingly, nest CY31 was actually CY2, nests CY38 and CY39 were CY7, nest CY41 was CY11, and nest CY29 was CY33. These nests are therefore not reported in Tab. 1.

No hatchery needed to be constructed this year, i.e. no nests were in such unsuitable sites that they had to be relocated.

Tab. 1: Overview of the nests at Çalış Beach in 2014 (<: nest laid before date; S: secret nest; -: no data available)
Tab. 1: Überblick über die Nester am Strand von Çalış im Jahr 2014 (<: Nest wurde vor Datum gelegt; S: "secret nest"; -: keine Daten vorhanden)

Nest Nr.	Date of egg laying	Distance to the sea (m)	Dry zone (m)	Moist zone (m)	Wet zone (m)	Track length (m)	Track width (m)	Nr. of body pits
CY-01	<04.06.'14	13.8	8.8	3.4	1.6	-	-	-
CY-02	<04.06.'14	14.1	9.7	1.2	3.2	-	-	-
CY-03	<04.06.'14	20.8	15.6	1	4.2	-	-	-
CY-04	<04.06.'14	37	34	1.8	1.2	-	-	-
CY-05	<09.06.'14	19.1	17	1.6	0.5	-	-	-
CY-06	20.06.'14	14.5	9.2	1.5	3.8	-	-	-
CY-07	19.06.'14	31.4	17.5	10	4	-	-	-
CY-08	19.06.'14	21.9	18.75	1.15	2	-	-	-
CY-09	20.06.'14	12.1	8.1	2	2	-	-	-
CY-10	<29.06.'14	26.8	22.8	1.5	2.5	-	-	-
CY-11	30.06.'14	11.1	9.5	0.8	0.8	26.4	0.61	1
CY-12	01.07.'14	16.5	11.9	2.3	2.3	30.8	0.74	0
CY-13	01.07.'14	17.1	14.2	1.8	1.1	55.4	0.65	0
CY-14	01.07.'14	16.1	11.4	3	1.7	23.2	0.61	1
CY-16	02.07.'14	13.1	10.5	2	0.6	32.2	0.55	0
CY-17	24.05.'14	7.4	3.7	2	1.7	-	-	-
CY-18	01.07.'14	20.5	16	2.5	2	39.7	0.6	2
CY-19	01.07.'14	17.2	13.5	2.5	1.5	28.6	0.7	0
CY-20	04.07.'14	11.2	8.1	1.8	1.36	23	0.68	0
CY-21	09.07.'14	11.8	9.1	0.7	2	28.6	0.6	1
CY-22	10.07.'14	14.6	10.9	1.4	1.3	33	0.62	0
CY-23	10.07.'14	15.41	12.61	1.2	1.6	36.6	0.67	2
CY-24	13.07.'14	25.1	20.65	1.65	2.8	54	0.63	2
CY-25	S	20.1	11.7	6.3	2.1	-	-	-
CY-26	S	28.17	19.07	5.6	3.5	-	-	-
CY-27	S	7.83	5.03	1.4	1.4	-	-	-
CY-28	24.07.'14	12.6	6.6	2	4	20.2	0.63	0
CY-30	26.07.'14	18.1	14.7	1.5	1.9	81.1	0.62	0
CY-32	S	22.2	20.1	1.4	0.7	-	-	-
CY-33	S	13.43	18.93	2.5	2	-	-	-
CY-34	S	11.8	7.3	2.2	2.6	-	-	-
CY-35	S	15.75	11.75	2.2	1.8	-	-	-
CY-37	S	16.15	13.35	1.3	1.5	-	-	-
CY-40	S	22	20.3	1.1	0.6	-	-	-
CY-42	S	15.1	3.2	1.4	10.5	-	-	-
CY-43	S	21.92	18.13	1.82	1.97	-	-	-
CY-44	S	23	-	-	-	-	-	-

Nineteen nests were laid in front of the promenade, between “Restaurant Çadiri” and “Caretta Beach Club”, and nineteen offside the promenade, i.e. from “Caretta Beach Club” to Çalış Teppe. The distance to the sea of nest CY-36 could not be measured because the exact position of the nest was not determined. The distance between the nests and the sea varied between 7.4 m and 37 m, the average was 17.75 m.

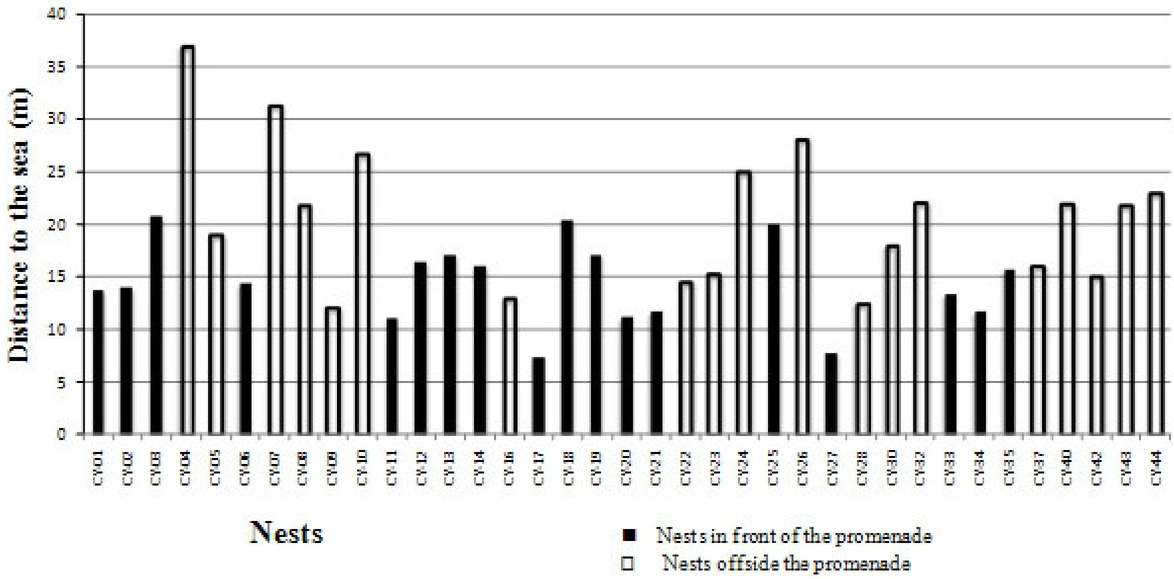

Fig. 5: Nest distance to the sea in meters. Black bars: nests in front of promenade; white bars: nests offside promenade.
Abb. 5: Abstand der Nester zum Meer in Meter. Schwarze Balken: Nester vor der Promenade; Weiße Balken: Nester abseits der Promenade.

A difference is evident (Fig. 5) between the nests laid in front of the promenade and those offside the promenade; the latter were 30% more distant to the sea. The mean distance to the sea of the nests in front of the promenade was 14.5m. The mean distance of the nests offside the promenade was 20.8m.

Fig.13: Overview of Calis Beach with the most important landmarks and the location of the nests.
Abb. 13: Überblick über Calis Beach mit den wichtigsten Landmarken und der Lage der Nester.
(source: Google Earth 2015)

Fig. 13a: Nests located in Calis , Sörf Cafe and Jiva Resort.
Abb. 13a: Nester bei Calis , Sörf Cafe und Jiva Resort.
(source: Google Earth 2015)

Fig. 13b: Nests around Caretta Beach Bar and along the promenade.
Abb. 13b: Nester vor und bei Caretta Beach Bar und entlang der Promenade.
(source: Google Earth 2015)

Tracks

During the field course, 38 tracks of adult *Caretta caretta* were found at Çalış Beach (Tab. 2). Fifteen of these tracks were successful nesting attempts, leading to the deposition of a nest. The other 23 attempts were unsuccessful.

The longest track was 81.1 m long, the shortest only 13.7 m because dogs disturbed the turtle. The average total track length was 38.5 m and the average track width was 0.62 m. In total there were 26 body pits.

After 30 June, monitoring shifts were conducted regularly twice a day, allowing to record all tracks laid by turtles. Comparing the number of nests laid and tracks made after this date helps to understand how successful the adult emergences on the beach are. Fourteen nests were laid and 35 tracks were found between the 30 June and 27 July. Thus, only 40% of tracks led to a successful nest.

Tab. 2: Overview of the tracks on Çalış Beach in 2014 (<: track laid before date; -: no data available)
Tab.2: Überblick über die Spuren am Strand von Çalış im Jahr 2014 (<: Spur vor Datum gelegt worden; -: keine Daten vorhanden)

Track Nr.	Nest Nr.	Date	Track lenght (m)	Track width (m)	Nr. of body pits	Dry zone (m)	Moist zone (m)	Wet zone (m)
1	No Nest	<04.06.'14	-	-	1	12	12	13
2	No Nest	09.06.'14	33.5	0.63	1	11	2	2
3	No Nest	<19.06.'14	-	-	1	6.3	12.6	12
4	CY-11	30.06.'14	26.4	0.61	1	9.5	0.8	0.8
5	CY-12	01.07.'14	30.8	0.74	0	11.9	2.3	2.3
6	No Nest	01.07.'14	16.5	0.62	0	3.8	3.1	1.1
7	CY-13	01.07.'14	55.4	0.65	0	14.2	1.8	1.1
8	CY-14	01.07.'14	23.2	0.61	1	11.4	3	1.7
9	CY-18	01.07.'14	39.7	0.6	2	16	2.5	2
10	CY-19	01.07.'14	28.6	0.7	0	13.5	2.5	1.5
11	CY-16	02.07.'14	32.2	0.55	0	10.5	2	0.6
12	CY-17	24.05.'14	-	-	-	3.7	2	1.7
13	No Nest	03.07.'14	52	0.62	2	16.9	0.8	1,2
14	No Nest	03.07.'14	39.7	0.64	4	16	0.8	1.2
15	CY-20	04.07.'14	23	0.68	0	8.1	1.8	1.3
16	No Nest	04.07.'14	21	0.62	2	7.2	1.1	0.9
17	No Nest	07.07.'14	21.1	0.62	1	8.2	0.7	0.9
18	No Nest	08.07.'14	-	-	-	-	-	-
19	CY-21	09.07.'14	28.6	0.6	1	9.1	0.7	2
20	No Nest	09.07.'14	48.8	0.63	2	20.6	1	0.7
21	CY-22	10.07.'14	33	0.62	0	10.9	1.4	1.3
22	CY-23	10.07.'14	36.6	0.67	2	12.6	1.2	1.6
23	No Nest	12.07.'14	33.5	0.64	0	10	4	2
24	No Nest	12.07.'14	45	0.64	0	1.5	3.5	14.7
25	No Nest	12.07.'14	39.3	0.63	0	13.3	3.3	1.7
26	CY-24	13.07.'14	54	0.63	2	20.6	1.6	2.8
27	No Nest	14.07.'14	64.2	0.62	1	23.1	1.1	0.8
28	No Nest	23.07.'14	25.7	0.59	1	5.9	4.9	1.7
29	No Nest	24.07.'14	28.2	0.56	0	10.4	1	2.8
30	No Nest	24.07.'14	74.2	0.67	1	22.1	1.8	2
31	CY-28	24.07.'14	20.2	0.63	0	6.6	2	4
32	No Nest	24.07.'14	49.1	0.67	0	4.1	14.8	2.9
33	No Nest	24.07.'14	13.7	-	0	3	2	1.6
34	No Nest	24.07.'14	71	0.54	0	29.8	1.9	1.6
35	No Nest	24.07.'14	25.3	0.65	0	6.8	2.7	2.5
36	No Nest	25.07.'14	-	0.62	-	-	-	0.9
37	CY-30	26.07.'14	81.1	0.62	0	14.7	1.5	1.9
38	No Nest	26.07.'14	54.3	0.56	0	20.9	1.9	1.3

Adults

In the nesting season 2014, between 30 June and 26 July, 12 adult females were spotted on the beach (Tab.3). None of the animals had been tagged before and the team did not put any new tags on them. It was therefore not possible to determine whether a turtle was spotted more than once.

Five dead turtles were found on the beach this year, one of them was a *Chelonia mydas*, the others *Caretta caretta* (see Falk, 2014).

Tab. 3: Size of the observed females of loggerhead turtle at Çalış Beach in 2014 (-: no data available; +: epibionts present)

Tab. 3: Größe der beobachteten unechten Karettschildkröten am Strand von Çalış im Jahre 2014 (-: keine Daten vorhanden; +: Epibionten vorhanden)

Adult	SCL	SCW	CCL	CCW	Epibionts	Track Nr.	Nest Nr.
1	0.72	0.54	-	-	+	18	No Nest
2	-	-	0.78	0.69	0	4	CY-11
3	-	-	0.77	0.72	+	5	CY-12
4	-	-	0.7	0.62	0	8	CY-14
5	0.7	-	0.75	0.63	0	19	CY-21
6	0.72	0.53	0.76	0.66	+	22	CY-23
7	0.65	0.49	0.69	0.64	0	31	CY-28
8	0.65	0.48	0.7	0.62	0	29	No Nest
9	0.76	0.54	0.78	0.64	0	30	No Nest
10	0.74	0.5	-	-	0	33	No Nest
11	0.72	0.51	0.75	0.64	+	38	No Nest
12	0.72	0.63	0.75	0.65	0	37	CY-30

DISCUSSION

As mentioned above, in 2014 we had the highest number of nests recorded ever since 1994 (Fig. 4). One positive interpretation is that this could be due to the sea turtle monitoring program itself. A Mediterranean loggerhead turtle needs about 16 to 28 years to reach sexual maturity (Casale et al. 2009). The project in Fethiye has been running since 1994. Thus, the first hatchlings supported by our team 20 years ago could be the ones that laid their eggs this year. Another possible explanation could be that this value reflects the normal fluctuation. Nonetheless, since the number of nests was also very high in 2013 already (35 nests), a simple "natural fluctuation" explanation is weakened. Another piece of evidence is the mean sizes of the observed females at Çalış Beach. Such values are broadly correlated with their ages. This year (2014) on Çalış Beach the mean size of observed females was 74cm CCL and last year (2013) 75cm CCL (Nagorzanski & Pifeas 2013). According to Margaritoulis et al. (2003), the nesting females' mean size in Turkey is above 76 cm CCL. This should correspond to an age over 20.6 years (Casale et al. 2009). This leads to the conclusion that the sea turtles at Çalış Beach, which are on average smaller, might be even younger. Clearly, more data from future years is needed to determine statistically significant trends.

Despite the welcome development in the number of nests, only 40% of tracks led to successful nest deposition. This number can be viewed in the light of the threats sea turtles face at Çalış Beach. Several nesting sites in the Mediterranean Sea are threatened by tourist development (Margaritoulis et al. 2003). So is Çalış Beach. The main threats to sea turtles induced by tourism include:

1. Light pollution: lights are being put up on the promenade for tourists. Those lights irritate the adult female sea turtles when trying to lay a nest and also the hatchlings, which orient toward the moonlight to get into the sea and become disorientated by the bright lights on the promenade. A solution to this problem could be to shield the lights towards the beach (e.g. by colouring the side that is exposed to the beach in black). Some promenade lights in Çalış have implemented this solution by shading the seaward side of the lamps.
2. Sun beds and umbrellas: sun beds and umbrellas are arranged on the beach for the tourists. They are not removed at night (although most are flipped up along the promenade in Çalış), when the female adults come out to lay their nests, and therefore the sea turtles can be disturbed by them and may return to the ocean without digging a nest. Furthermore, beach furniture can prevent them from reaching a suitable nesting place. This issue could be solved by requiring the hotels to remove their sun beds and umbrellas at night. Another issue is tourists bringing their own sun umbrellas at daytime. They stick them into the sand and could potentially destroy a secret nest, for example. This practice needs to be prohibited.
3. Mechanical cleaning of beaches: Some parts of Çalış Beach are being mechanically cleaned and smoothened every morning. This leads to tracks being destroyed and therefore some nests cannot be found by our team in the morning shifts. There is no necessity for smoothening the beach and cleaning up the litter can be done manually.
4. Driving on beaches: in Çalış we saw a lot of cars and motorbikes driving on the (non-promenade part of the) beach. This compresses the sand and the hatchlings have less chance of successfully emerging from the nest.

5. Tourists on the beach at night: many tourists were observed walking around, partying, fishing and picnicking on the beach at night. Due to Çalış Beach being a SPA, entering the beach between 8 pm and 8 am is actually officially prohibited (Fig. 11). Nevertheless, few people apparently obey this rule and therefore it would be an important step forward if this would be controlled and enforced more, at least during the nesting season.

One approach to broadly address all the above-mentioned problems is to inform the tourists and local residents about the fact that Çalış Beach is a nesting beach for sea turtles and about the life history of sea turtles in general. A study from 2011 showed that 38% of the people did not know that Çalış Beach is being used as a nesting beach by sea turtles (Rössler 2011). While working on the info desk this year, we had the same impression. Many people were surprised when they heard that they are staying on a nesting beach for sea turtles, and most of them were interested in sea turtles and their conservation (see also Klikovits 2014, chapter 14 this issue). Therefore the work at the info desk and cooperation of Turkish and Austrian students to inform everybody about sea turtles is very important.

It would also be very important to better inform the public by putting up more information signs. In 2014, new information signs were put up by us at every main entrance to the promenade part of the beach (Fig. 12), but long stretches of the beach lack any signs.

Another threat to sea turtles is pollution. "The Mediterranean is an enclosed sea and organic and inorganic wastes, toxic effluents and other pollutants rapidly affect the ecosystems. Pollution includes marine debris, oil pollution and a variety of chemicals." (Caminas 2004). Studies have proved that marine debris affects Mediterranean loggerheads (Grametz 1989; Basso 1992), and pollution on nesting beaches is a serious problem (Campbell et al. 2001). This is not only a problem for adult loggerheads, which mistake garbage for food, but also for hatchlings, which can get caught in garbage, e.g.: in plastic cups.

According to the IUCN report on sea turtles in the Mediterranean from 2010, another main threat at Fethiye beach is sand extraction (Türkozan & Kaska 2010). Especially the sand in Çalış has been heavily extracted, and therefore only gravel can be found there. This explains why two of our tracks did not lead to a nest. Both were found in Çalış with numerous body pits (Fig. 10), but no nest was found. Here, the underground was clearly unsuitable to dig a nest. This suspicion can be supported by following fact: this particular sea turtle had striking epibionts on her plastron, which could easily be seen in the tracks and therefore it was easy to assign the tracks to this sea turtle. We therefore knew that the same sea turtle came out on two consecutive days in Çalış Teppe without laying a nest. Shortly thereafter, tracks from the same sea turtle were found by our second team in Yaniklar on so-called small beach, where the substrate is sandy, and the turtle had laid a nest there.

Another threat that should be mentioned is the destruction of eggs by root plants. Although the IUCN report of 2010 on sea turtles states "the destruction of the eggs by plant roots is rarely reported on Turkish beaches" (Türkozan & Kaska 2010), we observed this phenomenon on Çalış Beach. Nest CY-08 and CY-10 were close to acacia trees and we had to remove the plant roots regularly to prevent them from destroying the eggs.

The distinction of Çalış Beach into a promenade section and a non-promenade section is clearly warranted by the effect on the adult turtle emergence process. Our results show a clear difference between the two: the nests laid offside the promenade were 30% farther away from the sea. This implies that the turtles would tend to lay their nests farther away from the sea, for example to prevent them from being flooded, but have no opportunity to do so because of the wall. Importantly, this difference could be even more distinct if there were no barriers to nesting on the off-promenade stretch. Here, too, however, an almost uninterrupted string of bars, restaurants, camping grounds etc. occupy areas that were once sandy beach stretches. More insight into this issue might be gained by measuring the distance from the sea to the wall and/or bars, as well as the distance from the nests to the wall and/or bars in future seasons.

It will be very interesting to document whether the trend of nest numbers will stay as positive as it has been over the last two years.

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APPENDIX

Fig. 6: Cages over nests CY-4 and CY-7
Abb. 6: Käfige über den Nestern CY-4 und CY-7 (Photo: E. Guariento)

Fig. 7: Cage over nest CY-5 between sunbeds
Abb. 7: Käfig über Nest CY-5 zwischen Sonnenliegen (Photo: E. Guariento)

Fig. 8: Tripod with sign over nest in Çalış Beach
Abb. 8: Tripod auf Çalış Beach
(Photo: N. Falk)

Fig. 9: Morning shift triangulating nest CY-21
Abb. 9: Frühschicht bei der Triangulation von Nest CY-21
(Photo: E. Guariento)

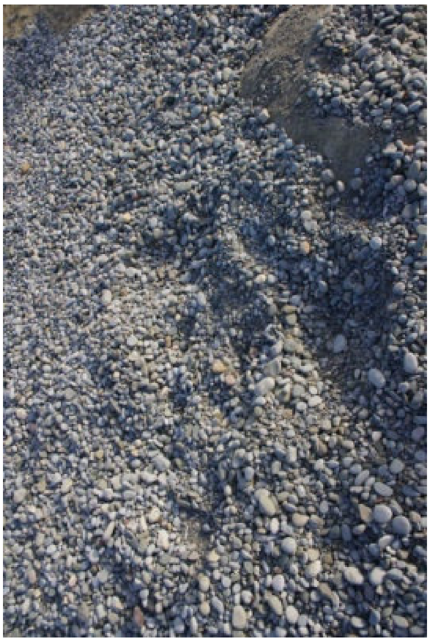
Fig. 10: “Body pit“ on unsuitable ground
Abb. 10: “Body pit“ über ungeeigneten Boden (Photo: E. Guariento)

Fig. 11: Information board on Çalış Beach
Abb. 11: Informationstafel auf Çalış Strand (Photo: E. Guariento)

Fig. 12: New information signs on main stairway entrances from promenade to Çalış Beach
Abb. 12: neue Informationstafeln an den Haupteingängen zu Çalış Strand
(Photo: M. Stachowitsch)

Nesting Activity of the Loggerhead Turtle, *Caretta caretta*, on the beaches Yaniklar and Akgöl, Turkey, in 2014

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KURZFASSUNG

Da Fethiye in der Türkei zu den wichtigsten Nistplätzen von *Caretta caretta* zählt, findet seit 1994 jährlich ein Monitoring Programm vor Ort statt. Im "Sea Turtle Field Course" werden, im Rahmen einer Zusammenarbeit mit türkischen und österreichischen Studenten, Daten über Nester, anthropogene Einflüsse, Hatchlinge und gefundene adulte Tiere gesammelt, um maximalen Erfolg bei Schutzbemühungen zu erzielen. 2014 wurden 4 adulte Weibchen gesichtet und insgesamt 61 Nester, 41 in Yaniklar und 20 in Akgöl, gefunden. Weiters wurden 67 Tracks gezählt, wobei 10 in Yaniklar und 5 in Akgöl zu einem erfolgreichen Nistversuch führten. Die Ergebnisse der vergangenen 20 Jahren zeigen eine Abnahme der Nestanzahl. Dieser Trend setzt sich auch im Blick auf die neuesten Untersuchungsergebnisse fort. Die Verteilung der Nester und die Verläufe mancher Tracks deuten darauf hin, dass sich der Zustand beider Strände in einigen Abschnitten negativ entwickelt und die Meeresschildkröten zunehmend Schwierigkeiten haben, einen geeigneten Nistplatz zu finden. Diese Erkenntnisse zeigen, dass, obwohl das Untersuchungsgebiet seit 1980 eine SPA ("Special Protected Area") ist, unzureichende Maßnahmen zum Schutz von Meeresschildkröten gesetzt wurden und konsequenteres, effektiveres Handeln notwendig ist.

ABSTRACT

Since Fethiye is one of the most important nesting sites for *Caretta caretta* in Turkey, a monitoring programme has been conducted there every year since 1994. The "Sea Turtle Field Course" is a collaboration between Austrian and Turkish university teachers and students, who collect data about nests, anthropogenic disturbances, hatchlings and encountered female turtles in order to maximize the success of protection efforts. In 2014, four adult females were encountered and a total of 61 nests, 41 in Yaniklar and 20 in Akgöl, were recorded. Furthermore, 67 tracks, ten of them with successful nesting attempts in Yaniklar and five in Akgöl, were recorded at both beaches. Observations over the last 20 years show a decline in the number of nests, which is again supported by the newest results. The distribution of the nests and the course of some tracks indicate that the condition of the beaches has deteriorated in many sections and that the turtles seem to have a harder time

finding suitable nesting spots. These findings show that, even though the area was designated an SPA ("Special Protected Area"), very few specific measures have been implemented to actually protect marine turtles, and more consequent, effective actions need to be taken.

INTRODUCTION

In the Mediterranean basin, three species of marine turtles occur regularly: *Caretta caretta* (loggerhead turtle), *Chelonia mydas* (green turtle) and *Dermochelys coriacea* (leatherback turtle). All of them are listed as Endangered or Critically Endangered on the 2004 IUCN Red List of Threatened Species (WWF Species Action Plan, 2005).

Two ecological stages are evident in a loggerhead turtle's life: An oceanic stage, when they frequent open waters and feed upon pelagic prey, and a neritic life-stage, when they visit shallow waters on the continental shelves and feed upon benthic prey (Bolton, 2003).

Adult female loggerhead turtles primarily emerge on sandy beaches to lay their eggs, such as those that are still present along some parts of Yaniklar and Akgöl in Fethiye (Miller et al., 2003).

Almost all nests laid by *Caretta caretta* can be found in the eastern basin, primarily in Greece, Libya, Cyprus and Turkey, where over 2000 nests are laid annually (Canbolat 2004). Initially, a total of 17 nesting beaches in Turkey were designated as key marine turtle nesting grounds in 1988 (Baran & Kasparek, 1989), but later with the consideration of new nesting sites and the review of the beaches, a total of important 22 nesting sites were listed recently, all of which are affected by some level of anthropogenic impact (Canbolat 2004).

Fethiye, where the field course took place, is considered one of these major nesting sites, thanks in part to long-term monitoring programs (WWF Action Plan 2005).

Although Fethiye was designated an SPA (Special Protection Area) in 1988 (Özdemir et al., 2008), large parts of Akgöl and Yaniklar are nowadays characterized by anthropogenic disturbance such as tourist resorts and a severe decline in nest numbers has been observed.

Marine turtles are threatened by a large number of (mostly) human activities, both on land and at sea. These include interaction with fisheries (intentional and unintentional killing), impact on nesting sites (e.g. sand extraction, beach furniture, mechanical cleaning or vehicles on the beach), noise pollution (adult females are highly sensitive to noise and light while approaching the beach to lay their eggs), litter or nest depredation (e.g. by feral/domestic dogs, foxes, jackals or seagulls) (WWF Species Action Plan 2005). Furthermore, increasing artificial lighting on or near the beach effects the ability of hatchlings to orient on land and in the sea (Lorne and Salmon 2007).

In 2014, the monitoring program in Fethiye took place for the 21st time since 1994. It aims to collect data about the development of the *Caretta caretta* population, which can be used to provide effective protection of loggerhead turtles. Austrian students, together with instructors and students from the Hacettepe University, worked on the project from 27 June until 13 September. Key data about nests, hatchlings and encountered adult females of *Caretta caretta,* as well as about anthropogenic disturbances were collected.

MATERIAL AND METHODS

Students monitored the beaches Yaniklar and Akgöl from the 27 June until 13 of September 2014. Every day, two groups of two to four people walked along both beaches starting from Onur Camp. One group went to Akgöl beach (1.5km), while the other group went to Yaniklar Beach (4.8km) until they reached Karataş Beach (”small beach”). Every day, surveys took place in the early morning and at night until the first nest started to hatch. Data were collected at both beaches and then later transcribed to the data sheets back in the camp.

Morning shifts

Morning shifts were conducted every day during the field course. Every morning, either from 5:30am when surveying the Yaniklar Beach, or 6am when going to Akgöl Beach, monitoring took place until work was finished, which was usually between 8am and 10am. As opposed to the night shifts, both beaches were surveyed in the morning shifts by two to four people walking along the beach at various heights to cover the whole area. During the first few weeks of the project, work primarily consisted of looking for tracks by adult female turtles and potential nests that may have been laid the previous night. Furthermore, already laid and marked nests needed to be checked (e.g. for predation, stones on/in the nest or potential removal of our marks). If an adult track was found, the track length and width, the distance to the sea (from the farthest part of the track down to the sea), body pits, swimming movements, direction of the track and started egg chambers were measured and noted by the team (Fig.1, Fig.2, Fig.3 in Appendix). Afterwards, tracks were covered to prevent collecting the same data twice. After the first few weeks until the end of the monitoring program, both beaches additionally were checked for hatchling tracks. If tracks were found, the hatched nest was identified based on the direction of the tracks. The number of hatchlings coming from the nest

was counted. The students then followed the tracks, if possible, to estimate how many hatchlings reached the sea safely. After collecting all data, these tracks were also covered.
If nests that were about to hatch soon were rated as threatened by artificial lighting, which would cause the hatchlings to run in the wrong direction, cages were put on top of the nest (Fig.4 in Appendix). If hatchings were found inside the cage in the morning, they were either immediately released to the sea until about 7am or, if found later, taken to the camp in a bucket filled with some moist sand and covered with a moist towel. This was designed to prevent predation and desiccation by releasing them during the day. Those hatchlings were then released to sea the same day at night, shortly before the night shift started.

Night shifts

Night shifts were conducted during the first three weeks of the project from 10pm to 2am until the first nest started to hatch. To avoid stepping on the hatchlings in the dark, night shifts were then stopped. Three to four people did alternating shifts on Yaniklar Beach or on Akgöl Beach, starting from Onur Camp. The beach was monitored for one length, the students then took a 30 min break at the end of the beach (Akgöl) or at a landmark called ”lonely tree” (Yaniklar) to avoid frightening away adult females, that were about to emerge on the beach to lay eggs. Then the group returned, took a second break and repeated to whole procedure. Such as during the morning shifts, the team also split up in a transverse line across the beach at different heights to monitor the whole width in order not to miss any turtle in the dark, because no flashlights were used during night shifts in order to prevent disturbing or confusing turtles on the beach.
If a turtle was detected, the students immediately stopped, crouched down several meters away to stay out of its sight and waited without making any noise in order to not disturb the turtle's attempt of laying a nest. After determining that the turtle had completed the nesting process and was on its way back to the sea, one person measured the straight and curved carapace length (SCL/CCL) and carapace width (SCW/CCW) with a wooden sliding caliper and a tape measure. Additionally, epibionts and injuries were recorded and the turtle was checked for possible tags on one of the flippers. Flashlights were used only to read and write down the measured data and other observations. The students always made sure to keep the light out of the turtle's field of vision.

Measuring and marking nests

Once the location of a potential nest was roughly located, the students used a metal rod (Turkish: Şiş), to pinpoint the exact spot of the nest. Accordingly, the rod was carefully pushed through the sand along the track where the nest was suspected. If the rod penetrated the sand easily at the depth of an egg chamber, the nest was found. To avoid losing a nest, a semicircle of larger cobbles was formed around the nest. On two stones, the nest number and date of nesting was written (e.g. Akgöl: AY-01, 30.6.14; Yaniklar: YY-01, 30.6.14). Additionally, six small twigs, two of them connected through a string, were placed behind the nest or were buried, also with the nest number and date of laying written on them (Fig. 5 in Appendix). Furthermore, the nest's distance to the sea, including the differentiation of the wet, moist and dry zone was recorded. Moreover, the distances to at least two different easily recognizable landmarks were measured, if the nest was located on a site high-frequented by tourists (increasing the probability that nest markings being removed or displaced).

On touristic beach parts, three wooden sticks were tied together (”tripod”) and placed on top of the nest with an attached information sheet (Fig.6 in Appendix). Finally, the nest sites were cleared of debris and other items to ensure a safe environment for the hatchling so they can reach the sea without getting trapped. Finally, there were so-called secret nests, which were either found by our Turkish colleagues prior to the arrival of the first Austrian students or were later noticed due to hatching.

RESULTS

The raw data of all nesting and emerging activities of adult female loggerhead sea turtles on the beaches of Akgöl und Yaniklar in 2014 are included in the table section of the Appendix.

Nests

In 2014, a total of 61 nests laid by female loggerhead sea turtles (*Caretta caretta*) were recorded on the beaches of Akgöl and Yaniklar. Compared to the last 20 years, with nest number peaks in 1995, 1998, 2001, 2003 and 2007, this result indicates a further downward trend (Fig. 7).

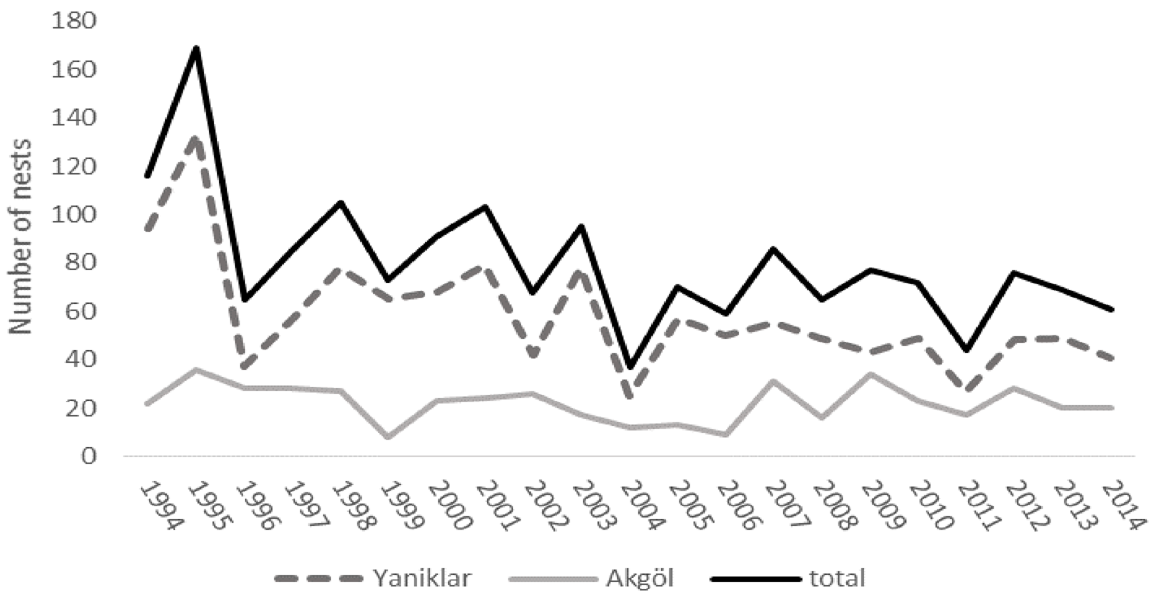

Fig. 7: Annual number of nests in Yaniklar and Akgöl from 1994 to 2014
Abb. 7: Jährliche Anzahl der Nester in Yaniklar und Akgöl von 1994 bis 2014

Approximately two-thirds of the nests (n=41) were located in Yaniklar, whereas the remaining third of the nests (n=20) were found in Akgöl. Only one quarter of all nests was "dated nests", having a known nesting date. The other nests, the so-called "secret nests", were either found by our Turkish colleagues prior to our arrival or could later be located due to the process of hatching.

The nests were not evenly distributed on the beach. Instead, we identified nesting hotspots, which mainly appeared to reflect the quality of the substrate, e.g. fine sand instead of cobbles, gravel or pebbles (Fig. 8, 8a-8e).

Fig.8: Overview of Yaniklar and Akgöl beach sections with landmarks and distribution of nests.
Abb. 8: Überblick über Yaniklar und Akgöl mit Landmarken und Verteilung der Nester.
(source: Google earth 2015)

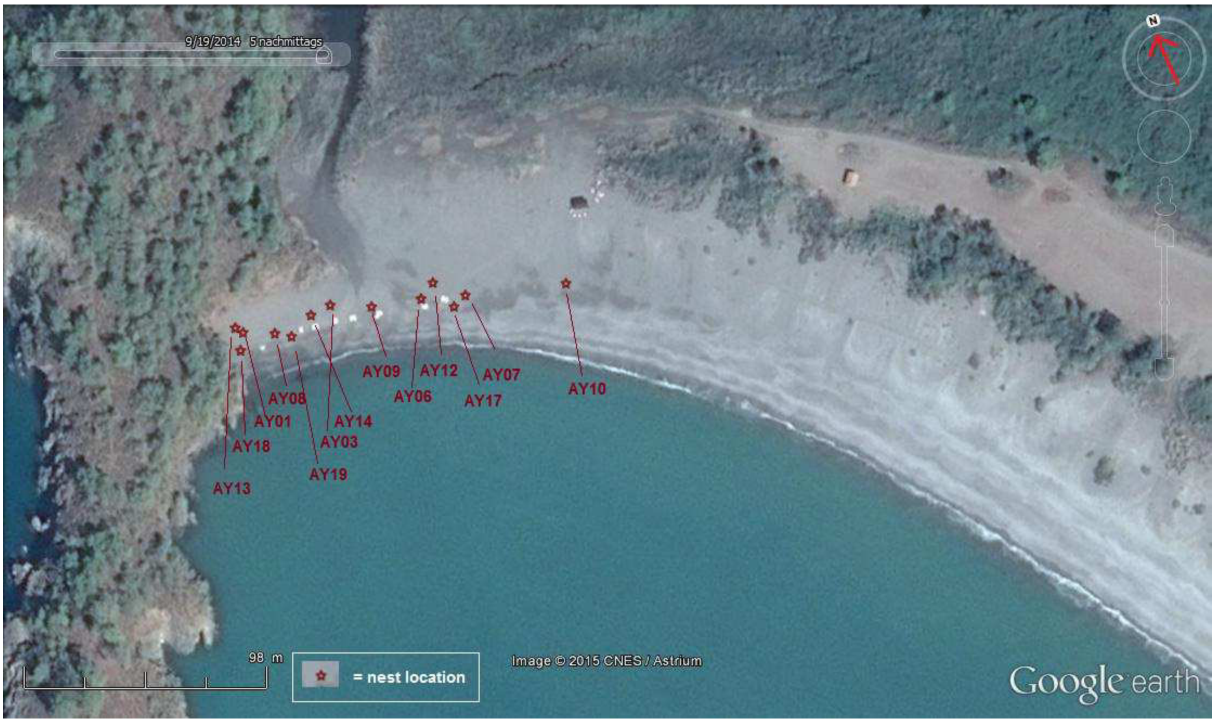

Fig.8a: Nests located around the riverbed of Akgöl.
Abb. 8a: Nester rund um das Akgöl-Flussbett.
(source: Google earth 2015)

Fig.8b: Nests located between Karoat Restaurant and Yonca Lodge.
Abb. 8b: Nestpositionen zwischen Karoat Restaurant und Yonca Lodge.
(source: Google earth 2015)

Fig.8c: Nests located between Majesty Club Lycia Botanica and Lonely Tree.
Abb. 8c: Nestpositionen zwischen Majesty Club Lycia Botanica und Lonely Tree.
(source: Google earth 2015)

Fig.8d: Nests located between Lonely Tree and Akmaz Buffet.
Abb. 8d: Nestpositionen zwischen Lonely Tree und Akmaz Buffet.
(source: Google earth 2015)

Fig.8e: Nests located around Karatas Buffet and at Small Beach.
Abb. 8e: Nestpositionen rund um Karatas Buffet und am Small Beach.
(source: Google earth 2015)

The distance of a nest to the sea is an important parameter associated with the beach conditions. The average distance of a nest to the sea was about 22.5 m in Yaniklar (n=41) and 17.5 m in Akgöl (n=19), both showing a standard deviation of around 10 m. The longest measured distance to the sea in Yaniklar was 59.6 m, whereas in Akgöl it was 42.4 m (Fig. 9, Fig. 10, Fig. 11). The distance to the sea was divided into three different sections, namely wet zone, moist zone and dry zone. The average distance of all nests was 13.5 m in the wet, 4 m in the moist and 3 m in the dry zone.

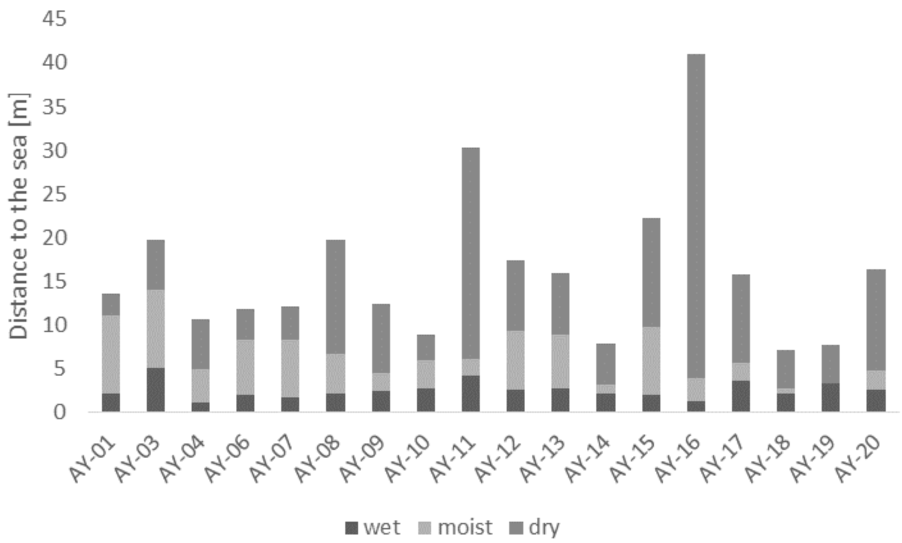

Fig. 9: Distance to the sea of the nests in Akgöl and relative proportions in the wet, moist and dry zone
Abb. 9: Entfernung der Nester zum Meer in Akgöl und relative Proportionen der nassen, feuchten und trockenen Abschnitte.

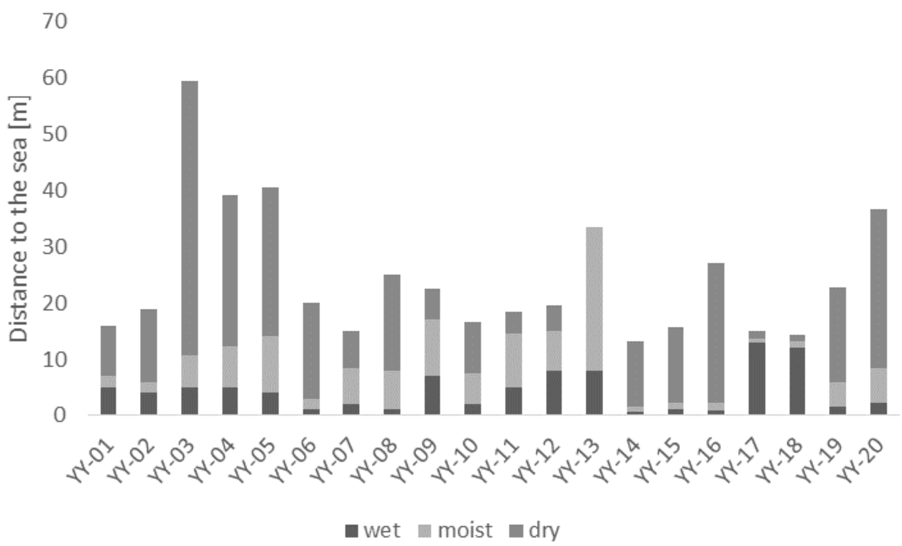

Fig. 10: Distance to the sea of the nests in Yaniklar and relative proportions in the wet, moist and dry zone.
Abb. 10: Entfernung der Nester zum Meer in Yaniklar und relative Proportionen der nassen, feuchten und trockenen Abschnitte.

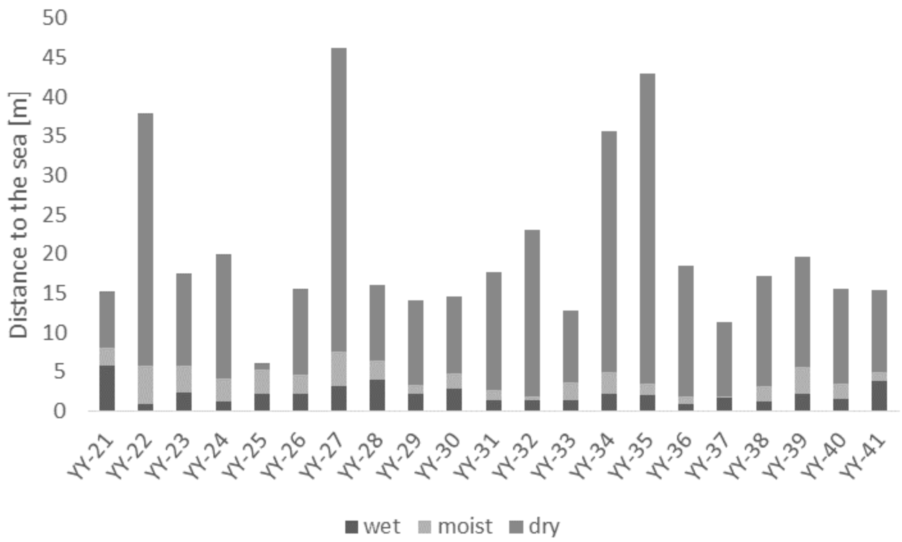

Fig. 11: Distance to the sea of the nests in Yaniklar and relative proportions in the wet, moist and dry zone.
Abb. 11: Entfernung der Nester zum Meer in Yaniklar und relative Proportionen der nassen, feuchten und trockenen Abschnitte.

Tracks

A total of 67 emergences of female loggerhead sea turtles – in the form of so-called tracks – were discovered and measured, with a success rate of approximately 20% on both beaches for a female *Caretta caretta* to lay a nest (Fig. 12).

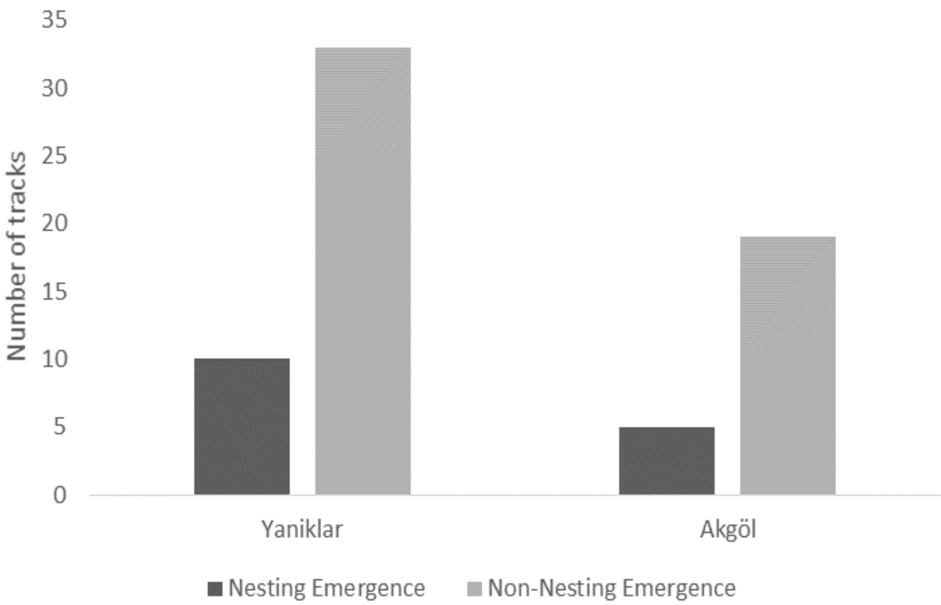

Fig. 12: Number of emergences from 29 June until 29 July, divided into successful and unsuccessful nesting attempts in Yaniklar and Akgöl Beach
Abb.12: Anzahl der Spuren zwischen 29. Juni und 29. Juli aufgeteilt in erfolgreiche und gescheiterte Nistversuche an den Stränden von Yaniklar und Akgöl

The longest tracks were found in Yaniklar and measured 238 m and 255 m, which are the longest tracks recorded for at least 4 years.
The track widths for a female *Caretta caretta* ranged from 0.50 m to 0.79 m, with an average width of 0.62 m.

<u>Adults</u>

We observed and measured four female *Caretta caretta* adults during our night shifts. None of them had a previous tag for an identification of the individual. We recorded their carapace dimensions as well as possible epibionts and further remarks. The average values for straight measurements were 67 cm length (SCL) and 52 cm width (SCW). The average curved carapace measures were 77 cm in length (CCL) and 68 cm in width (CCW) (Fig. 13). In comparison to the data of 2013 the turtles were bigger (2013: SCL = 61 cm; SCW = 44 cm; CCL = 74.5 cm; CCW = 64 cm; n=7).

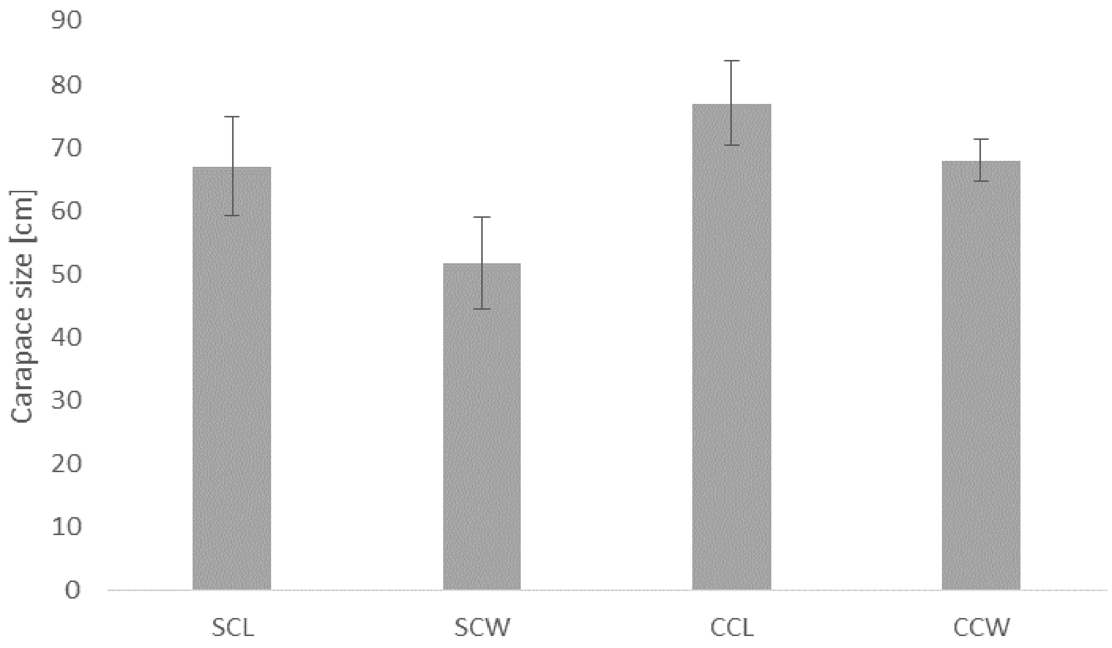

Fig. 13: Average carapace size (in cm) of adult females in 2014 (n=4) including standard deviation, SCL: straight carapace length, SCW: straight carapace width, CCL: curved carapace width, CCW: curved carapace width.
Abb. 13: Mittlere Panzergröße (in cm) der adulten Weibchen von 2014 (n=4) inklusive Standardabweichung, SCL: gerade Panzerlänge. SCW: gerade Panzerbreite, CCL: gekrümmte Panzerlänge, CCW: gekrümmte Panzerbreite

DISCUSSION

The data on *Caretta caretta* nesting activity in Yaniklar and Akgöl collected over the last 20 years shows a gradually decreasing number of nests on the monitored beaches. This year's results, a total number of 61 nests found in Yaniklar and Akgöl, further underlines this downward trend (Fig. 7).

Among the potential reasons for this tendency are the growing sector of industrial fishing, marine pollution, modern tourism and the thereby induced deterioration of nesting habitats. Commercial fishing kills adult turtles and reduces the odds of survival for juveniles. Due to by-catch, more than 44,000 sea turtles are being killed each year (Casale 2011).

Caretta caretta return to their nesting ground for oviposition every three to four years (Margaritoulis 2005), making natural peaks and troughs in nest numbers a possibility. In the last two decades however, the numbers of nests in Yaniklar and Akgöl are gradually decreasing, i.e. almost every successive peak and trough is lower than the previous one. Considering only the last decade, the number of nests remains more or less at the same level. This phenomenon could be due to increasing conservational efforts taken in this area, but further data collection is needed in order to assess the situation more comprehensively.

As female loggerhead sea turtles reach sexual maturity between the age of 20 and 25 (Casale 2011), we can now – and especially in the upcoming years – more directly observe the results of the protection efforts put into this project, i.e. the first turtle hatchlings supported two decades ago may now begin to return to their original nesting beach. Thus, we are looking forward to next years' monitoring data.

For nesting, female *Caretta caretta* need sandy, wide and open beaches. The substrate should be low in salinity, well-ventilated and humid, as well as far enough away from the shore to help rule out flooding due to tides and storms (Bolten 2003).

The beaches in Yaniklar and Akgöl are degrading. In particular, the former sandy stretches are being reduced and are increasingly replaced by coarse gravel and even cobbles. One reason for this is sand removal for construction, making it hard for sea turtles to find a suitable nesting substrate. The nesting success of *Caretta caretta*, provides a measure of the difficulties sea turtles are facing during the nesting procedure (Margaritoulis 2005). For an 11-year period (1990-2000) the mean nesting success rate in Laganas Bay, Greece, was 25.3%, whereas in Kyparissia Bay, Greece, the nesting success rate over the same period of time was 38.6% (Margaritoulis and Rees 2001). The author attributed the difference to the better quality of the substrate and the lesser human disturbance at Kyparissia Bay. In Yaniklar we observed a success rate of 23%, whereas in Akgöl the ratio was 21% (Fig. 12). Thus, nesting success in both beaches is on a comparable level. However, compared with Kyparissia Bay, nesting success seems to be relatively low. An explanation for this may again be the lack of suitable substrate in our study area and the anthropogenic impact in certain beach sections, i.e. noise and light pollution in front of the two hotel complexes Majesty Tuana and Majesty Botanica. Theoretically, one would expect a success rate of close to 100% in a perfect nesting area without any disturbances. Under this point of view, the approximate 20% nesting success in Yaniklar and Akgöl shows that we are far from ideal nesting conditions.

Our data reveal a lot of variation regarding the distance of the nests to the sea. We observed nests being laid close to the shoreline and others being laid relatively far away (up to 60 m) (Fig. 9, Fig. 10, Fig. 11). Considering the above-mentioned deteriorating substrate conditions, one can conclude that the sea turtles in Yaniklar and Akgöl may be moving further inland for oviposition (extreme tracks reaching up to 250 m length) or even more likely to abandon the nesting process here. Conversely, the limited presence of suitable substrate may explain the relatively large density of nests in specific areas like i.e. Karataş beach, where the nests are generally located in a closer proximity to the shoreline than in other areas (Fig. 8). The reduced availability of the preferred substrate, combined with the degradation of large areas of the beach, will eventually shift the nest distribution from an even one to the occurrence of annual nesting hotspots. One such hotspot is i.e. the northern end of Akgöl (Fig 8). Here in 2014, 60% of the nests of the entire Akgöl beach were laid on a rather short beach section. The preservation of such preferred locations is therefore indispensable.

This year we observed another such potential area, namely Karataş beach (also known as "small beach") in Yaniklar (Fig. 8). Over the last four years the number of nests varied from zero to two. However, this year we recorded a total of five nests in this short, isolated beach section. This beach, similar to the nesting hotspot on the northern end of Akgöl, is characterized by a fine-grained sandy substrate and is therefore very suitable for digging nests.

All in all the monitoring results of this year show the importance of further observation of the sea turtle population on the beaches of Yaniklar and Akgöl. In particular, as we are – in the upcoming years – going to observe the first hatchlings, that were supported twenty years ago when the "Sea Turtle Field Course" started, returning to their natal beaches in Fethiye and laying eggs themselves. It is indispensable to actively protect the sea turtles as individuals, however in order to give the sea turtle population the opportunity to recover, we have to reverse the degradation of the beaches and limit anthropogenic disturbances to a minimum. The first step in order to achieve this goal is getting the local people involved, telling them about our project and discussing issues and problems regarding sea turtles in Fethiye. Only knowledge and education can lead to effective conservation.

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APPENDIX

Fig.1, Fig.2: If an adult track was found, the track length and width, the distance to the sea, body pits, swimming movements, direction of the track and started egg chambers were measured and noted.
Abb.1, Abb.2: Bei Fund eines adulten Tracks wurden dessen Länge, Breite, Richtungsverlauf, Abstand des höchsten Punktes zum Meer, body pits, Schwimmbewegungen, sowie angefangene Eigruben vermessen bzw. vermerkt.

Fig.3: Body pit of an adult female *Caretta caretta*
Abb.3: Body pit einer adulten weiblichen *Caretta caretta*

Fig.4: Nests threatened by artificial lighting (which would cause the hatchlings to run in the wrong direction) were equipped with cages. Note position of this nest very far away from the sea.
Abb.4: Bei künstliche Lichtquellen in der Nähe eines Nest (die Hatchlinge laufen dann in die falsche Richtung), wurde ein Käfig über dem Nest angebracht. Dieses Nest wurde sehr weit vom Meer entfernt gelegt.

Fig.5: Marked nest with a semicircle of large cobbles and several wooden sticks behind the nest or buried. The nest number and date of laying are written on two stones and all sticks.
Abb.5: Markiertes Nest mit einem Steinhalbkreis und mehreren Holzstöcken, welche hinter dem Nest angebracht oder eingegraben wurden. An zwei Steinen, sowie an allen Holzstöcken wurden die Nestnummer und das Legedatum vermerkt.

Fig.6: On touristic beach parts, three wooden sticks were tied together ("tripod") and placed on top of the nest with an attached information sheet. This nest was laid quite close to the sea.
Abb.6: Bei Nestern, welche sich auf stark besuchten Strandabschnitten befanden, wurden drei Holzstöcke zusammengebunden ("tripod") und mit einem Informationsblatt über dem Nest angebracht. Dieses Nest wurde sehr nahe am Wasser gelegt.

Table 1 Annual number of nests in Yaniklar and Akgöl from 1994- 2014
Tab. 1 Jährliche Anzahl der Nester in Yaniklar und Akgöl von 1994 - 2014

Year	Yaniklar	Akgöl	total
1994	94	22	116
1995	133	36	169
1996	37	28	65
1997	57	28	85
1998	78	27	105
1999	65	8	73
2000	68	23	91
2001	79	24	103
2002	42	26	68
2003	78	17	95
2004	25	12	37
2005	57	13	70
2006	50	9	59
2007	55	31	86
2008	49	16	65
2009	43	34	77
2010	49	23	72
2011	27	17	44
2012	48	28	76
2013	49	20	69
2014	41	20	61

Table 2: Carapace measurements (in cm) of adult females in 2014 (n=4), SCL: straight carapace length, SCW: straight carapace width, CCL: curved carapace width, CCW: curved carapace width
Tab. 2: Panzerabmessungen (in cm) der adulten Weibchen von 2014 (n=4) SCL: gerade Panzerlänge. SCW: gerade Panzerbreite, CCL: gekrümmte Panzerlänge, CCW: gekrümmte Panzerbreite

Turtle #	SCL	SCW	CCL	CCW
1	78	64	87	71
2	56	45	70	63
3	68	49	79	71
4	66	49	72	67

Table 3 Nesting data Akgöl; AY = nest Akgöl; n.a. = no data available
Tab. 3 Nestdaten von Akgöl; AY = Nest Akgöl; n.a. = keine Daten verfügbar

Date	Nest #	Total track length [m]	Track width [m]	Number of body pits	Nest distance to sea [m]	dry	moist	wet
-05.06.2014	AY-01	n.a.	n.a.	n.a.	13.55	2.55	9	2
-05.06.2014	AY-02	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
-10.06.2014	AY-03	n.a.	n.a.	n.a.	19.7	5.7	9	5
-15.06.2014	AY-04	n.a.	n.a.	n.a.	10.6	5.8	3.8	1
-29.06.2014	AY-05	n.a.	n.a.	n.a.	42.4	n.a.	n.a.	n.a.
30.06.2014	AY-06	70.8	0.68	1	11.7	3.5	6.3	1.9
01.07.2014	AY-07	54.5	0.65	1	12	3.7	6.7	1.6
-01.07.2014	AY-08	n.a.	n.a.	n.a.	19.7	13	4.7	2
06.07.2014	AY-09	37.1	0.53	0	12.4	8	2.1	2.3
-13.07.2014	AY-10	n.a.	n.a.	1	8.9	3	3.2	2.7
-13.07.2014	AY-11	n.a.	n.a.	1	30.3	24.3	1.9	4.1
17.07.2014	AY-12	48.7	0.63	0	17.3	8	6.8	2.5
19.07.2014	AY-13	36.8	0.5	0	15.9	7.1	6.1	2.7
-25.07.2014	AY-14	n.a.	n.a.	n.a.	7.8	4.7	1.1	2
-27.07.2014	AY-15	n.a.	n.a.	n.a.	22.2	12.5	7.8	1.9
-31.07.2014	AY-16	n.a.	n.a.	n.a.	41	37.2	2.6	1.2
-01.08.2014	AY-17	n.a.	n.a.	n.a.	15.7	10.1	2	3.6
-05.08.2014	AY-18	n.a.	n.a.	n.a.	7	4.3	0.7	2
-12.08.2014	AY-19	n.a.	n.a.	n.a.	7.7	4.5	0	3.2
-17.08.2014	AY-20	n.a.	n.a.	n.a.	16.4	11.7	2.2	2.5

Table 4 Nesting data Yaniklar; YY= nest Yaniklar; n.a. = no data available
Tab. 4 Nestdaten von Yaniklar; YY = Nest Yaniklar; n.a. = keine Daten verfügbar

Date	Nest #	Total track length [m]	Track width [m]	Number of body pits	Nest distance to sea [m]	dry	moist	wet
-05.06.2014	YY-01	n.a.	n.a.	n.a	16	9	2	5
-05.06.2014	YY-02	n.a.	n.a.	n.a	19	13	2	4
-05.06.2014	YY-03	n.a.	n.a.	n.a	59.6	49	5.6	5
-05.06.2014	YY-04	n.a.	n.a.	n.a	39.2	27	7.2	5
-05.06.2014	YY-05	n.a.	n.a.	n.a	40.6	26.6	10	4
11.06.2014	YY-06	n.a.	n.a.	n.a	20	17	2	1
-02.06.2014	YY-07	n.a.	n.a.	n.a	15	6.5	6.5	2
-01.07.2014	YY-08	n.a.	n.a.	n.a	25	17	7	1
-17.06.2014	YY-09	n.a.	n.a.	n.a	22.6	5.5	10.1	7
-18.06.2014	YY-10	n.a.	n.a.	n.a	16.7	9.1	5.6	2
-17.06.2014	YY-11	n.a.	n.a.	n.a	18.5	4	9.5	5
-19.06.2014	YY-12	n.a.	n.a.	n.a	19.5	4.5	7	8
-16.06.2014	YY-13	n.a.	n.a.	n.a	33.5	0	25.5	8
-01.07.2014	YY-14	n.a.	n.a.	n.a	13.1	11.6	0.9	0.6
-01.07.2014	YY-15	n.a.	n.a.	n.a	15.7	13.4	1.2	1.1
-01.07.2014	YY-16	n.a.	n.a.	n.a	27.1	24.9	1.3	0.9
-01.07.2014	YY-17	n.a.	n.a.	n.a	15	1.4	0.6	13
-01.07.2014	YY-18	n.a.	n.a.	n.a	14.4	1.2	1.1	12.1
-29.06.2014	YY-19	n.a.	n.a.	n.a	22.8	17	4.3	1.5
-29.06.2014	YY-20	n.a.	n.a.	n.a	36.6	28.1	6.3	2.2
02.07.2014	YY-21	67.5	0.62	4	15.2	7.2	2.2	5.8
04.07.2014	YY-22	83.1	0.61	0	37.95	32.15	4.9	0.9
04.07.2014	YY-23	41.1	0.77	1	17.5	11.8	3.4	2.3
06.07.2014	YY-24	39.7	0.52	3	19.9	15.8	2.9	1.2
07.07.2014	YY-25	22.8	0.6	1	6	0.8	3.1	2.1
-12.07.2014	YY-26	n.a.	n.a.	n.a	15.6	11	2.5	2.1
16.07.2014	YY-27	134.3	0.54	5	46.3	38.8	4.4	3.1
-17.07.2014	YY-28	n.a.	n.a.	n.a.	16	9.6	2.4	4
19.07.2014	YY-29	30.4	n.a.	1	14	10.7	1.2	2.1
-19.07.2014	YY-30	29	n.a.	n.a.	14.5	9.8	1.9	2.8
23.07.2014	YY-31	38	0.54	0	17.7	15	1.4	1.3
-25.07.2014	YY-32	n.a.	n.a.	n.a.	23.1	21.3	0.5	1.3
27.07.2014	YY-33	28.5	n.a.	1	12.7	9	2.3	1.4
27.07.2014	YY-34	72.7	0.68	0	35.7	30.8	2.7	2.2
-27.07.2014	YY-35	n.a.	n.a.	n.a.	43	39.5	1.5	2
-02.08.2014	YY-36	n.a.	n.a.	n.a.	18.5	16.6	1	0.9
-04.08.2014	YY-37	n.a.	n.a.	n.a.	11.3	9.4	0.3	1.6
-06.08.2014	YY-38	n.a.	n.a.	n.a.	17.2	14	2	1.2
-08.08.2014	YY-39	n.a.	n.a.	n.a.	19.6	14	3.5	2.1
-13.08.2014	YY-40	n.a.	n.a.	n.a.	15.5	12	2	1.5
-30.08.2014	YY-41	n.a.	n.a.	n.a.	15.4	10.4	1.2	3.8

Table 5 Track data Yaniklar; n.a. = no data available
Tab. 5 Trackdaten von Yaniklar; n.a. = keine Daten verfügbar

Date	Nest #	Total track length [m]	Track width [m]	Number of body pits	# of started egg chambers	dry	moist	wet
-05.06.2014	1	n.a.	n.a.	n.a.	n.a.	8	3	5
-05.06.2014	2	n.a.	n.a.	4	0	9	3	5
05.06.2014	3	n.a.	n.a.	0	0	12	3.5	5
29.06.2014	4	52.4	0.54	3	0	n.a.	n.a.	n.a.
29.06.2014	5	58	0.68	1	1	n.a.	n.a.	n.a.
29.06.2014	6	45.7	0.57	1	0	n.a.	n.a.	n.a.
29.06.2014	7	48.2	0.57	2	0	n.a.	n.a.	n.a.
29.06.2014	8	53	0.64	2	4	n.a.	n.a.	n.a.
01.07.2014	9	n.a.	n.a.	6	0	63	8	4
01.07.2014	10	129	0.61	6	0	n.a.	n.a.	n.a.
02.07.2014	11	47.5	0.69	1	0	14.5	2.2	0.8
02.07.2014	12	33.5	0.58	1	0	13.2	2.1	0.9
02.07.2014	13	32.5	0.6	0	1	6.8	4.2	1.1
02.07.2014	14	85.8	0.64	4	0	35.4	3.4	1.4
02.07.2014	15	26.6	0.68	0	2	18	1.8	3.6
03.07.2014	16	47.3	0.79	4	1	13.8	6	2.2
03.07.2014	17	11.2	0.65	0	0	6.1	4.1	1
04.07.2014	18	24.5	0.66	1	0	19.7	2.9	1.9
04.07.2014	19	57.8	0.75	0	0	22.3	2.1	2.7
04.07.2014	20	24.4	0.67	1	0	4.9	4.9	1.2
12.07.2014	21	91.3	0.54	0	1	23.9	2.3	2.8
14.07.2014	22	23.2	0.65	1	0	5.1	5.4	0.7
14.07.2014	23	58.6	0.62	1	1	18.8	4	4.2
14.07.2014	24	61.9	0.62	1	0	18.9	3.8	2.7
15.07.2014	25	87	0.6	2	0	33	6	3
15.07.2014	26	37.6	0.55	3	0	8.2	3.8	3
18.07.2014	27	36	0.5	1	1	17.7	0.4	0.7
19.07.2014	28	55.5	0.6	2	3	22.9	0.5	1.6
19.07.2014	29	46.6	0.6	3	2	18.3	1.2	1.6
25.07.2014	30	255.5	0.56	2	0	67.6	2.6	0.8
25.07.2014	31	238.8	0.62	12	1	48.6	0.9	2
26.07.2014	32	41.3	0.61	1	0	11.1	1.2	3.9
27.07.2014	33	91.4	0.66	2	2	28.2	3.9	1.4
28.07.2014	34	34	0.65	1	0	9	3.5	3.5
28.07.2014	35	54	0.61	4	0	18.3	3.1	1.6
29.07.2014	36	59	0.6	2	0	10.9	6	1.4

Table 6 Track data Akgöl; n.a. = no data available
Tab. 6Trackdaten von Akgöl; n.a. = keine Daten verfügbar

Date	Nest #	Total track length [m]	Track width [m]	Number of body pits	# of started egg chambers	dry	moist	wet
29.06.2014	1	n.a.	n.a.	1	0	n.a.	n.a.	n.a.
-29.06.2014	2	n.a.	n.a.	1	1	n.a.	n.a.	n.a.
29.06.2014	3	50.9	0.55	1	0	n.a.	n.a.	n.a.
30.06.2014	4	41.7	0.68	1	1	n.a.	n.a.	n.a.
01.07.2014	5	56.5	0.54	2	0	20.6	3.1	2.3
01.07.2014	6	27.8	0.64	1	0	4,6	6.7	1.6
01.07.2014	7	43.8	0.58	1	0	24.1	2.3	2.2
01.07.2014	8	47.9	0.69	1	0	18.8	1.4	0.8
06.07.2014	9	73.9	0.55	1	0	27.1	3.3	1.1
13.07.2014	10	24.4	0.65	4	0	7.5	0.9	1.8
13.07.2014	11	38.7	0.62	1	0	9.4	3.1	3.9
15.07.2014	12	28.8	0.59	1	0	7.8	2.8	2.5
15.07.2014	13	28.6	0.65	2	0	8.8	4.1	2.3
15.07.2014	14	18	0.65	1	0	6.5	4.8	3.1
16.07.2014	15	67	0.64	0	0	18.2	0.8	4.2
16.07.2014	16	19.7	0.63	2	0	10	6.2	3.5
16.07.2014	17	58.5	0.63	4	0	17.7	2.5	6.8
17.07.2014	18	63.3	0.66	0	0	8.3	7.3	3.6
22.07.2014	19	34.2	n.a.	0	0	12.8	2.2	1.5
26.07.2014	20	13	0.6	0	0	5.8	1.1	1.7

Loggerhead turtle hatchlings in Çaliş 2014

Sonja Bamberger, Jan Martini

KURZFASSUNG

Im Sommer besuchen Touristen und Meeresschildkröten gleichermaßen den Strand von Çaliş. Das als SPA (Special Protected Area) ausgewiesene Gebiet wird seit 1994 von diversen türkischen Universitäten (2014: EKAD - Ecological Research Society) in Zusammenarbeit mit der Universität Wien untersucht. Im Jahr 2014 wurden 38 Nester im Çaliş Abschnitt gezählt, von diesen hatten 20 ein unbekanntes Nestdatum, da diese vor der durchgängigen Untersuchungsperiode gelegt oder erst durch Hatchlinge bzw. deren Spuren entdeckt wurden. Insgesamt wurden 2638 Eier gezählt, davon waren 89.1% befruchtet, mit einem Durchschnitt von 72 Eier pro Nest und einer durchschnittlichen Inkubationszeit von 48 Tagen. Durchschnittlich wurden 41 Hatchlinge pro Nest, insgesamt 1406, beobachtet während sie das Meer erreichten.

ABSTRACT

During summer, Çaliş beach is visited by tourists and nesting sea turtles alike. The SPA (Special Protected Area) has been monitored regularly since 1994 by several Turkish universities (2014: EKAD - Ecological Research Society), with support from the University of Vienna. In this year, 38 nests were found on the Çaliş subsection of Fethiye bay. In 20 of these 38 nests, the nesting date was unknown (12 of them being “secret nests” whose localisation was first possible by following hatchling tracks). A total of 2638 eggs were laid, 89.1 % of them were fertilized. 10.8 % of the fertilized eggs did not hatch. The latter can be further distinguished into 38.1 % early, 10.1 % mid- and 51.8 % late embryonic stage. On average, 72 eggs were laid per nest and the average incubation time was 48 days. The average number of hatchlings per nest was 41 and in total 1406 were observed while reaching the sea.

INTRODUCTION

Over millions of years, sea turtles have existed in all of the world's oceans. Two of the remaining six sea turtle species, the Green turtle (*Chelonia mydas*, Linnaeus 1758) and the Loggerhead turtle (*Caretta caretta*, Linnaeus 1758), nest in the Mediterranean Sea, with main nesting sites along the coasts of Greece, Turkey, Cyprus and Libya (Casale & Margaritoulis 2010). According to the IUCN Red list of Threatened Species, the Loggerhead turtle is a critically endangered species (Internet 1). The species is also protected under several conventions (e.g. Barcelona Convention, Bern Convention, CITES) (Canbolat 2004, Margaritoulis et al 2005).

In the 2.456-km-long Mediterranean coastline of Turkey, 17 key sea turtle nesting sites have been identified by Baran and Kasparek (1989). Dalyan, Dalaman, Fethiye, Patara, Kumluca, Belek, Kizilot, Demirtas, Gazipasa, Goksu, Kanzanli, Akyatan and Samandagi are classified as beaches with a high density of nests, but no detailed data about the relative importance of these nesting grounds was provided. According to Canbolat (2004), Belek, Dalyan, Kumluca, Kizilot and Anamur are classified as the primarily important nesting sites for the Loggerhead turtle, considering nesting values, whereas Fethiye beach is listed (with 5.4 % contribution to the overall nesting activity in Turkey) as a second degree nesting ground (Canbolat 2004). Çaliş beach is considered to be one of the three subsections of Fethiye bay, Muğla Province, Turkey. About 2.5 km of the total 3.5 km beach is a nesting area of the Loggerhead sea turtle (Ilgaz et al 2007). The whole Fethiye bay nesting region is a Special Protected Area and since the early 1990s the three sections Akgöl, Yaniklar and Çaliş are being monitored by several Turkish universities (2014: EKAD - Ecological Research Society), with support from the University of Vienna. Fethiye has become a popular vacation destination and the environment suffers from tourist-related problems. Many hotels, restaurants and bars are protected from the sea by a promenade that defines half of Çaliş beach. The beach is affected by light pollution caused by hotels, restaurants, bars and street lights on the promenade and people on the beach (Appendix Fig. 13 and 14). Especially this light-polluted section of the beach along the promenade is considered to be the main nesting ground because it is fine grained (Venizelos 2011).

The beach area suffers also from illegal sand removal and the use of heavy vehicles (e.g. Appendix Fig. 1). The former removes the beach, the latter compresses the sand: both activities impede nesting female turtles. Female loggerhead sea turtles nest about two to four times per season (Canbolat 2004). In general, female sea turtles have a strong site fidelity to certain nesting areas (Broderick et al 2007). Broderick & Godley (1996) reported incubation times for Cyprus Loggerhead turtle eggs between 42 to 60 days. Incubation time depends on many factors such as temperature, substrate type or oxygen concentration in the sand (Baskale & Kaska 2005). After emerging from the sand, usually during night, sea turtle hatchlings crawl seawards, orientated by visual clues: the seawater is brighter than the vegetation behind the sea because the water reflects the light while the vegetation absorbs it. This draws the hatchlings to the sea (Mrosovsky 1967). If brighter artificial lights come from landward the hatchlings become disorientated and crawl inland until they perish from dehydration, exhaustion or are captured by predators (Tuxbury & Salmon 2005).

This report evaluates collected nesting data on the Loggerhead sea turtles along Çaliş beach to discover trends over time as well as threats to sea turtles influencing nesting activity and success. We also propose further conservation measures to counteract overall declining nesting activity caused by human interaction and to preserve this endangered sea turtle species from human-caused extinction.

MATERIAL AND METHODS

In the nesting period 2014, monitoring of Loggerhead sea turtle (*Caretta caretta*) nesting activity was carried out by 11 students from the University of Vienna (Austria) and eight students from the Ecological Research Society EKAD (Turkey) from 30 June to 11 September. The monitoring was conducted during two shifts, the morning shift and the night shift. Morning shifts started at 6 a.m. and consisted of at least 2 persons checking the 3.15-km-long beach section extending from Cadiri Restaurant to Çaliştepe. The night shift started at the Çadiri Restaurant and consisted of at least two persons patrolling the beach until Surf Café, representing an about 2.2-km-long section of the beach. During the night shifts, the beach was patrolled two times from 10 pm to 2 am with a 20-minute break between each route. In the last two weeks, the patrols were divided into three shifts, mostly consisting of two persons. The morning shifts started after darkness at around 6 a.m. Alternating teams checked the remaining nests along the above-described beach section each morning. During nights, the shifts were separated into two parts starting at 10 p.m. and 2 a.m. and lasting about two hours each. The general task was to look for adult turtles, hatchlings (compare Appendix Fig. 12), tracks of adults or hatchlings (Appendix Fig.11) and the position of the nests. Newly discovered nests were sheltered with a metal cage surrounded by a net with a mesh of about 1 cm aperture size. All installed cages were checked in each shift in order to see if the nests hatched already and because beach-goers often misused them as dustbins or displaced them

(Appendix Fig. 2), although information sheets were attached to them. After a minimum of 40 days, the nest is considered to be a candidate for an upcoming hatch (Stachowitsch & Fellhofer, pers. comm.). At this time, the net was lifted up during morning shifts and closed before sunset. This was necessary because hatchlings emerge during the night and orientate themselves on the light reflection in the water. Light pollution, for instance car headlights, street lights and lights of buildings (e.g. Appendix Fig. 1) guide them in the wrong direction. This made it necessary to close the cages and trap hatchlings during the night, while at daytime, the cages had to be open to prevent the hatchlings from dying in the hot sun. If hatchlings were found during the night or in the morning before 7.30 a.m. they were released in the sea immediately (Appendix Fig. 15, 16). If they were found after about 7.30 a.m., they were put in a bucket with moist sand and covered with a towel during day. Fig. 11 (Appendix) shows hatchlings in a bucket, but note that these were further distributed into further buckets to ensure enough space. These collected hatchlings were released in the following night shift in a dark section of the beach, often by providing them with a 3-m-long trough dug into the sand, sheltering them from lights and enabling them to be better observed until they reached the water. Nest excavations were conducted about three to five days after the last hatchling emerged. The distance to the sea, diameter of the nest and depth of the top and the bottom of the egg chamber were measured. The eggs were counted and divided in open and closed eggs. The closed eggs were opened and categorized in unfertilized eggs (no reddish spot) and fertilized eggs (e.g. reddish spot present as shown in Fig. 3, Appendix). The embryonic state of the fertilized eggs was recorded (early: no pigmentation, < 1 cm; middle: pigmented eyes, > 1 cm; late: full pigmentation, almost completely developed). Examples for the different embryonic stages are shown in Fig. 4-8 (Appendix). Dead and still living hatchlings in the nest were noted. Eggshells and dead hatchlings were returned to the nest cavity and covered with sand. Still living hatchlings were released or put inside a bucket (Appendix Fig. 11; note that they are later separated into smaller groups to ensure enough space) and released at night. All the data were transferred on datasheets and further calculations done in Microsoft Excel 2013.

RESULTS

The nesting period 2014 started in late May and lasted until the end of July. An overview of the collected and calculated data is shown in Table 1. In total, 38 nests were recorded on the beach of Çaliş, which is an increase by three nests compared to the previous nesting season. The development of the nest number over the last 21 years is shown in Fig. 1. This year, in 20 cases, the nesting date was unknown. This means that the nests had either an approximate nesting date (laid before nightshifts were done on a regular basis, i.e. before 30 June, see Tab. 1) or they were identified during the hatching process (e.g. CY44). Therefore, no incubation time could be calculated (see Tab. 1). In average, the incubation time of the 17 remaining nests of known date is 48 days (SD±4).

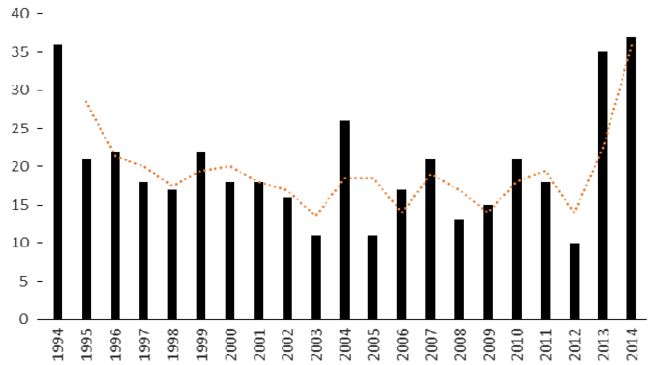

Fig. 1: Total number of nests on the beach of Çaliş from 1994 to 2014: The highest numbers were recorded in 1994, 2013 and 2014. The red dotted line shows the middle average trend over the nesting periods.
Abb. 1: Vergleich der Nestzahlen in Çaliş per Nistsaison von 1994 bis 2014: Hohe Nestzahlen (≥35 Nester) wurden in den Jahren 1994, 2013 und 2014 gezählt. Die gepunktete rote Linie zeigt den durchschnittlichen Trend der Nestzahlen über die einzelnen Nistperioden an.

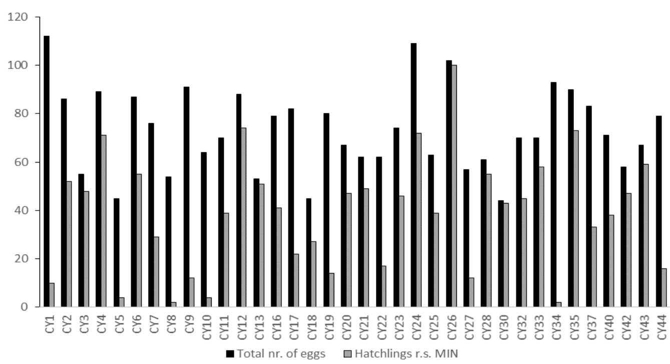

Fig. 2: Total number of eggs (black) compared with the observed and therefore minimum number of hatchlings reaching the sea (grey) for each nest. Missing nest numbers are due to misidentified nests or missing data.
Abb.2: Gesamtanzahl der Eier pro Nest (schwarz) im Vergleich zur beobachteten und daher als Mindestanzahl anzunehmender das Meer erreichender Hatchlinge (grau). Nicht durchgängige Nestnummern sind durch unzureichende Nestidentifizierung oder fehlende Daten verursacht.

A total number of 2.638 eggs were counted, 2.351 (89.1 %) of them were categorized as fertilized. An average number of 72 eggs per nest (SD±17) was calculated, the total number of eggs in comparison to the observed and therefore minimum number of hatchlings reaching the sea is shown in Fig. 1 for each nest. Comparing the different nests, CY26 is the most successful nest, with a very high number of eggs and almost all hatchlings observed reaching the sea Note that for example in this case, the number of hatchlings reaching sea deviates from the number of empty shells, which can happen due to miscounting of hatchlings or tracks during the nightshifts or egg counting mistakes during excavation.

The maximum number of hatchlings reaching the sea was calculated by subtracting the number of dead or predated hatchings from the number of empty shells counted during excavation. The respective numbers of the last 21 years of monitoring effort are shown in Fig.3. This nesting season, the value is 1.861 hatchlings, which amounts to 70.6 % of the total number of eggs or 79.2 % of the total number of fertilized eggs. This means that in the nesting season 2014, an estimated maximum of two-thirds of the total number of eggs was fertilized and (remained) alive: these hatchlings are considered to have reached the sea. In total, 10.8 % of the eggs did not hatch.

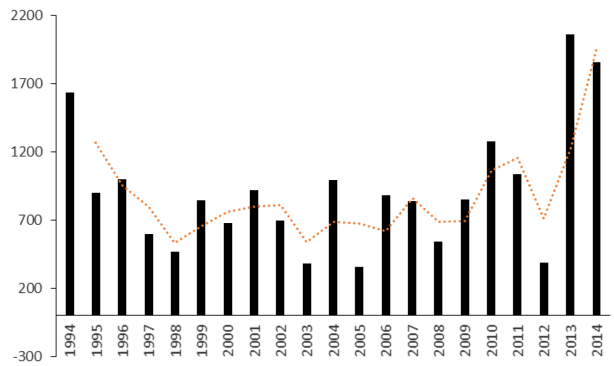

Fig. 3: The calculated maximal number of hatchlings reaching the sea from 1994 to 2014: In 1994, 2013 and 2014 high numbers of hatchlings reached the sea, with peaks of over 1,600, whereas in the seasons 1998, 2003, 2005 and 2012 the calculated maximal numbers were less than 500. The red dotted line shows the middle average trend.
Abb. 3: Die berechnete maximale Anzahl das Meer erreichender *Caretta caretta* Hatchlinge über die Nistperiode 1994 bis 2014 zeigt Spitzen in den Jahren 1994, 2013 und 2014 mit mehr als 1,600 Hatchlingen sowie einen Rückgang der berechneten Zahlen in den Jahren 1998, 2003, 2005 und 2012 auf unter 500 das Meer erreichende Hatchlinge. Die gepunktete Linie zeigt den durchschnittlichen Trend.

Six of the initially total counted 44 nests were misidentified, namely CY15, CY29, CY31, CY38, CY39, CY41 (see Table 1).These nests were either nesting attempts without oviposition (CY15) or could be assigned to already existing nests. Our calculations are based on the rectified nest numbers. The nests CY14 and CY36 were excluded from all calculations because the nest chamber was not found during the excavation attempt.

Tab. 1: Overview of all nest data for the nesting period 2014: nest date (-date: secret nest, nest laid before date; secret: unknown nest date), incubation time (s: unknown, secret status), number of empty shells, hatchlings reaching sea minimum and maximum (hatch.: hatchlings, r.s.: reaching sea), pred. (predated) eggs, sum of not hatched fertilized eggs, dead hatchlings (found in nest, predated, found outside), dead hatchlings stuck in egg, unfertilized eggs, total number of fertilized eggs and total number of eggs are listed for each nest. (-: no data, n.h.= not hatched, h.r.s= hatchling reaching the sea, fert.= fertilized).
Tab. 1: Überblick über jeweiligen Nestdaten die Nistsaison am Strand von Çaliş im Jahr 2014.
Observations made: + predation, ~ nest near sea (flooded) or area watered, Δ car tracks over nest,
* nest lost, not included in further calculations, ^ misidentified nest (nesting attempt without oviposition)
During excavation: ○ suspected fungal infestation, ● Spaceholder egg, ■ Albino-like hatchling(s),
□ Larvae or adult insects of the orders Diptera or Coleoptera (e.g. Tenebrionidae) present,
♦ Twins or up to four embryos found in one egg

Nest Nr.	Nest date	Incubation time	Notes	Nr. of empty shells	H. r.s. MIN	H. r.s. MAX	Sum of n.h. fert. eggs	Dead h. (in nest/ pred./ found outside)	Dead h. stuck in egg	Unfert. eggs	Total Nr. of fert. eggs	Total Nr. of eggs
CY1	-4.6.15	s		89	10	87	11	2	0	12	100	112
CY2	secret	s		82	52	82	2	1	1	1	85	86
CY3	-4.6.15	s		49	48	49	1	1	1	4	51	55
CY4	-4.6.15	s	♦	76	71	76	8	0	0	5	84	89
CY5	-9.6.15	s		8	4	6	2	2	0	35	10	45
CY6	20.06.15	45	○□	69	55	56	4	17	4	10	77	87
CY7	19.06.15	45		69	29	62	0	7	0	7	69	76
CY8	-19.6.15	s	□+	45	2	21	8	24	0	0	53	54
CY9	20.06.15	51	○□~	81	12	75	1	6	0	9	82	91
CY10	-29.6.15	s	○□	12	4	5	16	7	0	36	28	64
CY11	30.06.15	47		70	39	70	0	0	0	0	70	70
CY12	01.07.15	46		80	74	80	2	0	0	6	82	88
CY13	01.07.15	49		52	51	50	1	2	0	0	53	53
CY14	01.07.15	-	*	-	-	-	-	-	-	-	-	-
CY15	-	-	^	-	-	-	-	-	-	-	-	-
CY16	02.07.15	48		70	41	50	8	21	1	0	79	79
CY17	24.07.15	60	~	20	22	20	43	0	0	19	63	82
CY18	01.07.15	45		37	27	31	8	6	0	0	45	45
CY19	01.07.15	53	●	29	14	29	0	0	0	51	29	80
CY20	04.07.15	52		66	47	66	0	0	0	1	66	67
CY21	09.07.15	48		50	49	50	11	0	1	1	61	62
CY22	10.07.15	44	■	32	17	21	23	14	2	6	56	62
CY23	10.07.15	44	○	50	46	49	18	3	5	4	70	74
CY24	13.07.15	43	□	92	72	91	9	6	0	3	106	109
CY25	-15.7.15	s		57	39	52	2	5	0	4	59	63
CY26	-16.7.15	s		97	100	97	2	0	0	3	99	102
CY27	-24.7.15	s	○	36	12	35	19	1	0	2	55	57
CY28	24.07.15	48		54	55	54	5	0	0	2	59	61
CY29	-	0	=CY33	-	-	-	-	-	-	-	-	-
CY30	26.7.15	47		43	43	43	1	0	0	0	44	44
CY31	-	0	=CY02	-	-	-	-	-	-	-	-	-
CY32	-27.7.15	s	Δ	57	45	49	6	8	0	7	63	70
CY33	secret	s		67	58	67	2	0	0	1	69	70
CY34	secret	s	○	27	2	26	19	2	1	46	47	93
CY35	secret	s	□■	85	73	85	5	0	0	0	90	90
CY36	secret	s	*	0	16	0	0	0	0	0	0	0
CY37	secret	s		65	33	44	18	21	0	0	83	83
CY38	-	-	=CY07	-	-	-	-	-	-	-	-	-
CY39	-	-	=CY07	-	-	-	-	-	-	-	-	-
CY40	-7.8.15	s	●□	61	38	52	2	10	1	7	64	71
CY41	-	-	=CY11	-	-	-	-	-	-	-	-	-
CY42	-17.8.	s	+	53	47	50	3	5	2	0	58	58
CY43	-24.8.	s		61	59	61	4	1	1	1	66	67
CY44	-30.8.	s	○♦+	34	16	20	22	34	20	3	76	79
			Sum	**2025**	**1406**	**1861**	**286**	**206**	**40**	**286**	**2351**	**2638**

During excavation, the presence of insect larvae or insects of the orders Coleoptera (e.g. Tenebrionidae) and Diptera were observed in seven of the 35 nests (see Table 1). These are suspected to have a negative impact on the eggs (see Baran et al 2001). Predation (Appendix Fig. 9) was recorded three times (CY8, CY42, CY44), in the case of CY44 the nest was discovered due to dog predation.

In total, three hatchlings with low pigmentation similar to Albinism were recorded in CY22 and CY35 (Appendix Fig.8). In one case, the head of the dead hatchling was deformed. Two of them were still living when the eggs were opened during the morning excavation of CY22, but died later. Albinism has previous been reported for Loggerhead and Green turtles (Türkozan, & Durmuş 2001) at this nesting area.

Nest CY7 was located at the Picnic Area near the Dolmus Otogar bus station. During hatching, hatchlings were disorientated because of the street lights here. Tracks were found (Appendix Fig.13), especially under these lights. Hatchlings were overrun (Appendix Fig. 14) or were trapped in garbage lying around.

DISCUSSION

With 38 nests during the nesting season 2014, a new nest record was documented in Çaliş since the project launch 21 years ago (see Fig. 1). In general, Çaliş beach can be divided into two subsections, a narrower part in front of the promenade with fine-grained sand, and a wider, coarse-grained sand part. The average incubation time on the subsection in front of the promenade was 50 days: in total 1.260 eggs were laid in 17 nests (note that nests CY14 and CY36 were not considered in this number and further calculations as there are no data available). An estimated maximal number of 935 (74.2 %) hatchlings reached the sea here. This beach subsection beside the promenade is considered to be a nesting area with good quality (Venizelos 2011). In contrast, the average incubation time on the wider subsection was 46 days: in total 1.378 eggs were laid in 19 nests. An estimated maximal number of 926 (67.2 %) hatchlings reached the sea here. The average incubation period of nests along the promenade compared to nests on the wider subsection reveals only a small difference of four days.

Comparing the calculated maximum number of hatchlings reaching the sea, the nesting period 2014 ranks (with 72 eggs per nest, SD±17) second after last year, where the average number of eggs per nest was five eggs per nest higher, in total 79 eggs per nest (see Fischer & Pranger 2013) which is accompanied with the new nest record in 2014. One can expect irregularly occurring natural fluctuations of nesting activities. Female sea turtles are thought to become sexually mature at an estimated minimum of 13 years (calculated for Loggerhead turtles in Florida by Frazer & Ehrhart 1985). In the Mediterranean they are thought to nest in a two-year interval with an average of 2 nests per year (Broderick et al 2002). Such fluctuations may reflect disturbances or changes in the fitness of the females, or reflect presumed potential positive effect since the start of the conservation measures in 1994, which might have gradually boosted the population and therefore increased nest numbers. Interestingly, this development partly contrasts the predicted decline of Loggerhead nesting activities along Fethiye bay published by Ilgaz et al (2007). According to the trend in nesting data from 1993-2004, they predicted a decrease of nests to 40-50 in 2015 for the whole Fethiye beach. Do the recent two years with 35 or more 35 nests (for Çaliş beach alone) represent mere outliers or are they the first years showing evidence of a recovering Loggerhead population? Although the nest numbers in Çaliş show an increase the nest numbers of the other two subsections (Yaniklar, Akgöl) show a flattening off or even a decrease in nest numbers (compare Fig. 17, Appendix). Further monitoring is necessary to identify the future trend and the reasons for the increase of nest numbers, which would run counter to the predictions.

Nonetheless, one should not be too optimistic about the actual status of the Loggerhead population: As in previous years, almost the whole section of Çaliş beach was degraded during the nesting season in the form of light pollution (caused by cars, disco lights, lighted buildings), disturbance by humans who are present on the beach during night time, contrary to regulations. These activities can distract the females from oviposition and also have a negative impact on the nests: they may be destroyed, the beach can become compressed, garbage on the beach may trap hatchlings, or the hatchlings are drawn in the wrong direction, away from the sea. In the case of nest CY7, hatchlings escaped from the cage and tracks were found at the Dolmus Otogar bus station, which was close to the nest and well-lit during the night. Tracks were found especially in the direction of and under the street lights. Several hatchlings were found overrun, the others might have been predated by dogs. The high level of light pollution at the beach, in addition to the numbers of disoriented and therefore lost hatchlings, show the need for reducing lights during the night. This would immediately decrease a major threat to the hatchlings (beyond predation, and becoming trapped in fish nets (Appendix Fig. 10) or garbage).

When predicting future trends, it is thought that approximately one in a thousand hatchlings becomes mature and returns to the beach of origin. Considering this year's number of observed hatchlings reaching sea (1,406), an estimated one to two adult females will survive until maturity. This value compares poorly with the four dead Loggerhead turtles recorded for the bay of Fethiye in 2014. This calls for increasing the awareness of tourists and local communities about the needs of Loggerhead turtles to ensure their survival.

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APPENDIX

Fig.1: Light pollution, cars and people on the beach
Abb.1: Lichtverschmutzung, Autos und Menschen am Strand
(Photo: J. Martini)

Fig.2: Old nest cage with garbage
Abb.2: Alter Käfig als Mülleimer verwendet
(Photo: S. Bamberger)

Fig.3: Red spot: sign for a fertilized yet undeveloped egg
Abb.3: Roter Punkt: Zeichen für befruchtetes Ei
(Photo: J. Martini)

Fig.4: Early embryonic stage (quadruplet)
Abb.4: Frühes Embryonalstadium (Vierlinge)
(Photo: S. Bamberger)

Fig.5: Mid-embryonic stage
Abb.5: Mittleres Embryonalstadium
(Photo: J. Martini)

Fig.6: One middle and one late embryo
Abb.6: Mittlers und spätes Embryonal-Stadium
(Photo: S. Bamberger)

Fig.7: Late embryo
Abb.7: Spätes Embryonalstadium
(Photo: J. Martini)

Fig.8: Late albino-like embryo
Abb.8: Spätes Albino-Embryonalstadium
(Photo: E. Guariento)

Fig.9: Dead hatchling of a predated nest
Abb.9: Predated Hatchling
(Photo: J. Martini)

Fig.10 Dead hatchling found trapped in fishing net
Abb.10: Toter Hatchling im Fischernetz verfangen(Photo: S. Bamberger)

Fig.11: Freshly collected hatchlings
Abb.11: Frisch geschlüpfte Hatchlinge
(Photo: S. Bamberger)

Fig.12: Hatchling starting to the sea
Abb.12: Hatchling auf dem Weg zum Meer
(Photo: J. Martini)

Fig.13: Because of light pollution, hatchlings were disoriented into the bus station (Dolmuş Otogar).
Abb.13: Hatchlingspuren in der Bushaltestelle
(Photo: M. Stachowitsch)

Fig.14: Run-over hatchling at Dolmuş Otogar
Abb.14: Überfahrener Hatchling an der Bushaltestelle
(Photo: S. Bamberger)

Fig.15: Hatchling shortly before reaching the sea
Abb.15: Hatchling fast im Meer
(Photo: J. Martini)

Fig.16: After many obstacles, this hatchling reached the sea
Abb.16: Schwimmender Hatchling
(Photo: J. Martini)

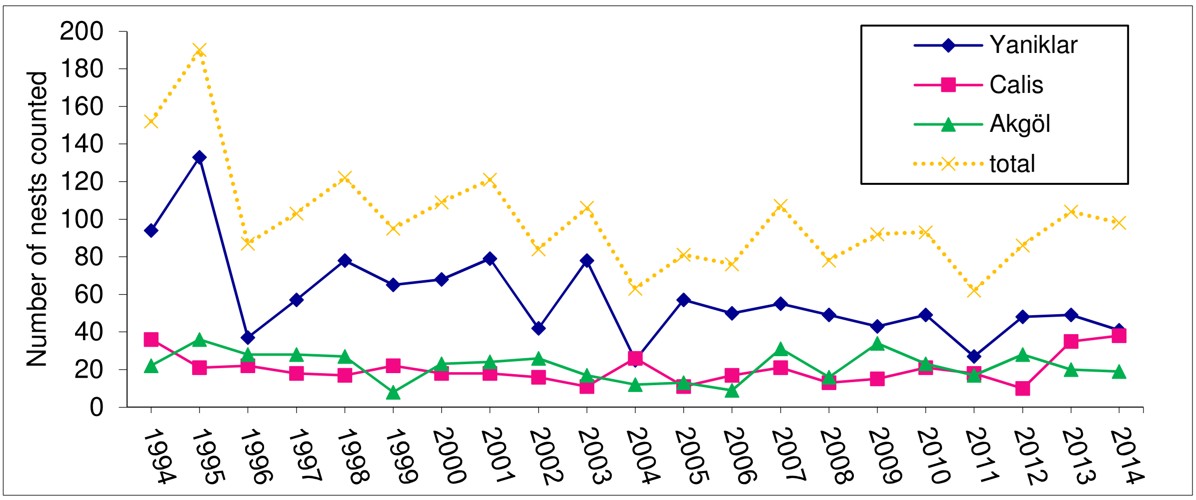

Fig. 17: Development of nest numbers in Fethiye beach (blue line – Yaniklar, red squares – Çaliş, green triangles– Akgöl, dotted yellow line – total number) over the nesting periods from 1994 to 2014
Abb. 17: Trend der Nestzahlen in Fethiye mit den 3 Subsektionen Yaniklar (blau), Çaliş (rote Quadrate) und Akgöl (grüne Dreiecke sowie die Gesamtnestzahlen (gepunktete gelbe Linie) über die Jahre 1994 bis 2014.

Caretta caretta nests and hatchlings in Yaniklar 2014

Lilith Jopp & Marius Adrion

KURZFASSUNG

Dieser Teil des Berichtes zum Meeresschildkrötenkurs 2014 behandelt die Nester und Schlüpflinge von *Caretta caretta* am Strandabschnitt Yaniklar des Niststrandes Fethiye, Türkei. Der Strand wurde von Ende Juni bis Mitte September observiert und es wurden insgesamt 61 Nester dokumentiert (Teilabschnitte Yaniklar: 41 und Agköl: 20). 4886 Eier wurden gelegt von denen 3886 (79.5%) befruchtet waren und 850 (17.4%) unbefruchtet. Die mittlere Eieranzahl pro Nest betrug 82.8 ± 22.9. Von den befruchteten Eiern starben 565 (11.6%) Embryos in den Eiern, 150 (3.1%) Eier wurden durch Fressfeinde getötet. Des Weiteren wurden 18 (0.3%) Schlüpflinge tot im Ei steckend und 142 (2.9%) tot im Nest gefunden. 23 (0.5%) Schlüpflinge starben auf dem Weg zum Meer, während weitere 30 (0.6%) von Fressfeinden am Strand gefressen wurden. 3121 Schlüpflinge (63.9%) erreichten das Meer. Dies ergibt einen Schlupferfolg von 63.1 ± 28.5%. Die mittlere Inkubationszeit war 46 ± 4.5 Tage.

Die mittlere Distanz der Nester zum Meer betrug 20.5 m ± 10.5 m, der mittlere Durchmesser der Eikammer war 0.23 m ± 0.05 m, die mittlere Tiefe 0.41 m ± 0.07 m, die mittlere Tiefe bis zu den ersten Eiern 0.26 m ± 0.08 m.

Während der letzten 20 Jahre konnte ein negativer Trend in der Nestanzahl festgestellt werden.

ABSTRACT

This part of the report of the sea turtle conservation course deals with the nests and hatchlings of *Caretta caretta* at the Yanikar section, Fethiye nesting site, Turkey. The beach was observed from late June to mid-September and 61 nests were recorded (subsections Yaniklar: 41 and Akgöl: 20). In total, 4886 eggs were laid, 3886 (79.5%) of those were fertilized and 850 (17.4%) unfertilized. The average clutch size was 82.8 ± 22.9. 565 (11.6%) of the fertilized eggs died as embryos, 150 (3.1%) were predated. In addition, 18 (0.3%) hatchlings were found dead stuck in their eggs and 142 (2.9%) dead inside the nest. 23 (0.5%) hatchlings died on their way to the sea and 30 (0.6%) were killed by predators on the beach. 3121 (63.9%) hatchlings reached the sea. This yields a hatching success rate of 63.1 ± 28.5%. The average incubation time was 46 ± 4.5 days. The mean nest distance to the sea was 20.5 m ±

10.5 m, the mean nest diameter 0.23 m ± 0.05 m, the mean depth of the egg chamber 0.41 m ± 0.07 m, and the mean distance to the top of the eggs 0.26 m ± 0.08 m.
During the last 20 years, a negative trend in nest numbers was apparent.

INTRODUCTION

After becoming sexually mature, loggerhead sea turtles, *Caretta caretta*, migrate to mating areas. Mating periods may last more than six weeks. After mating, males return to their foraging areas, while females continue to the subtropical and temperate nesting areas. The nesting sites are beaches in the region in which they themselves hatched. Within one reproductive season (typically occurring in intervals of 2-4 years) they lay one to six clutches and return to their nesting sites with a high accuracy. Nesting beaches must exhibit certain crucial criteria such as easy access from the sea and have enough sand cohesion to allow nest construction; temperatures conducive to egg development; low salinity; high humidity; and well-ventilated substrate to facilitate embryonic development. A typical nest is flask shaped and has the following average measures: chamber diameter = 23-26 cm, depth to top of eggs = 35 cm and depth to bottom of chamber = 60 cm (Miller et al. 2003).
In Turkey the average number of eggs per clutch is 93 eggs, with a range from 23-134 eggs (Geldiay et al. 1982).
The development of the embryo depends on the temperature within the nest. Sun, shade, rain, and heat generated within the nest – and even the position of the egg itself within the nest – have an influence on the temperature environment. On the one hand, temperature dictates the speed of embryonic development. At cool temperatures around 25 °C it can take 65-70 days until hatching, whereas at warmer temperatures around 35 °C it takes usually around 45 days until hatching (Ernst et al. 1994, Spotila 2004). On the other hand, egg incubation temperature determines sexual differentiation in the middle third of the development. The so-termed pivotal temperature at which 50% of each gender will be produced is, according to Kaska et al. (1998), between 28.6-29.7 °C for loggerhead turtles in the eastern Mediterranean. Temperatures above this threshold lead to females, below to males (Kaska et al. 1998, 2006). Eggs are not viable outside the range of 24-34°C (Ernst et al. 1994, Spotila 2004).
After the incubation time the young loggerheads (= hatchling, Fig. A1 and A2 in the Appendix) hatch from the egg and usually need more than two days to get to the surface (Miller et al. 2003). The emergence from the nest occurs commonly at night in a range from 1-11 days (Hays et al. 1992: 5-11 days; Peters et al. 1994: 1-8 days) and is controlled by a

threshold temperature above which the hatchlings do not emerge (Miller et al. 2003). After reaching the sea the hatchlings continue to swim outwards up to 20 days (Hays et al. 1992, Fig. A19).

In addition to natural causes of mortality such as predation, development failure and inundation (Miller et al. 2003), there are many human-caused problems. According to the IUCN Marine Turtle Specialist Group report (Casale and Margaritoulis 2010), beach restructuring, human exploitation, human-caused erosion and debris are common threats to the terrestrial habitats (nesting sides) of loggerhead turtles.

Our work is designed to combat these challenges, gather information and contribute to the conservation of the loggerhead sea turtle.

MATERIAL AND METHODS

From 28.06.2014 until 13.09.2014, participants of the sea turtle course from the University of Vienna were present at the Yaniklar section of the Fethiye nesting beach and recorded daily nesting and hatching activities of *Caretta caretta*, the Loggerhead sea turtle. Prior to this time, Turkish colleagues controlled the beaches regularly for nests. The students went on morning shifts every day for the whole period at the two subsections Akgöl and Yaniklar, including "small beach" – Karataş beach (see chapter 7, Fig. 8, Bürger & Kriegl 2014, this volume). Another student team worked at the beach of Çalis.

To record and measure female Loggerhead turtles, night shifts were conducted in the first period until hatching of the nests began, after which it was too risky to walk at night without jeopardizing hatchlings. At nightshifts the adult sea turtles were measured on their way back to the sea (see chapter 7, this volume); nests, depending on the situation, were marked, checked for stones in the nest, and marked with a numbered table tennis ball. Further measurements were made by the morning shift in daylight to avoid potentially disturbing other emerging adult sea turtles. This year no hatcheries (eggs moved from the original nest to an artificial nest) were made. On the one hand, it seemed as if no nests were positioned in highly unfavorable sites, on the other hand "large scale movement of eggs into hatcheries […] has the potential for killing large numbers of eggs" (Limpus et al. 1979).

In some cases, nest cages (for example to prevent the hatchlings from becoming distracted by artificial light) were checked at night, but only if the respective nest was in close range and could be reached without any risk to other hatchlings.

Morning shifts started, depending on the time of sunrise, at circa 6 a.m. In teams, both beaches were controlled for adult tracks, new nests, hatching activities and unusual events. In addition, every known nest was controlled. In this report we confine ourselves to hatching activities. To detect every possible hatchling track, at least two people walked along the beach next to each other and evenly spaced so to be able to survey the beach in its full breadth. Already recorded nests were examined closely by checking the upper centimeters for hatchlings, stones or abnormities such as flies or malodors, especially when the due hatch date approached (calculated at 40 days incubation time according to Ernst et al. (1994) and Spotila (2004)). Hatchling tracks were counted and followed to determine potential predation (by dogs, crabs, birds…) and rule out stuck or lost hatchlings.

So-called "secret nests", nests not found before hatching, were discovered based on the first hatchling tracks, recorded and marked (as the other nests but without a table tennis ball). Where necessary, a path from the nest to the sea (especially through the beach wrack zone) was cleared of rubbish and marine debris to enable the hatchlings easier passage.

All found living hatchlings – whether collected from cages, nests or found on their way to the sea – were released to the sea if possible at that moment. An immediate release was not possible if the temperature was already too hot, predators were seen or the condition of the hatchlings was expected to improve until the night. In this case, hatchlings were taken back to the camp in clean buckets filled with moist sand and covered with a moist cloth. In the camp they were kept protected and regularly checked in a cool shaded place until they were released at night. Found or kept hatchlings were released a few meters away from the sea to enable a potential imprinting to their natal beach ("The turtles […] leave their natal beaches as hatchlings, migrate to open sea, and spend a period of years in distant oceanic and/or neritic areas before eventually returning to the natal region to reproduce" (Lohmann et al. 2008). Such imprinting might, however, have already occurred when the embryos were still inside the eggs (Fuxjager et al. 2014). All found dead hatchlings (except during excavations) were removed and buried far away from any nests to avoid attracting predators.

Three to four days after the last hatch date an excavation was performed. The nest was carefully dug up until the first egg shells were encountered and the measurement "top of the eggs" was taken. Then the content of the egg chamber was removed. Still living hatchlings were released immediately or taken back to the camp. Dead hatchlings, dead hatchlings stuck in egg and still closed eggs were sorted and counted. Furthermore, the closed eggs were opened and differentiated in unfertilized eggs and fertilized, not hatched eggs with the three stages early embryonic, middle embryonic and late embryonic. Unfertilized eggs were determined by the missing blastoderm. Early embryonic eggs are those with blastoderms and/or small, unpigmented embryos, middle embryonic eggs are those with embryos having already pigmented eyes but unpigmented carapace and extremities, late embryonic eggs are those with fully pigmented but not hatched hatchlings. The size of the embryos (e.g. < 1 cm = middle embryonic) can be a hint for classifying the fertilized eggs but is not the crucial criterion.

Afterwards the measurements "bottom of chamber", "diameter of chamber" and "distance to the sea" were taken. Finally the nest content as well as all markings were buried.

All data was added into standardized paper data sheets and processed with Microsoft Excel.

The length of the beach was measured on satellite images in Google Earth (© 2013 Google Inc.)

RESULTS

In total, 61 nests of *Caretta caretta* were recorded on the Yaniklar section of the Fethiye nesting area in the 2014 nesting season. The overall mean nesting density was 11.43 nests km^{-1}, but nests were mostly clustered in areas with finer sand (see chapter 7, Fig. 8, Bürger & Kriegl 2014, this volume). The turtles made their nests at an average distance to the sea of 20.5 m, with distances ranging from 7.0 to 53.1 m. The average egg chamber was 41 cm deep with a diameter of 23 cm. Clutch sizes ranged from 13 to 133 eggs with a mean of 82.8 eggs (Tab. 1). Overall hatching success was 63.1 %, spanning from complete loss to 97.6 %. Incubation duration was measured for 12 nests and averaged 46 days with a range of 36 to 54 days.

Tab. 1: Measurements of nests at Yaniklar beach, combined with relevant nesting parameters.
Tab. 1: Maße der Nester in Yaniklar, zusammen mit wichtigen Nestparametern.

	Mean ± S.E.	min.	max.	n
Distance to the sea	20.5 ± 10.5 m	7	53.1	58
Diameter of egg chamber	0.23 ± 0.05 m	0.12	0.4	57
Depth of egg chamber	0.41 ± 0.07 m	0.24	0.57	58
Depth to first eggs	0.26 ± 0.08 m	0.1	0.47	58
Clutch size	82.8 ± 22.9	13	133	59
Hatching success	63.1 ± 28.5 %	0	97.6	59
Fertilized eggs	79.5 ± 22.8 %	0	100	59
Incubation time	46 ± 4.5 days	36	54	12

Altogether, 4886 eggs were laid, of which 79.5 % (3886) were fertilized. Hatchlings from 80.3 % of these fertilized eggs reached the sea (Tab. 2). The first nests at Yaniklar beach started to hatch on 14 July and the last hatching event occurred on 13 September. Therefore the hatching season was 59 days long.

Tab. 2: Numbers of eggs and hatchlings in 61 *Caretta caretta* nests in Yaniklar 2014.
Tab. 2: Anzahl der Eier und Schlüpflinge in 61 *Caretta caretta* Nestern in Yaniklar 2014.

	n = 61	%
Total number of eggs	4886	
Fertilized eggs	3886	79.5
Dead embryos	565	11.6
Embryonic stage: early	224	4.6
Embryonic stage: middle	110	2.3
Embryonic stage: late	231	4.7
Unfertilized eggs	850	17.4
Predated eggs	150	3.1
Hatchlings	3334	68.2
Reached the sea	3121	63.9
Predated	30	0.6
Died on the beach	23	0.5
Dead in nest	142	2.9
Stuck in egg	18	0.3

The emergence of hatchlings peaked in early August, with 20 new nests hatching from 28 July to 10 August (Fig. 1). In total, 167 hatching events were recorded, with some nests hatching in a single burst (11 nests) and others spread out up to 7 events over 9 days. Four nests (AY-09, YY-08, YY-16 and YY-25) did not hatch at all (0% hatching success). Beyond these "0%" nests there were five nests with a hatching success rate lower/equal to 30%, which is half of the average success rate (AY-10: 3%, YY-36: 8%, YY-13: 16%, YY-34: 29% and AY-06: 30%).

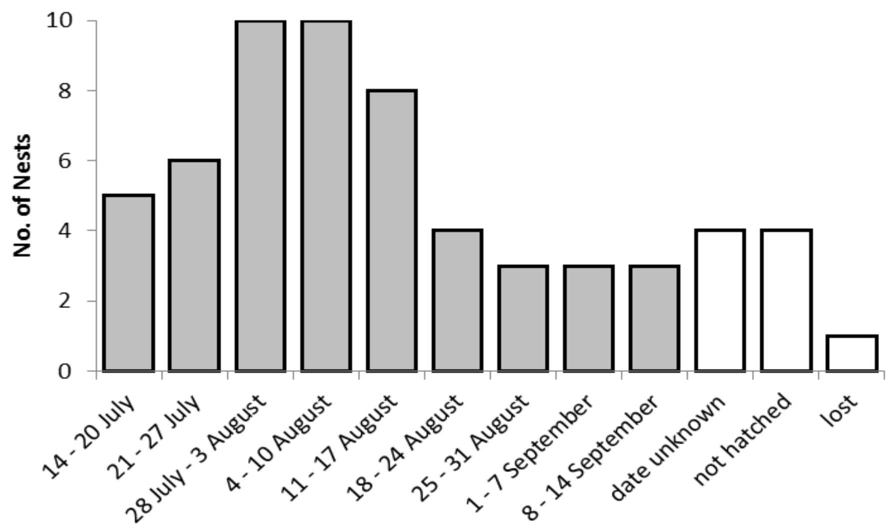

Fig.1: Number of nests by first hatch date (n = 61) at Yaniklar beach during the 59-day hatching period, by week.
Fig.1: Anzahl der Nester (n = 61) in Yaniklar, die während der 59 Tage dauernden Schlüpfphase zum ersten Mal schlüpften, nach Wochen gruppiert.

The emergence of hatchlings and their way to the sea was largely unobstructed, with notable exceptions. Birds apparently took hatchlings from at least three emergence events. Three nests were dug up, probably by dogs, with one nest completely depredated and at least 75 eggs destroyed. At least 2 nests were dug up by persons who were not part of the research group. Based on crab and hatchling tracks, beach-dwelling crabs (such as ghost crabs, Ocypodinae) apparently took some hatchlings and dug into one nest (AY-18), although it is unknown whether eggs or hatchlings from this nest were actually predated by crabs.
Hatchlings were disoriented and strongly misoriented by artificial light in at least five hatching events (nests AY-16, AY-15, YY-03, YY-05, YY-27), resulting in some hatchlings crawling in seemingly random directions, but eventually reaching the sea. Many others completely turned inland must be counted as lost and dead. Hatchlings from nests in the sandy section in the northernmost end of the Akgöl subsection were clearly misled towards the distant city lights of Fethiye, which made them crawl strongly to the left rather than straight to the sea.
97 % of the nests (59 out of 61) were excavated and their contents examined. The excavations yielded empty egg shells (3303, Fig. A7), unfertilized (850) and fertilized eggs (11.6 % of all eggs). The fertilized eggs not only contained dead embryos, invertebrates, nematodes and fungi were also found living on and in the eggs. Dead embryos inside the fertilized eggs were classified into three groups: early, middle, late stages (Fig. A3, A4, A5 and A6). Invertebrates found in the nests were specified as larvae or pupae of Diptera, Coleoptera and Tenebrionidae (Fig. A15, A16 and A17). Many nests were infested with fungi, which gave the eggs a

greenish, bluish or reddish color (Fig. A13 and A14) and the yolk an almost solid consistency, but there was no systematical data collection of fungal infestation. Two nests contained abnormal eggs that were less than half the size of the normal eggs (Fig. A8). One nest contained an egg with twin embryos (middle stage); leucistic/albino embryos were found twice (Fig. A9).

DISCUSSION

The number of nests (Fig. 2), total number of eggs (Fig. 3) as well as hatchlings reaching the sea (Fig. 4) in Yaniklar continues to show an overall decreasing trend since the beginning of the conservation course in 1994. This downward trend is most apparent in nest numbers (Spearman's correlation $\rho = -0.55$, $p = 0.011$, $y = y = -2.6299x +109.21$), but also the total numbers of eggs and most importantly, hatchlings reaching the sea are apparently declining in the long term. The situation is not as dramatic as was predicted by Ilgaz et al. (2007), though. Based on nesting data from 1992 to 2004, they estimated nest numbers of just above 50 for the whole Fethiye nesting beach (i.e. Calis, Yaniklar, Akgöl) in 2014, which did not come true, as there were 61 nests in the Yaniklar section alone this year. In Dalyan, a nesting beach not far north of Fethiye, nest numbers varied considerably between years, too, as has been the case in Yaniklar. In Dalyan, however, there was no apparent overall downward trend from 1988 to 2005 (Türkozan & Yilmaz 2008).

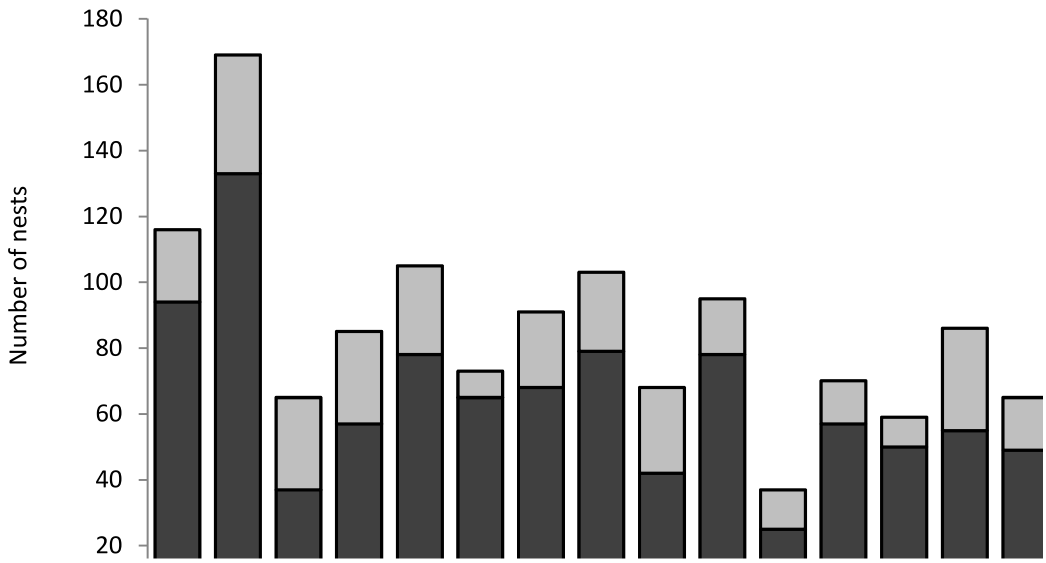

Fig. 2: Nest numbers in Yaniklar (dark grey) and Akgöl (light grey) from 1994 to 2014.
Fig. 2: Nester in Yaniklar (dunkelgrau) und Akgöl (hellgrau) von 1994 bis 2014.

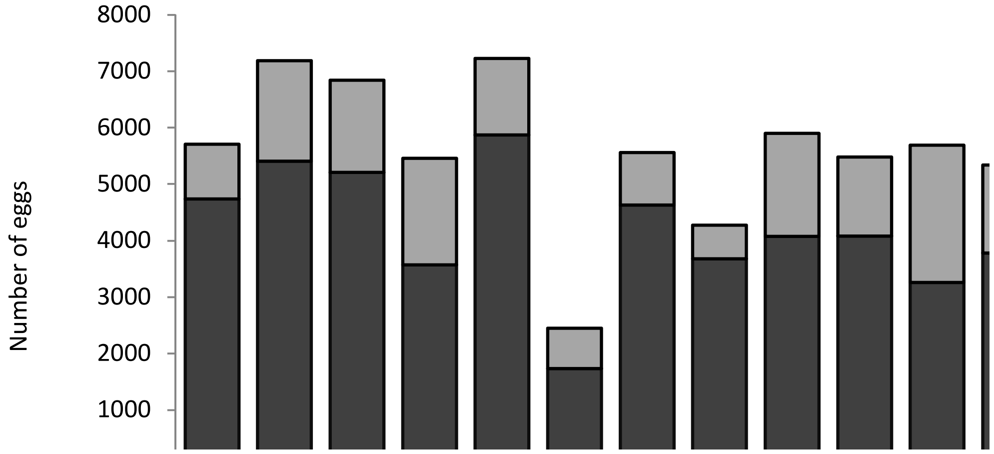

Fig. 3: Eggs in nests on Yaniklar beach from 1999 to 2014. Dark grey: subsection Yaniklar, light grey: subsection Akgöl.
Fig. 3: Eier in den Nestern in Yaniklar von 1999 bis 2014. Dunkelgrau: Teilabschnitt Yaniklar, hellgrau: Teilabschnitt Akgöl.

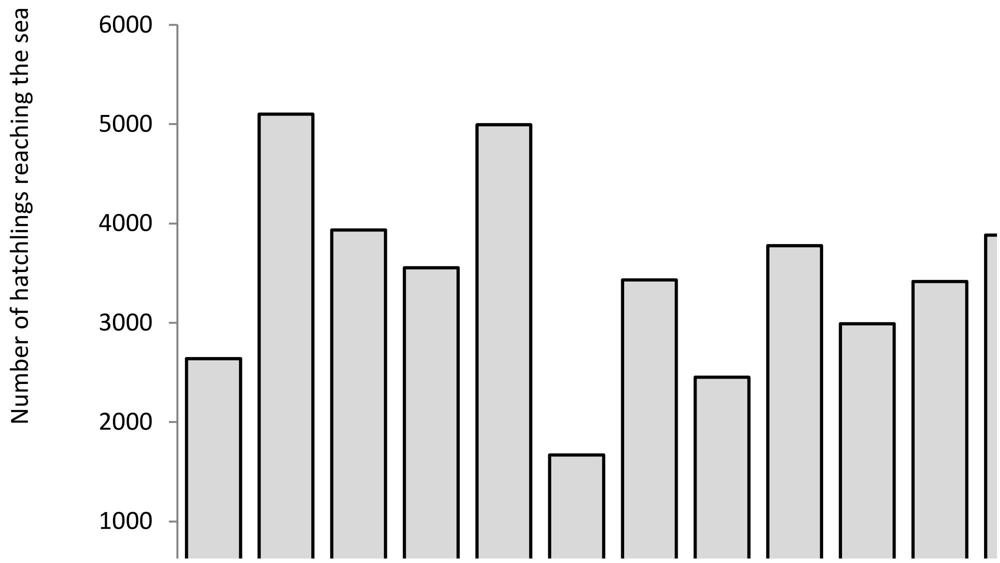

Fig. 4: Hatchlings reaching the sea in Yaniklar from 1994 to 2014.
Fig. 4: Schlüpflinge, die das Meer erreichten von 1994 bis 2014.

The mean nesting density for the Yaniklar section in 2014 is close to the average density for the years 1992 to 2004, which was 14 ± 4.4 nests km^{-1} in Fethiye (Ilgaz et al. 2007). The mean nest distance to the sea in the 2004 and 2005 seasons in Fethiye was 18.14 m (Özdemir et al. 2008) and 15.8 in 2000-2002 (Kaska et al. 2006), for the Yaniklar section it was 20.6 m in 2013 (Bauer & Hirtl 2013), 19.5 m in 2012 (Prader & Rabel 2012) and 17.8 m in 2011 (Buck & Steiner 2011). The 2014 value (20.5 ± 10.5) lies within this range. One nest was detected after it was laid, but lost and not found again (AY-02). Nest AY-02 was found in early June at the northern end of Akgöl beach close to other initially lost nests (AY-01, AY-03, AY-04), which were re-discovered during hatching. AY-02 either never hatched or was too close to the sea to be detected during hatching (i.e. wave action would have obliterated the tracks). It is unlikely that other later found nests in this area, such as AY-19 were identical to nest AY-02 because the marked table tennis ball was never found.

Clutch sizes of *Caretta caretta* nests range between 23 and 198 eggs, with a mean of 112.4 per clutch (Miller et al. 2003). At Yaniklar beach, the average clutch size was 78.7 (range 31-119) in 2013, 83.9 (range 17-143) in 2012. This year (2014), the smallest clutch only had 13 eggs, which is the smallest of all nest records we could find in the literature. The largest clutch (133 eggs) and the average clutch size (82.8 eggs) from this year fall within the typical range.

Incubation durations of loggerhead sea turtle nests in the Mediterranean basin range from 49-67 days (Kaska et al. 1998: 52-63 days; Kaska et al. 2006: 49-67 days). At Yaniklar beach, the average incubation time was 48.2 days (range 37-59) in 2012, 49.5 days (range 43-60) in 2013. Compared to the last years in Yaniklar and Fethiye as a whole, this year's incubation times were rather short, with an average of 46 days, ranging from 36 to 54 days.

Development, hatching and reaching the sea can fail due to different reasons. Egg failure, according to Peters et al. (1994), is caused mainly by infertility and early embryonic mortality.

Miller et al. (2003) state that hatching success is typically 80% or higher, a value which could not be reached by this year's 61 nests at Yaniklar beach, where the average hatching success was only 63.1%. Some nests were very successful with up to 97.6% of the eggs hatching, but one third of the nests had a hatching success of less than 50%. Five nests did not hatch at all. Nest AY-09 probably never hatched because it was laid in the wet zone of the seasonal stream sometimes running from the Akgöl lake to the sea. YY-08 was located very close to the vegetation and was perforated by reed roots (Fig. A11 and A12) and hence never hatched. YY-16 was predated in three separate events by a dog or similar animal. This destroyed 75 eggs. YY-25 was very close to the sea (7.9 m) and was inundated several times (Fig. A10). Despite exchanging wet with dry sand manually, the eggs were not developed, were decomposed and fungi infested (Fig. A13).

Only four hatchlings emerged from nest AY-10, while 59 fertilized eggs remained unhatched (hatching success = 3%). The nest depth was around this year's average (0.21 m in comparison to the mean from 0.26 m ± 0.08 m) and neither predation nor inundation was recorded. One possible reason could be that the nest lay beneath/close to a frequently used path taken by beach visitors. This constant trampling could lead to compressed sand, which might affect the gas and water exchange, which are crucial to embryonic development (Miller et al. 2003) or result in small egg movements, which might cause development failure (Limpus et al. 1979).

Also YY-36 (8%), YY-13 (16%) and YY-34 (29%) had a relatively low hatching success rate, mainly due to high percentage of unfertilized eggs (YY-36: 90%, YY-13: 49%, YY-34: 47%). YY-13 also had a high number of dead hatchlings in the nest (11). AY-06's relatively low hatch rate is among other causes due to an unusually high percentage of the dead middle embryos (56%). According to Özdemir et al. (2008) the crucial stages in development are the early and late embryonic stages, which is mirrored in our own results: highest mortality occurred in early and late stages (early: 224 = 4.6%; middle: 110 = 2.3%; late: 231 = 4.7%). The high percentage of dead middle-stage embryos in AY-06 could be an effect of a single event such as a temperature drop.

According to Peter et al. (1994), microbial invasion can result in egg failure. Invertebrates and fungi can also lead to mortalities inside the nest. In Fethiye beach, tenebrionid larvae caused damage by penetrating eggs and hatchlings (destroying 8.1% of the eggs and 0.6% of hatchlings, Katilmiş et al. 2006). Egg mortality functions as a nutrient source for mycobiota and causes a progressive spread of fungal hyphae to adjoining viable eggs (Philott & Parmenter 2012). Invertebrates as well as fungi were observed this year.

According to Miller et al. (2003), abnormal nest contents such as yolkless eggs (placeholder eggs), multi-yolked eggs, chain-form eggs and shell-less eggs occur infrequently. This year only two nests with placeholder eggs (Fig. A8) were recorded. As in many other animals (and in humans) albinism and twins (www.spektrum.de) occur also in sea turtles and were observed twice respectively once this year (Fig. A9).

During the hatching period, many potential predators, for example crabs, birds, dogs, foxes, badgers, hedgehogs, rats and fishes are present (Türkozan and Yilmaz 2008). This year predation by birds, crabs and dogs reduced the number of hatchlings reaching the sea or even destroyed a whole nest (YY-16). Other predation, from for example foxes or hedgehogs, could not be detected.

Sometimes hatching occurs at daytime, leading to lethal overheating (Hays et al. 1992, Miller et al. 2003). This is most likely the reason for dead hatchlings found on top of nests and on the way to the sea (23). This factor might also explain why some hatchlings died in the nest (142). Other factors such as compressed sand (Peter et al. 1994) or loose sand (Miller et al. 2003) can lead to emergence delay and failure and therefore to death inside the nest. In general the mortality rate of *Caretta caretta* (as in other marine turtles) is high: according to some calculations, approximately 1/1000 survives from egg to adulthood (Frazer 1986).

Coastal development typically leads to an increase in artificial light at nesting beaches at night. Such lighting repels not only adult females while nesting but also disrupts the nocturnal orientation of hatchlings. The sea-finding process of hatchlings is directed by two visual clues: light intensity and horizon elevation. With the disturbance of visible artificial light, the turtles may crawl in circuitous paths (disorientation) or landwards (misorientation) and fail in locating the sea. The result is death by exhaustion, dehydration or predation (Berry et al. 2013, Tuxbury & Salmon 2005, Witherington & Bjorndal 1991). Light pollution is, besides noise pollution, the most serious problem for turtles on Fethiye beaches (Başkale & Kaska 2005). This year at least five hatching events were heavily affected by artificial light. Hatchlings from the nests YY-03, YY-05 and YY-27 were misled by construction lights of a huge hotel building site (Barut Hotel Fethiye, see chapter 9, this volume). At hatching events at the northern end of the beach of Akgöl, nearly all hatchlings were misled by the lights of Fethiye. The resulting disorientation of the hatchlings caused longer pathways to the sea (which might reduce the fitness of the affected hatchlings). In nest YY-27 the construction light caused landwards orientation and those hatchlings died/ were predated. Hatchlings from nest AY-16 were attracted by light from a nearby house but were brought to the sea by the residents. To prevent ongoing misorientation the lights were switched off by the owners and a cage was installed. Hatchlings from nest AY-17 crawled directly into the nearby restaurant (Karaot Restaurant) because of its electrical light. Also in this case the owner released the hatchlings to the sea.

Another human threat is waste, which has a severe impact on adult turtles as well as hatchlings (Triessnig et al. 2012). The beaches of Yaniklar are popular for local people and tourists, sometimes leading to fatal pollution (Fig. A18). Beyond the amount of pollution, also directly negative impacts such as noise pollution, disturbance to nests by sunshades, trampling, towels, digging activities, trespassing on the beach at night, driving with cars and motorcycles at the beach, sand removal etc. are on the increase. The mechanisms behind tourism such as hotel construction and beach alteration add yet another level of habitat degradation for *Caretta caretta*.

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APPENDIX

Fig. A1: Hatchling on the way to the sea.
Fig. A1: Schlüpfling auf dem Weg zum Meer.
(Photo: M. Adrion)

Fig. A2: Hatchling hit by the first wave.
Fig. A1: Schlüpfling erreicht das Meer.
(Photo: M. Adrion)

Fig. A2: Early embryonic stage with blastoderm.
Fig. A3: Frühes embryonales Stadium mit Keimscheibe.
(Photo: L. Jopp)

Fig. A4: Early embryonic stage with visibly developed embryo (on left).
Fig. A4: Frühes embryonales Stadium mit sichtbar entwickeltem Embryo (links).
(Photo: M. Lambropoulos)

Fig. A5: Middle embryonic stage.
Fig. A5: Mittleres embryonales Stadium.
(Photo: M.-I. Herzog)

Fig. A6: Late embryonic stage.
Fig. A6: Spätes embryonales Stadium.
(Photo: M.-I. Herzog)

Fig. A7: Empty egg shells after excavation.
Fig. A7: Leere Eischalen nach einer Excavation.
(Photo: L. Jopp)

Fig. A8: Yolk-less egg or so called placeholder egg (second from left) in comparison to normal-sized eggs.
Fig. A8: Dotterlose Ei oder Platzhalter-Ei (zweites von links) im Vergleich zu normal großen Eiern.
(Photo: E. Guariento)

Fig. A9: Deformed albino embryo.
Fig. A9: Deformierter Albino Embryo.
(Photo: M. Adrion)

Fig. A10: Inundated nest YY-25.
Fig. A10: Überflutetes Nest YY-25.
(Photo: M. Stachowitsch)

Fig. A11: Reed-perforated nest YY-08.
Fig. A11: Von Schilf durchwachsenes Nest YY-08.
(Photo: M. Stachowitsch)

Fig. A12: Close-up of nest YY-08. Reed roots penetrate eggs.
Fig. A12: Von Schilf durchbohrtes Ei in Nest YY-08.
(Photo: M. Stachowitsch)

Fig. A13: Fungi-infested egg from nest YY-25.
Fig. A13: Von Pilz befallenes Ei aus Nest YY-25.
(Photo: M.-I. Herzog)

Fig. A14: Fungi-infested embryo from nest YY-05.
Fig. A14: Von Pilz befallener Embyro aus Nest YY-05.
(Photo: L. Jopp)

Fig. A15: Egg infested by larvae and eggs.
Fig. A15: Von Dipteren-Larven und –Eiern befallenes Ei.
(Photo: L. Jopp)

Fig. A16: Embryo infested by dipteran larvae.
Fig. A16: Von Dipteren-Larven befallener Schlüpfling.
(Photo: M.-I. Herzog)

Fig. A17: Coleopteran larva from a sea turtle nest.
Fig. A17: Käferlarve aus einem Meereschildkrötennest.
(Photo: M. Lambropoulos)

Fig. A18: Dead hatchling trapped in marine debris (fishing line).
Fig. A18: Toter Schlüpfling, verfangen in Müll aus dem Meer (Fischleine)
(M.-I. Herzog)

Fig. A19: Hatchling swimming in sea.
Fig. A19: Schlüpfling schwimmt in Meer.
(Photo: S. Bamberger)