Nature conservation field course: Protection of sea turtles (*Caretta caretta*) in Turkey 2012

Projektpraktikum: Schutz von Meeresschildkröten (*Caretta caretta*) in der Türkei 2012

Stachowitsch, M., Fellhofer, C.,
Lambropoulos, M. & E. Rameder (eds.)

University of Vienna
Faculty of Life Science
Department of Marine Biology
Althanstrasse 14   A-1090 Vienna
www.seaturtlecourse.jimdo.com

FREUNDE DES TIERGARTEN SCHÖNBRUNN www.freunde-schoenbrunn.at
BLAUER KREIS Zoologische Gesellschaft Österreichs für Tier- und Artenschutz
VEREIN der FREUNDE des HAUS DES MEERES
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EXECUTIVE SUMMARY

Stefanie Jernej

Wie in den letzten 18 Jahren fand auch heuer 2012 wieder das Projektpraktikum „Meeresschildkröten – Schutz von Meeresschildkröten in der Türkei, Projekt zu angewandtem Naturschutz“ statt. Seit 1994 werden hierbei zwei an der Mittelmeerküste der Türkei gelegene Nistgebiete der Unechten Karettschildkröte (*Caretta caretta*) betreut. Die beiden Strände – Çaliş und Yaniklar/Akgöl in Fethiye sind SEPAs (Special Environmental Protection Areas). Dennoch stehen sowohl die adulten Weibchen, als auch die Hatchlinge zahlreichen Bedrohungen gegenüber. Betreut wurden die Strände in Kooperation der Universität Wien mit einer türkischen Universität, welche in diesem Jahr die Pamukkale Universität Denizli war.

Die Unechte Karettschildkröte (*Caretta caretta*) ist eine von sieben Arten von Meeresschildkröten. Alle Arten stehen auf der Roten Liste der IUCN. *Caretta caretta* wird nach der IUCN als „Endangered“ geführt. Das Verbreitungsgebiet der Unechten Karettschildkröte ist sehr groß, es erstreckt sich über die subtropischen Gewässer von Florida, Georgia, North und South Carolina, Karibik, Mosambik und Südafrika sowie im Mittelmeer. Im östlichen Teil liegen die Niststrände hauptsächlich an der griechischen und türkischen Küste.

Im Jahr 2012 wurde im Zeitraum von 01. Juli bis 15. September das Praktikum durchgeführt. Insgesamt wurden heuer an den beiden Stränden 86 Nester der Unechten Karettschildkröte betreut. Die Anzahl der gefundenen Nester ist deutlich höher als im Vorjahr (62), welches der niedrigste Wert seit Beginn der Aufzeichnungen war.

Calis

Der etwa 3,5 km lange Strandabschnitt, in Calis wurde täglich von 01. Juli bis 29. August, morgens und abends kontrolliert. Zusätzlich dazu wurde der Infostand auf der Promenade betreut. Dieser war täglich von 21 bis 24 Uhr besetzt und die Studenten versuchten, sowohl Touristen als auch Einheimische über die schwierige Situation der Meeresschildkröten aufzuklären und Informationsbroschüren zu verteilen.

In diesem Jahr wurden am Strand von Calis nur zwei adulte weibliche Schildkröten gesichtet, welche auch erfolgreich markiert werden konnten (Tag Nr. TRY0302 und TRY0303). 14 Spuren wurden aufgezeichnet. Zehn der Landgänge endeten mit einem erfolgreich Nistversuch, dies ist der niedrigste jemals in Calis aufgezeichnete Wert. Dies spiegelt den langjährigen Trend in Fethiye wieder.

Die durchschnittliche Entfernung der Nester zum Meer betrug 20,75 m. Insgesamt wurden 689 Eier gelegt, woraus 390 Hatchlinge (56,6%) schlüpften und erfolgreich das Meer erreichten. Somit lag diese Rate nur geringfügig unter dem Durchschnitt der letzten Jahre (60,2 %). 76 der gelegten Eier waren unbefruchtet, 171 starben im Embryonalstadium ab und 52 bereits geschlüpfte Schildkröten starben auf ihrem Weg ins Meer aufgrund von Prädation durch Hunde und anderen Ursachen. Bis auf ein Nest waren alle anderen „Secret Nests", welche erst durch den Schlupf der ersten Hatchlinge und der von ihnen hinterlassenen Spuren gefunden wurden.

Wie schon in den Jahren zuvor, wurden auch heuer wieder die Veränderungen am Strand erfasst. Insgesamt wurden mehr Sonnenliegen bzw- Schirme gezählt, als im Jahr zuvor (Sonnenliegen: 2011:1624, 2012:1627, Sonnenschirme: 2011:711, 2012:773). Weitere Hindernisse, welche den adulten Weibchen die Eiablage erschwerten, sind großflächig ausgelegte Teppiche direkt am Strand, Autos und bauliche Maßnahmen, wie die Fertigstellung der neuen Hotelanlage „Jiva Beach Resort" und die Errichtung zahlreicher Wasserrettungs-Aussichtstürme, sowie Duschkabinen entlang der Promenade. Ein biologisches Problem stellen die angepflanzten Akazien dar, im Speziellen deren Wurzeln, die ein dichtes, weit verzweigtes Netz im Sand bilden und somit sowohl die Eiablage, als auch dann den Schlupf der Hatchlinge erschweren. Jedoch gab es auch eine positive Veränderung für die Meeresschildkröten. Entlang der Promenade in Calis werden die Sonnenliegen über Nacht hochgeklappt, wodurch den eiablegenden Weibchen der Zugang zu geeigneten Nistplätzen erleichtert wird. Zur Reduktion für das wohl globalste aller Probleme, die hohe Müllbelastung, konnten bis jetzt leider noch keine erfolgreichen Maßnahmen getroffen werden.

Yaniklar

In Yaniklar wurden über den gesamten Zeitraum des Projektes von 01. Juli bis 15. September in Morgenschichten die beiden Strandabschnitte Yaniklar und Akgöl kontrolliert, zusätzlich von Beginn des Praktikums bis Mitte Juli auch in Abendschichten.

Insgesamt konnten 76 Nester gezählt werden (Yaniklar 48, Akgöl 28). Während der Nachtschichten wurden sieben adulte Weibchen gesichtet. Insgesamt wurden während des Beobachtungszeitraumes 70 Spuren in Yaniklar und 47 in Akgöl gesehen und vermessen. Neun der Landgänge endeten in Yaniklar mit einer erfolgreichen Eiablage, in Akgöl zehn. Dies zeigt deutlich, dass ein Großteil nicht zu einem erfolgreichen Abschluss gebracht werden konnte (Yaniklar 93,7 %, Akgöl 95,3 % erfolglos). In den letzten fünf Jahren gab es in Yaniklar nur in zwei Jahren (2008 und 2010) um ein Nest mehr, ansonsten waren es immer weniger Nester. In Akgöl ist es ähnlich, hier gab es sogar nur ein Jahr (2009), in dem diese Nestanzahl übertroffen wurde. Was in Akgöl stark auffällt ist, dass hier sehr viele Nester auf sehr engem Raum sehr nah beieinander liegen. Die durchschnittliche Entfernung der Nester zum Meer betrug in Yaniklar ca. 20 m und in Akgöl 19 m. Somit ist die Distanz zum Meer an allen drei Strandabschnitten im heurigen Jahr sehr ähnlich.

Die 76 Nester in Yaniklar ergaben heuer 6299 Eier. Die durchschnittliche Eianzahl betrug 86,2 Eier pro Nest. Die Verteilung war ungleich (min.: 17, max.: 153). Die durchschnittliche Inkubationszeit dauerte 48,2 Tage (min.: 37, max.: 59). Die durchschnittliche Schlüpferfolgsrate betrug 73,3 % und die Mortalitätsrate lag bei 15,1 %.

In Akgöl wurden in diesem Jahr zwei Hatcheries durchgeführt, die jedoch keinen Schlupferfolg zeigten, die Embryonen starben bereits in einem frühen Entwicklungsstadium im Ei ab. Dieser totale Misserfolg ist aber als Ausnahme anzusehen, da 66,3 % aller Hatcherie Eier (welche seit 1997 durchgeführt und aufgezeichnet wurden) erfolgreich ausgeschlüpft sind.

Auch in Yaniklar wurden die Strandveränderungen erfasst. Dieses Jahr wurden insgesamt 439 Sonnenliegen gezählt, ein Plus von 48 Liegen zu 2011. Zwei der drei Informationsschilder, welche 2011 aufgestellt wurden, waren schwer beschädig. Einzig das Informationsschild innerhalb der Hotelanlage des Lykia Botanika Beach & Fun Club, war in sehr gutem Zustand. Die im letzten Jahr ausgehoben Gräben, welche die Autos am befahren des Schildkrötenniststrandes hindern sollten, waren alle zugeschüttet und mussten erneut gegraben werden. Trotz dieser Bemühungen waren leider einige Autospuren in unmittelbarer Nähe der Nester zu finden. Weiters stellen die intensive Benutzung von motorisierten Wasserfahrzeugen und Wassersportgeräten eine große Gefahr für die Schildkröten dar, genauso wie die Fischerei mit Netzen in Strandnähe.

Auch heuer wieder wurde von einigen Studenten das DEKAMER Sea Turtle Research, Rescue and Rehabilitaion Center Dalyan besucht. Dort wird versucht, verletzen Schildkröten zu helfen und diese dann wieder in die Freiheit zu entlassen.

Im Rahmen des Projektes wurden 6 Bachelorarbeiten verfasst.

Um die Thematik „*Gestrandete Meeresschildkröten in Fethiye*“ zu bearbeiten, wurden in Nacht- und Morgenschichten die Strände abgegangen und gefundene Kadaver durch Körpervermessung und Untersuchungen identifiziert und analysiert. Zwei tote Unechte Karettschildkröten wurden im Hafen von Fethiye angeschwemmt, eine weiter am Strand von Calis und die knöchernen Überreste einer Schildkröte wurden am Strand von Yaniklar gefunden. Als Grund für den Tod dieser Schildkröten, konnten die Langleinenfischerei sowie Plastikmüll festgestellt werden.

In der Arbeit „*Meeresmüll: Mesolitter am Strand Yaniklar*“ wurden die beiden Standabschnitte Yaniklar und Akgöl in Bezug auf die Häufigkeit und die Verteilung des Meso-litters (Müllfragmente in einer Größe von 1 - 75 mm) verglichen. Dafür wurden auf beiden Strandabschnitten jeweils zwei nochmals untergliederte Transekte abgesteckt und mithilfe zweier Siebe mit 2 und 4 mm Porengröße bearbeitet. An beiden Strandabschnitten zeigten sich Unterschiede je nach Lage des Transekts, doch drei Stoffklassen waren in allen sehr stark vertreten: 280 Stücke von Styropor in unterschiedlichen Größen, organisches Material und 71 Stücke Plastik.

Um die „*Lichtverschmutzung an der Strandpromenade in Calis*“ Lichtverschmutzung festzustellen, wurden die Lichter der Promenade gezählt und die Lichtintensität mit einem Lux-Messgerät, sowohl vor den Lokalen, als auch direkt bei den Nestern gemessen. 2012 wurden gleich viele Lichter wie im vorigen Jahr gezählt (1013). Der höchste gemessene Lux-Wert lag bei 57 lux, der niedrigste bei 2 lux. Sieben der an der Promenade gefundenen Nester befanden sich eher am westlichen nicht so stark beleuchteten Teil, wobei zwei der Nester sich trotzdem in Gebieten mit hoher Lichtintensität (>20 lux) befanden. Weitere 3 Nester befanden sich fernab der Promenade an dunkleren Strandabschnitten. Verglichen mit einer wolkenlosen Vollmondnacht, die eine Lichtintensität von 0,2 lux hat, sind die Tiere einer enormen Lichtverschmutzung ausgesetzt.

Zur Erhebung der Daten für die Arbeit „*Temperatur Messungen in Caretta caretta Nestern auf den Stränden von Yaniklar und Calis*“ wurden batteriebetriebene Temperaturmessgeräte, Tiny Tags, in die frisch gelegten Nester an den beiden Stränden gelegt. Direkt daneben wurde von Menschenhand eine künstliche Eigrube angelegt und ebenfalls mit einem Tiny Tag bestückt, um später einen Vergleichswert zu haben. Die durchschnittliche Temperatur in Calis lag über die gesamte Dauer bei 34,1 °C (max.:36,5 °C, min.: 30,5 °C). Die Temperaturen im Kontrollnest waren sehr ähnlich. Die durchschnittliche Temperatur in Yaniklar betrug 29,8 °C (max.: 31,3 °C, min.: 27,8 °C). Somit war die Nesttemperatur im Durchschnitt am Strand in Calis um min. 3 °C höher, als in Yaniklar. Der allgemeine Trend in den Temperaturkurven zeigt zu Beginn einen allmählichen Anstieg bis zum höchsten Gipfel, danach sinkt die Temperatur stetig weiter ab.

Im Rahmen dieses Projekts „*Nistverhalten und Störungen in Yaniklar*“ wurden sechs adulte Meeresschildkröten am Strand beobachtet, die dem für die Weibchen der Unechten Karettschildkröte typischen Zyklus von 2 bis 3 Jahren folgten und an ihren Geburtsstrand zurückkehrten, um dort ihre Eier abzulegen. Die einzelnen Phasen des Nistvorganges wurden mit einer Stoppuhr gemessen und analysiert. Nur eines der sechs Weibchen zeigte das komplette Ethogramm einer nistenden Meeresschildkröte, diese legte eine Strecke von 38,2 m in 47,35 min zurück, die anderen fünf Tiere wurden wahrscheinlich durch anthropogenen Einfluss gestört und kehrten zurück ins Meer ohne ihre Eier abzulegen. Hier war die durchschnittlich zurückgelegte Distanz 49,1 m in 14,6 min.

In der Studie *„Die seewärtige Orientierung von Caretta caretta Hatchlingen auf türkischen Niststränden"* werden die Effekte von anthropogen verursachten Lichtern sowie Fahrzeugspuren quantifiziert und analysiert. Hierfür wurden die Spuren von Hatchlingen, die aus zwölf Nestern an den Stränden von Yaniklar und Akgöl schlüpften, untersucht. Insgesamt wurden 441 Hatchlingspuren vermessen und innerhalb eines 5 m Kreises, welcher in 8 Sektoren unterteilt war, aufgezeichnet. 408 von ihnen schafften es, dass Meer zu erreichen. Die deutliche Desorientierung zeigt, dass die Hatchlinge sehr wohl vom künstlichen Licht beeinflusst wurden. Ebenso übten Fahrzeugspuren einen negativen Einfluss auf die seewärts gerichtete Orientierung aus. Die längste zurück gelegte Stecke waren 102,5 m, im Gegensatz zu Distanzen von > 10 m. Durch den längeren Aufenthalt am Strand, setzen sich die Hatchlinge einem größeren Prädationsdruck aus und durch den längeren Weg, werden mehr der Energiereserven verbraucht.

Im Vergleich zu all den anderen Jahren, setzt sich leider der negative Trend bezüglich der Anzahl der Nester fort. Die touristische Nutzung des Strandes, mit dem sehr spärlichen Wissen über die Meeresschildkröten der Besucher unterstreicht die Notwendigkeit der Meeresschildkrötenschutz- und Forschungsarbeit der türkischen Universitäten gemeinsam mit der Universität Wien.

EXECUTIVE SUMMARY

Stefanie Jernej

As in the past 18 years, the field course "protection of sea turtles in Turkey" was conducted again this year (2012). Since 1994, two nesting areas of the loggerhead turtle (*Caretta caretta*) located on the Mediterranean coast of Turkey have been monitored. These two areas – the nesting beaches Çaliş and Yaniklar/Akgöl in Fethiye – are SEPAs (Special Environmental Protection Areas). Nonetheless, the adult females as well as the hatchlings still face numerous threats here. The beaches were monitored this year in collaboration between the University of Vienna and Denizli University, Pamukkale.

The loggerhead sea turtle is one of seven species of marine turtles. All species are on the IUCN Red List. *Caretta caretta* is listed by the IUCN as "Endangered". The distribution of the loggerhead sea turtle is very large. It extends across the subtropical waters of Florida, Georgia, North and South Carolina, Caribbean, Mozambique and South Africa and the Mediterranean Sea. In the eastern part of the Mediterranean Sea, nesting beaches are located mainly on Greek and Turkish coasts.

In 2012 the field course was held in the period from 1 July to 15 September. Overall, this year the students recorded 86 nests of the loggerhead turtle at the two beaches. The number of nests found was significantly higher than last year (62). Note, however, that the number of nests in 2011 was the lowest value since the beginning of the records. Compared to all the other years, the negative trend in the number of nests appears to be continuing. The reasons for this overall decline are no doubt almost exclusively anthropogenic: plastic marine debris left by beach-goers or thrown overboard from boats, intensive fishing, strong tourism with its many modifications of beaches, including severe light pollution.

Calis

The 3.5-km-long section of beach in Calis was patrolled daily from 1 July to 29 August in morning and evening shifts. In addition an information booth was operated on the promenade. The info booth was open daily from about 9 to 12 p.m. The students showed films and explained the plight of the sea turtles to tourists and local residents. Furthermore information brochures in several languages were distributed.

In 2012, only two adult female turtles were seen on the beach of Calis. These two individuals were successfully tagged (Tag No. TRY0302 and TRY0303). Fourteen adult tracks were recorded. Ten of the tracks on the beach ended with a successfully dug nest. This is the lowest value ever recorded in Calis. This reflects the overall long-term declining trend in Fethiye.

The average distance from the nests to the sea was 20.75 m. The total number of the laid eggs was 689. 390 of the eggs hatched successfully (56.6%) and reached to the sea. Thus, the rate was only slightly below the average of the recent years (60.2%). 76 of the laid eggs were unfertilized. 171 already died in an embryonic stage and 52 hatched turtles died on their way to the sea due to predation by dogs or the heat of the sun and other threats. All nests except for one were so called "secret nests": they were found only after the tracks left by the emergence of the first hatchlings.

As in the past years, also this year the changes on the beach were recorded. The number of sunbeds in 2011 was 1624, whereas this year, 1627 were counted. The number of umbrellas increased from 711 to 773. A reduction of the sunbeds by 32 % and the parasols by 28.5 % was determined in Calis. However, in Ciftlik the number increased considerably, the sunbeds by 29.8% and the umbrellas even by 52%. Many obstacles make it more difficult for the adult females to find a good place to lay their eggs, for example carpets, which covered certain parts of the sand surface in front of various beach facilities, vehicles and structures directly on the beach. This included the construction of several lifeguard towers and shower cubicles along the promenade. Moreover, a major new hotel complex, "Jiva Beach Resort", was erected, complete with dense beach furniture. A biological problem is the planting of acacia trees, especially because of their roots, which form a densely branched and impenetrable network in the sand. This makes it virtually impossible for adult females to dig a hole for their eggs within a radius of several meters around each tree and can also impede hatchlings when they hatch and emerge on the surface of the beach. However, positive changes for the sea turtles were also recorded. Along the promenade in Calis. sunbeds were stacked overnight. This provides the adult females better access to adequate nesting sites. For the reduction of the waste pollution (plastic and other items left by beach-goers), no successful solution was found: on some stretches of beach, small containers were set into the sand and emptied in the early morning, but these were apparently used by only a minority of visitors and tended nonetheless to be overfilled.

Yaniklar

Over the entire course period from 1 July to 15 September the two beach areas Yaniklar and Akgöl were monitored in morning shifts. In addition, from the start of the project until mid-July the beaches were also patrolled in evening shifts.

In total, 76 nests were counted (Yaniklar 48, Akgöl 28). During the night shifts, seven adult females were sighted. Overall, during the observation period 70 tracks in Yaniklar and 47 in Akgöl were recorded and measured (i.e. excluding all secret nests laid early in the season). Nine of the emergences onto the beach in Yaniklar ended successfully and the female turtles were able to lay their eggs. In Akgöl, ten of the recorded tracks led to a nest. This clearly shows that the majority of the emergences were unsuccessful. In the last five years there were only two years (2008 and 2010) with more nests than this year in Yaniklar (but only one more). This is also reflected in the situation in Akgöl: this year's value was exceeded on only one year (2009). Strikingly, most of the nests in Akgöl were in a very small section at the end of the beach and were also very close together. The average distance of the nests to the sea was about 20 m in Yaniklar and 19 m in Akgöl. Thus the distance to the sea on all three sections of the beach was very similar this year.

In the 76 nests in Yaniklar, 6299 eggs were counted. The average number of eggs was 86.2 per nest. The number of the eggs was unevenly distributed among the nests (min.: 17, max.: 153). The average incubation period lasted 48.2 days (min.: 37, max.: 59). The average rate of successful hatches was 73.3% and the mortality rate was 15.1%.

In Akgöl this year, two hatcheries were made for nests made in the surf zone. Neither of the two hatched successfully. The embryos died at an early stage of development in the egg. This failure must be regarded as an exception because 66.3% of all the hatchery eggs recorded since 1997 hatched successfully.

Beach changes were also recorded in Yaniklar. This year the total number of sunbeds was 439, an increase of 48 beds compared with 2011. Two of the three information signs which were erected in 2011 were severely damaged. Only the information sign within the hotel complex of Lykia Botanika Beach & Fun Club was in very good condition. The ditches dug last year along the landward side of the beach to prevent vehicle access to the sea turtle nesting sites were all filled in over winter and had to be re-dug. These efforts were largely successful but had to be repeated because some car tracks continue to be found in the immediate vicinity of nests. Furthermore, intensive use of motorized watercraft and water sports equipment, mostly from the two major hotels along Yaniklar beach, continue to represent a great threat to the turtles; fishing with nets directly offshore was also recorded.

The DEKAMER Sea Turtle Research, Rescue and Rehabilitation Center Dalyan were visited by some of the students this year. This center is designed to help injured turtles and then release them into the wild again.

This year, 6 Bachelor theses were written in the framework of the field course.

The Bachelor subject "Beached Sea Turtles in Fethiye" was treated on the beaches during the course of night and morning shifts. Carcasses found were identified and analyzed though sketches, measurement and photographs. Two dead loggerhead turtles were stranded and dead in the port of Fethiye. A further individual was found on the beach of Calis. The skeletal remains of a turtle were found on Yaniklar beach. The likely cause of death of some of these turtles was longline fishery and plastic waste.

In "Marine debris: Mesolitter on the beach of Yaniklar" the frequency and distribution of mesolitter (garbage fragments sized 1 - 75 mm) on the two beach areas Yaniklar and Akgöl were compared. On both beach sections, two further subdivided transects were laid and processed using two sieves with 2 and 4 mm pore size. On both parts of the beach, differences could be shown depending on the location of the transects. Three classes of material were very well represented: 280 pieces of polystyrene (styrofoam) in different sizes, organic material and 71 pieces of plastic.

To detect the "Light pollution on the beach promenade in Calis", the lights along the promenade were counted and the light intensity was measured with a lux meter. Both parameters were measured in front of the bars as well as directly in front of the nests. In 2012 as many lights were counted as last year (1013). The highest value measured was 57 lux. Seven of the nests were located along the promenade at the western, less strongly illuminated part. Two of the nests were located in areas of high light intensity (> 20 lux). Three more nests were located far away from the darker parts of the beach promenade.

To collect data for the thesis "Temperature measurements in *Caretta caretta* nests on the beaches of Calis and Yaniklar", battery-powered thermometers, Tiny Tags, were placed in the freshly laid nests on the two beaches. Directly next to the nest, the students dug an artificial hole. Both the natural nest and the artificial one were equipped with a Tiny Tag to obtain a comparison. The average temperature in Calis over the entire period was 34.1 ° C (max.: 36.5 ° C, min.: 30.5 ° C). The temperatures in the artificial nest were very similar. The average temperature in Yaniklar was 29.8 ° C (max.: 31.3 ° C, min.: 27.8 ° C). Thus, the average temperature in the nest at Calis was about 3 ° C higher than in Yaniklar. The general trend in the temperature curves shows a gradual increase up to the highest peak, then a steady decline to the end of the season.

For the thesis "Nesting behavior and disturbances in Yaniklar", six adult sea turtles were observed on the beach. The female loggerhead turtle typically return to their birth beach every

two to three years to lay their eggs. The individual phases of the egg-laying process were measured with a stopwatch and analyzed. Only one of the six females showed a complete ethogram of a nesting sea turtle. The successful female covered a distance of 38.2 m and dug her nest in 47.35 min. The other five individuals did not complete the nesting process, probably due to anthropogenic disturbances and returned to the sea without laying their eggs. Here, the average distance the females covered on the beach was 49.1 m in 14.6 min.
In the study "The seaward orientation of *Caretta caretta* hatchlings on Turkish nesting beaches" the effects of anthropogenic lights and vehicle tracks are quantified and analyzed. This involved measuring the tracks of the hatchlings emerging from twelve nests on the beaches of Yaniklar and Akgöl. A total of 441 hatchling tracks were measured and recorded within a 5 m diameter circle, which was subdivided in 8 sectors. 408 of them successfully reached the sea. Many deviated from the direct path to the sea, and this disorientation shows that the hatchlings were influenced considerably by the artificial lights. Likewise, vehicle tracks had a negative influence on the seaward orientation. The longest distance traveled on the beach was 102.5 m – in contrast to the nest-to sea distances of approx 10 m. This extended distance and therefore prolonged stay on the beach subjects the hatchlings to a higher risk of predation and a much greater expenditure of their energy reserves.
Overall, the trends in the nest numbers, the increasing use of the beach by humans and the often poor state of knowledge of visitors about sea turtles and their requirements underlines the importance of continued sea turtle conservation work by the Turkish universities and their partner, the University of Vienna.

The nesting season of loggerhead turtles (*Caretta caretta*) on Çaliş Beach (Fethiye, Turkey) in 2012

Anna Kreiderits

KURZFASSUNG

Von 1. Juli – 15. September 2012 wurde im türkischen Fethiye das seit 1994 jährlich durchgeführte „Projektpraktikum zum Schutz und Management der Unechten Karettschildkröte (*Caretta caretta*)" der Universität Wien in Zusammenarbeit mit der türkischen Universität Pamukkale, abgehalten. Fethiye ist eine „Special Environmental Protected Area" (SEPA) zu dem natürlich auch die Nistgebiete gehören. Insgesamt waren 20 österreichische Studenten und Studentinnen vor Ort und betreuten zusammen mit den türkischen Kollegen die Strände in Yaniklar und Çaliş.

In Çaliş wurde bis zum 29. August täglich der etwa 3,5 km lange Strand morgens und abends kontrolliert. In der Nachtschicht wurde unter anderem nach adulten weiblichen Unechten Karettschildkröten Aussschau gehalten, die zur Nestablage an den Strand gekommen waren. Ihnen sollte die ungestörte Eiablage ermöglicht werden, indem Störquellen, wie Menschen und Tiere am Strand, möglichst unterdrückt wurden. Die Tiere wurden vermessen und markiert. Von den hinterlassenen Kriechspuren („tracks") und Nistplätzen wurden ebenfalls Daten aufgenommen und fertige Nester wurden mit Metallkäfigen geschützt. Ab Beginn der Schlupfzeit wurde der Strand auch nach frisch geschlüpften Schildkröten („hatchlinge") abgesucht und der Verlauf der Nestentwicklung wurde genau beobachtet. Es wurde dafür gesorgt, dass die Jungtiere möglichst selbstständig ihren Weg ins Meer finden konnten.

In der Nistsaison 2012 wurden am Strand von Çaliş 10 Nester gefunden, was die geringste Anzahl in 19 Jahren Projektdurchführung darstellt. Es konnten zwei adulte *Caretta caretta* Weibchen gesichtet und markiert werden und insgesamt wurden 14 tracks entdeckt. Die durchschnittliche Entfernung der Nester vom Meer betrug dieses Jahr 20,75 m. Die starke touristische Nutzung des Strandes gilt als hauptsächlicher Problemfaktor für den rückläufigen Nisterfolg. Entlang der Strandpromenade herrscht eine erhöhte Lichtverschmutzung aufgrund der beleuchteten Bars, Restaurants und Hotels, und die Geräuschkulisse ist durch laute Musik geprägt. Am Strand treffen Schildkrötenweibchen auf Menschen, die auch nachts beim Wasser sitzen, schwimmen oder picknicken, Hunde und Hindernisse wie Sonnenliegen und –schirme.

Das Projektpraktikum hat es sich zum Ziel gesetzt den Fortbestand der *Caretta caretta* Population in Çaliş auch weiterhin zu sichern und zu fördern indem einerseits praktische

Arbeit am Strand geleistet wird und andererseits die Touristen und auch die einheimische Bevölkerung informiert und über die Bedeutung dieses Naturgebietes aufgeklärt werden.

ABSTRACT

From July 1 until September 15 2012, the field course for the protection and management of the loggerhead turtle (*Caretta caretta*), that has been annually held since 1994, took place in Fethiye (Turkey). The work is conducted by the University of Vienna in cooperation with Turkish universities, this year it was Pamukkale Üniversitesi. Fethiye is designated "Special Environment Protected Area"(SEPA). Twenty Austrian students and the Turkish team worked on the beaches of Yaniklar and Çaliş in Fethiye.

The beach of Çaliş, which is about 3.5 km in length, was controlled every morning and evening until the 29 August. The teams looked for female loggerhead turtles that had emerged onto the beach for nesting. The aimed was to reduce sources of disturbance such as people and animals on the beach, so that the turtles could lay their eggs undisturbed. If possible the adult sea turtles were measured and tagged. Data was taken also from tracks and nesting sites that were found. Metal cages were put on top of nests as protection. When hatching started, the beach was also monitored for freshly hatched turtles and the nests were controlled carefully. The hatchlings should reach the sea in a healthy state and as independently as possible.

In the nesting season 2012 10 nests were found on Çaliş Beach. That's the lowest number in the19 years that the course has been held. Two female *Caretta caretta* were sighted and tagged and 14 tracks could be documented. This year the average nesting position was at a distance of 20.75 m from the sea. The main overall problem seems to be the touristic impact on the beach. Because of the bars, restaurants and hotels along the promenade, the light pollution and noise on the beach are very high. Emerging sea turtles are confronted with sunbeds and umbrellas standing in their way and people on the beach and in the sea, also by night.

The monitoring and research aims to help the population of *Caretta caretta* in Çaliş also for the future by being active on the beach and also informing the tourists and local residents about the value of this natural habitat.

INTRODUCTION

The loggerhead turtle (*Caretta caretta*), part of the family Cheloniidae, is one of seven occurring sea turtle species. It is distributed in the offshore regions of warm temperate and subtropical oceans worldwide (Bowen et al. 1993). In the Mediterranean Sea the loggerhead turtle is the most frequent sea turtle species. Another nesting species include the green turtle (*Chelonia mydas*). *Dermochelys coriacaea*, *Eretmochelys imbricata* and *Lepidochelys kempii* have also been occasionally sighted in the Mediterranean, but do not nest here. The loggerhead turtle is classified as “endangered” by the IUCN Red List of Threatened Species (www.iucnredlist.org 2012). Furthermore it is protected by the Convention for the International Trade in Endangered Species (CITES) and strictly protected by the Convention on the Conservation of European Wildlife and Natural Habitats, Annex II (Bern Convention) (www.cites.org 2012, conventions.coe.int 2012).

Adult loggerheads are reddish-brown on the dorsal side and have a lighter-coloured ventral side. Their carapace, about 70 – 110 cm in length, is heart-shaped and, along with the plastron, heavily keratinized (Dodd 1988). The head is rather broad and massive with strong jaw muscles and a robust beak-like rhampoteca to crush hard-shelled animals, such as molluscs and crustaceans (Wyneken 2001). Apart from these prey items, the loggerhead turtle as an omnivore also feeds on sponges, seaweed, fish and jellyfish (Spotila 2004). The dorsal side of the skull characteristically shows two pairs of prefrontal scales and one interprefrontal scale. Typically the nuchal scute of the carapace is in contact with the first of mostly 5 lateral scutes (Wyneken 2001). An adult *Caretta caretta* can reach a bodyweight of about 200 kg (Spotila 2004).

At the age of about 12-30 years female *Caretta caretta* reach maturity (Bowen et al. 1993). The turtles show nest-site fidelity and commonly return to their natal beach for egg deposition in intervals of 2-3 years (Spotila 2004). The female approaches the beach at night and usually first swims along the beach in a parallel line (Hailman & Elowson 1992). When there is no noticeable source of disturbance she emerges from the water and moves across the beach on a fairly straight path to find a proper nesting site. She then starts making the body pit. Thereby she uses her limbs to shove aside the dry surface sand around and under her body to build a shallow pit (Hailman & Elowson 1992). Afterwards the female starts digging the egg chamber by alternating scooping motions of her rear flippers. The chamber usually is about 50 cm deep and has a diameter of 20-25 cm (Hailman & Elowson 1992). If the female is disturbed in this stage of nesting, for example through noise, lights or people, she will stop and turn back to the sea. Otherwise the egg deposition can begin. Up to 100 eggs and more can be extruded through the cloacal tube (Hailman & Elowson 1992). The female normally does not stop the nesting procedure if disturbed in this stage of nesting. After laying the eggs, the female uses her rear flippers to backfill the chamber with sand and to tamp it. At the end, the nesting spot gets camouflaged through characteristic sweeping movements of mainly the front flippers

(Hailman & Elowson 1992). Afterwards the turtle turns back to the sea. Within the whole nesting procedure the female might pause for some minutes several times. Often she starts making a body pit and suddenly interrupts for no obvious reason to move on to a better spot. In one nesting season a female loggerhead turtle can lay 1-4 clutches.

When a sea turtle moves on the beach, its crawlway, the so-called “track”, stays visible in sand or pebbles and can be used to reconstruct the shore leave and to find the nest, if one has been constructed. The species, the direction of crawling and also individual characteristics can be determined based on a track.

Çaliş is one of 22 nesting sites for *Caretta caretta* along the Mediterranean coast. It is situated in Fethiye in the south-west of Turkey (Fig. 1). Fethiye (Çaliş) is designated a Special Environment Protected Area (SEPA) in order to safeguard its rich wildlife. It is also a touristic hot spot, which has bad impact on nature in many cases. The light-polluted and noisy promenade, with its uninterrupted row of restaurants, bars and hotels and the continually frequented beach, where sunbeds and umbrellas are positioned through the whole summer season (Fig. 2), represent the main sources of disturbance for female loggerhead turtles trying to find a nesting spot. Also animals such as dogs and cats as well as discarded litter, for example in the picnic area, pose a risk for adult sea turtles and hatchlings.

In cooperation with Turkish universities, in 2012 like the year before it was Pamukkale Üniversitesi, the University of Vienna has since 1994 run an annual long-term nature conservation field course in order to monitor and protect the loggerhead turtle population in Çaliş and also in Yaniklar, another *Caretta caretta* nesting beach in Fethiye. The work involves patrolling the beach, informing tourists and residents, and collecting data.

Fig.1: Location of Fethiye on the Mediterranean coast in south-west Turkey.
Abb.1: Lage von Fethiye an der Mittelmeerküste im Süd-Westen der Türkei.
Quelle: maps.google.at

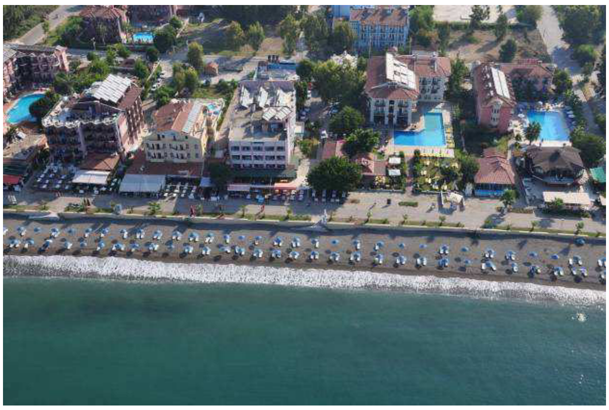


Fig.2: Aerial view of Çaliş Beach. Sunbeds and umbrellas occupy the beach.
Abb.2: Luftaufnahme vom Strand in Çaliş. Sonnenliegen und –schirme prägen das Strandbild.
(Photo: M.Stachowitsch)

MATERIAL AND METHODS

From 1 July to 29 August 2012 the team of the *Caretta caretta* field course, made up of students from the University of Vienna and the University of Pamukkale, worked on Çaliş beach to protect and monitor the local nesting population of *Caretta caretta*.

The coast of Çaliş is about 3500m long and about half of the beach stretches along a promenade wall. The substrate varies from fine sand to large pebbles. Because of the touristic influence, there are sunbeds and umbrellas along the shoreline. The level of light pollution is quite high, coming from the bars and restaurants along the promenade. The area was monitored by the students in the course of daily shifts.

Night shifts

At 10 p.m. the first group of 3-4 students started patrolling the beach. Keeping a parallel formation (next to the promenade, in the middle of the beach and next to the waterline) the team walked from starting point "Restaurant Çadiri" (Fig. 4) to "Surf Center" (Fig. 4) and ,after a 15-minute break, back again. This took about two hours. Thus at 12 p.m. the next group could take over and walk the same route again until about 2 a.m. The beach zone behind "Surf Center" was not controlled at night because it is less frequented by tourists and therefore the risk of being disturbed is not as high for sea turtles. All together the beach was patrolled four times per night.

The teams were equipped with a wooden calliper, a short and a long measuring tape, red-light flashlights, a thermometer, walkie-talkies, a field data book and, after hatching started, also a bucket.

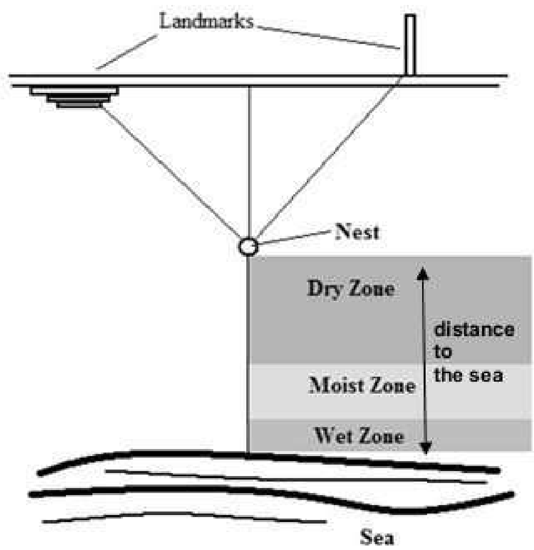
If an adult female turtle was seen approaching the beach in order to lay eggs, the observers sat or lay down on the ground and remained quiet. They also tried to block all disturbance factors from the turtle, such as people and dogs. The female's behaviour was observed and if eggs were laid the total time of nesting and all nesting stages was noted (see Hollergschwandtner, this volume). When the female returned to the sea, either after or without having completed the nesting procedure, the team took measurements and controlled for or attached a metal tag. While one person held the turtle by standing beside it, another team member measured the curved carapace length (CCL) and width (CCW) with the short measurement tape as well as the straight carapace length (SCL) and width (SCW) with the calliper. Meanwhile the female was checked for epibionts on her carapace. All data was recorded into the data book. Tags were attached on the right flipper using a special applicator. The turtle was released into the sea immediately after the treatment. Afterwards the tracks the turtle left behind on the beach surface (Fig. 7) were measured (length and width). Also the number of body pits and incomplete egg chambers was recorded. Furthermore the exact position of the nest was determined by triangulation (Fig. 3). Thereby the distance between three nearby reliable landmarks and the nest was determined with the long measuring tape. Also the distance to the sea, including wet, moist and dry zone, was measured.

Nests, whose the exact date of egg laying was known, were numbered with a "C" for "Çaliş" and a number (e.g. Nest number C1). A metal cage was put on top of the nest as soon as possible after finding it. This year the Turkish team provided new cages (Fig. 8). At the time hatching was expected to start, the old cages (Fig. 8) were used, because they have plastic nets at the bottom. These nets were pulled down every evening to ensure that hatchlings stayed safely inside the cage; they were pulled up again in the morning to give the hatchlings the possibility to get to the sea in case they hatched during the day, which is rare but does occur.

In case the turtle had already returned into the sea when the team arrived, the tracks were measured and potential nesting spots were examined with a metal rod ("shish") in order to check whether egg laying had taken place or not. Thereby the metal rod was carefully inserted into the ground. An egg chamber was detected, when the metal rod penetrated into the sand more easily, because the sand is much looser there.

Nests, whose date of egg laying was not known, so-called "secret nests", were numbered CS1 (Çaliş Secret 1), CS2, CS3, etc. After the measurements were completed all traces were wiped away, to avoid double data taking.

Fig.3: Schematic illustration of a triangulation of a nest in order to determine the exact nesting position.
Abb.3: Schematische Darstellung der Triangualtion eines Nestes um die exakte Nestlage zu dokumentieren.
(Grätzl & Greistorfer 2010)



From the beginning of hatching time, in mid-July, the beach was also checked for hatchlings and hatchling tracks in order to indirectly find hatching nests (see Beißmann & Birngruber this volume). Beginning on 3 August the night shift was changed to a simple "nesting control", in which only the remaining cages were checked for hatchlings. This was, because no adults or unknown nests would have been expected anymore.

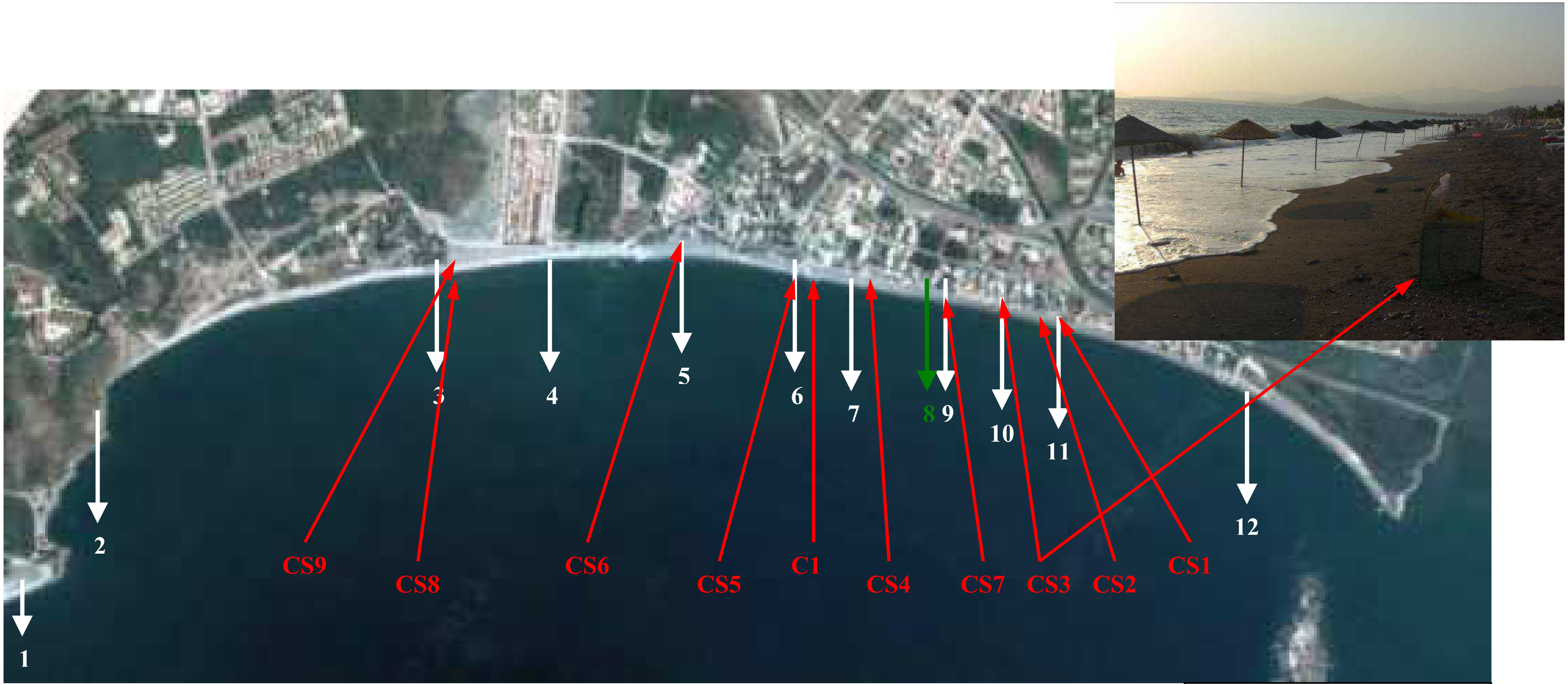
Morning shift

Beginning at 6 a.m. the beach was patrolled once by 3-4 persons. The starting point was again "Restaurant Çadiri" (Fig. 4) and the end point was "Çaliş tepe" (Fig. 4).

The beach was checked for any tracks and nests of turtles that had come out during the night and had not been found by the night shift team. All data, including measurements and location for tracks and triangulation for nests, was recorded into the data book and metal cages were put on top of nesting sites.

Every morning the position of all cages was exactly determined by triangulation to make sure that they were still on top of the nests and had not been moved during the night.

During hatching time the cages were also checked carefully for hatchlings and the plastic nets were pulled up.



1 Yaniklar beach
2 Çaliş tepe
3 Surf Center
4 Picnic area
5 Otogar
6 Caretta Beach Club
7 Hotel Dolphin
8 *Caretta caretta* Info desk
9 Hotel Güneş
10 Hotel Area
11 Hotel Idee
12 Restaurant Çadiri

Fig.4: Beach plan of Çaliş 2012 including important orientation points (white arrows), the *Caretta caretta* Info desk (green arrow) and the locations of the nests CS1-CS9 and C1(red arrows). CS 3 is also shown in detail (top right).

Abb.4: Strandplan von Çaliş 2012 mit wichtigen Orientierungspunkten (weiße Pfeile), dem *Caretta caretta* Info-Stand (grüner Pfeil) und den Positionen der Nester CS1-CS9 sowie C1(rote Pfeile). CS 3 ist auch als Nahaufnahme dargestellt (rechts oben).

Quelle: maps.google.at

RESULTS

Tracks

In 2012, 14 tracks were found on Çaliş Beach, only one (Track no. 6) resulted in successfully dug nest (Tab. 1). Six of 14 tracks included the traces of one or two body pits. Except for one (Track no.12) all tracks were situated on the beach part that lies beyond the promenade wall, mostly in the so-called picnic area. The average furthest distance of a track to the sea was 24.1 m. The range is from 17.8 m to 35 m (Tab. 1). The average track length was 46.6 m. The turtles covered between 10 m and 65 m on their visit to the beach (Tab. 1). The average track width was 0.6 m.

Tab.1: Overview of *Caretta caretta* tracks found on Çaliş Beach in the season 2012. "-" means no data. Only track no.6 (bold) led to a successful nest.
Tab.1: Überblick über die am Strand von Çaliş gefundenen *Caretta caretta* Spuren in der Saison 2012. "-" bedeutet keine Daten vorhanden. Nur Track Nr.6 (fett) führte zu einer erfolgreichen Nestanlage.

Track no.	Date (2012)	Furthest distance to the sea (m)	Total length (m)	Track width external/internal (m)	No. of body pits
1	2.7.	29	53.8	0.5/0.12	1
2	3.7.	26	53.1	0.6/0.17	0
3	3.7.	18	44	0.7/0.16	0
4	5.7.	17.8	48.3	0.6/0.12	1
5	5.7.	35	59.3	0.54/-	0
6	**6.7.**	**26.3**	**57.2**	**0.54/-**	**2**
7	7.7.	24	65	0.72/-	0
8	7.7.	19.5	39.3	0.65/-	2
9	7.7.	26	26.6	0.62/-	0
10	7.7.	25.8	52.8	0.6/-	0
11	15.7.	-	10	-	-
12	16.7.	24.3	52.4	0.56/-	0
13	17.7.	20.1	47.7	0.56	2
14	17.7.	21.6	43.2	0.54/-	1

Adults

On three occasions an adult *Caretta caretta* was sighted and measured on Çaliş Beach this season. Because one female was encountered twice, only two different individuals were measured. Both turtles got their right flipper tagged (Tab. 2). One of them (tag no. TRY0302) dug a nest when observed the second time. The other one (TRY0303) was disturbed and turned back to the sea without laying eggs. Both individuals were measured (Tab. 2).

Two more adult sea turtles were sighted in Çaliş but no data could be taken. One swam along the beach but did not leave the sea and the other one stayed in the wet zone only, hindering data collection.

This season, one dead turtle was washed ashore on Çaliş Beach (Fig. 9) (see Kautek this volume).

Tab.2: Data of adult *Caretta caretta* found and tagged on Çaliş Beach in 2012, including SCL (straight carapace length), SCW (straight carapace width), CCL (curved carapace length) and CCW (curved carapace width).

Tab.2: Daten der adulten *Caretta caretta,* die 2012 am Strand von Çaliş gefunden und mit Tags markiert wurden. SCL (straight carapace length) sowie SCW (straight carapace width) entsprechen der Länge bzw. Breite des Tieres gemessen mit einer starren Schiebelehre und CCL (curved carapace length) sowie CCW (curved carapace width) entsprechen der Länge bzw. Breite des Tieres gemessen mit einem biegsamen Maßband.

Tag no.	Date (2012)	SCL (cm)	SCW (cm)	CCL (cm)	CCW (cm)
TRY 0302	5.7. + 6.7.	67	48.5	69	61
TRY 0303	15.7.	63	50	67	61

Nests

Altogether, 10 nests were found on Çaliş Beach during the breeding season 2012. The exact date of egg deposition was known for nest C1 only (Tab. 3). The other nests (CS1-CS9) were so-called "secret nests", for which the egg deposition date could only be assumed. CS1-CS5 had been laid before the Austrian team arrived in Çaliş and were found by our Turkish colleagues. CS6 was found by the Austrian team through information provided by a local resident and CS7-CS9 were discovered only based on the first hatchlings that emerged.

Five of the nests were laid along the promenade, two directly after the promenade wall's end in front of "Caretta Beach Club" (Fig. 4) and three in the "picnic area" (Fig. 4).

C1, laid on 6 July, was the last nest of the season. This corresponds well with the last nests in 2011 (4 July) and in 2010 (10 July) (Filek 2011, Grätzl & Greistorfer 2010). In 2009, however, the nesting season took one month longer and ended on 6 August (Federspieler & Sperandio 2009).

In 2012 the lowest number of nests was documented ever since the project has started in 1994 (Fig. 5). This season there were nine nests less than the average number of nests for the last 18 years, which is 19 nests, and eight nests less than last year (Filek 2011). In 2003 and 2005 the number of nests was similarly low (11 nests). The most nests were documented in 1994

(36 nests) and in 2004 (26 nests). The chronicle shows slight peaks in 1996 and in 1999 (both 22 nests) and also in 2007 and in 2010 (both 21 nests). The general trend seems to be declining (Fig. 5).

Tab.3: The collected data of the nests in Çaliş Beach in 2012. (- means no data available)
Tab.3: Die gesammelten Daten der Nester in Çaliş Beach 2012 (- bedeutet keine Daten verfügbar)

Nest No.	Date	Location	Distance to the sea (m)	Dry zone (m)	Moist zone (m)	Wet zone (m)
C1	6.7.2012	Caretta Beach Club	26.3	20.7	4.1	1.5
CS1	-	Hotel Idee	17	8.4	4.9	3.7
CS2	-	Hotel Idee	10.8	3.7	3.8	1.9
CS3	-	Hotel Area	10.8	6.4	1.9	2.5
CS4	-	Hotel Dolphin	12.3	8.5	2.2	1.6
CS5	-	Caretta Beach Club	20	15.8	2.4	1.8
CS6	-	In front of Dolmus Otogar	32	30	1	1
CS7	-	Hotel Güneş	7.8	-	-	-
CS8	-	Next to Surf Center	34.2	31.9	1.4	1
CS9	-	Next to Surf Center	36.3	34.3	1.35	0.7

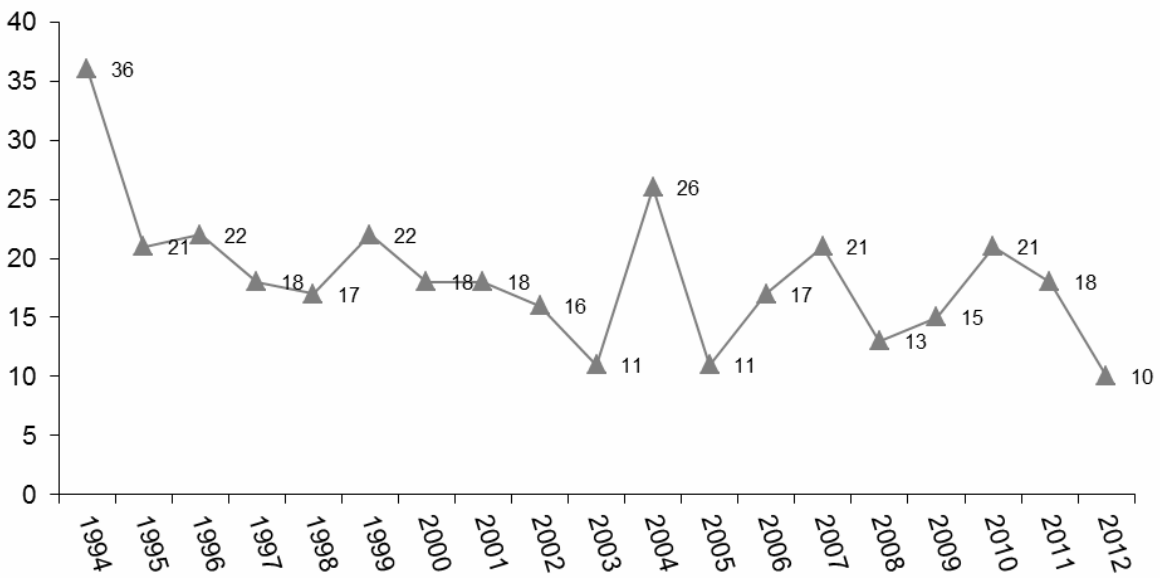


Fig.5: Chronicle of the number of nests on Çaliş Beach for the seasons 1994 – 2012. Although fluctuations are recognizable, the general trend seems to be declining.
Abb.5: Chronik der Anzahl der Nester am Strand von Çaliş für die Saisonen 1994 – 2012. Obwohl gewisse Fluktuationen erkennbar sind, scheint der generelle Trend absteigend zu sein.

This year the average nesting position was 20.75 m from the sea (Fig. 6). It was noticeable that nests located directly along the promenade were 35% closer to the sea than those located next to “Caretta Beach Club” or in the picnic area (Tab. 3). The extension of the wet and moist beach zones in front of the nests was quite constant, with a variation of about 3-4 m (Tab. 3). These zones did not seem to have an effect on the nests’ position.

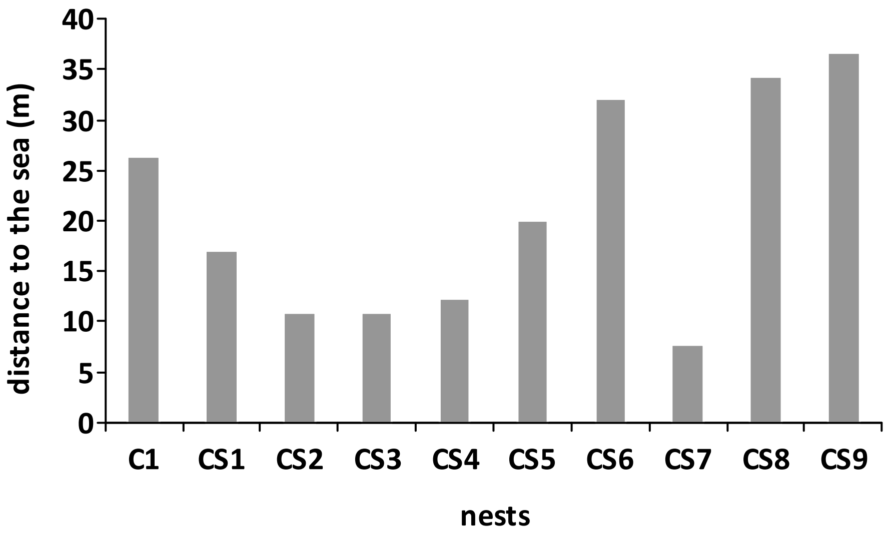


Fig.6: Distances to the sea of all nests (C1, CS1-CS9) in Çaliş Beach in 2012.
Abb.6: Entfernungen zum Meer von allen Nestern (C1, CS1-CS9) in Çaliş Beach in der Saison 2012.

On 25 July the tide rose so high that the nests CS2, CS3 and CS7 were set under water. They were dug up until the eggs were reached and wet sand was replaced by fine dry sand from the surrounding beach.

The nests CS4 and CS6 were built into a very hard and dense underground containing many stones. These two nests were dug up, refilled with fine sand and checked regularly to make sure that the hatchlings did not get stuck. The plastic net of the metal cage on top of CS6 was damaged, and a cat was seen waiting in front of the nest twice.

The cages on the nests C1 and CS5 in front of “Caretta Beach Club” were often damaged by a family of dogs living at this restaurant. They pulled down the plastic nets and, in the case of the new cages (Fig. 8), also lay on top of the nest inside the metal boundary. Moreover the dogs also dug down to the eggs. Therefore the new cages were replaced by the old models (Fig. 8) even before hatching started: an additional cage was placed on every side of the nest cage itself to block access by the dogs. These nests were even more carefully controlled at the time of hatching.

No hatchery was constructed on Çaliş Beach this year.

DISCUSSION

The fact that only one of the found tracks resulted in a successful nest (Tab. 1) gives the strong impression that the degree of disturbance is quite high for female loggerhead sea turtles on Çaliş Beach and discourages them from laying their eggs (Magyar 2008) The search for the optimal nesting spot costs valuable energy that the females could better use for the costly nesting procedure later on (Miller et al. 2003). Most tracks were located away from the beach part directly along the main promenade. One potential explanation is that the turtles perceive the picnic area as a calmer spot with less colourful lights and noisy music. While this is true, there are other sources of disturbance in this area, such as people sitting on the beach eating and drinking in groups and sometimes also staying overnight. Moreover, in many parts outside the promenade area, the beach texture is not conducive to nesting, i.e. large pebbles and cobbles. These two facts probably are the reason for the high number of "turn backs" without making a nest on this part of the beach.

In July, when the nature conservation field course on *Caretta caretta* was started, the touristic high season had already begun. The turtles seen by us this year emerged after midnight. Therefore, our interpretation is that most females waited until visitors had left the beach and the restaurants and bars had turned down the music and lights, before emerging to look for a suitable nesting position. This could explain why fewer adult turtles were sighted ascending the beach (Tab. 2) than tracks could be found (Tab. 3).

One turtle was found on two consecutive days. This is a good example for females showing nest-site fidelity and coming to the beach several times until successful nesting is possible. Tagging makes it possible to follow the turtles' life histories and determine how strictly they are bound to their natal beaches even though the nesting environment might be getting worse.

Over the long term, the number of nests in Çaliş shows a general decline (Fig. 5). In 2012 the fewest nests were found ever since the documentation began (Tab. 3). It is known that female *Caretta caretta* lay their eggs in a 2-3 years rhythm (Spotila 2004), and therefore some fluctuation is to be expected. Nontheless, the population is apparently decreasing. Following the fluctuations (Fig. 5) and taking the natural nesting rhythm into account, the season 2013 could once again show an increase in the number of nests again. The main reason for the declining number of nests is probably the touristic utilization, which continues unabated (see chapter "Changes on Çaliş Beach in 2012"). The different sources of disturbance - lights, often colourful and flashing, loud music, people sitting and walking on the beach, often with flashlights, and also swimming at night, predators, such as dogs and cats, and cars driven onto the beach - provide an impacted and dangerous environment for the females and probably lead to a what could be called “nesting-stress”. Apart from the many sea turtles that ascend the beach and leave without laying their eggs, there is also a considerable number that locate their nests too close to the sea, where they can be negatively affected by the tides. Three nests, CS2, CS3 and CS7, were built rather close to the sea (Tab. 1) and were flooded this season. Without the control and care of the field course team, the embryos would probably not have survived. One possible explanation is that the females were stressed by the disturbances and preferred to stay closer to the sea to keep the time on the beach as short as possible.

In order to reduce “nesting-stress” it would be necessary for the access to the beach to be forbidden and also rigorously controlled after 8 p.m. at night. The implementation of legal regulations seems to be an important working point (Oruc et al. 2009). It is understandable that local families want to use the beach for picnics. One possibility would be to restrict the picnic time to the weekends and restrict the space to a smaller area. Furthermore, more litter bins should be put up, so that visitors are more encouraged to dispose their waste properly. Sunbeds should be removed during the night so they do not hinder the ascending female loggerheads (Fig. 10) as well as the descending hatchlings. Umbrellas should be fixed in the underground, and private umbrellas brought along by the beach visitors should be forbidden, because they could harm an unmarked nest when stuck into ground. The lights along the promenade should be shielded better, so that they do not pollute the beach so much, and flashing laser light shows should be banned.

The information status of not only tourists but also local inhabitants is no doubt of crucial importance: a study from 2011 showed that, out of 86 people, 38% did not know that *Caretta caretta* uses Çaliş Beach as a nesting site (Rößler 2011). The importance of the communication between the field course team and the local residents was demonstrated perfectly in case of nest CS6. Due to the information provided by a resident the nest could be found and marked with a metal cage. The cooperation of Turkish and Austrian students in this endeavour is therefore really a great benefit because together we can reach a wider spectrum of different nations.

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APPENDIX

Fig.7: Track of an adult *Caretta caretta* on the beach.
Abb.7: Spur einer adulten *Caretta caretta* am Strand.
Quelle: E. Hollergschwandtner 2012

Fig.8: A new metal cage model (right) has been provided this year. The old model (left) has a flexible plastic net at the bottom and was still used when hatching started.
Abb.8: Dieses Jahr wurde ein neues Käfigmodell zur Verfügung gestellt (rechts). Käfige des alten Types (links) sind mit einem verstellbaren Platiknetz am Boden ausgestattet und wurden während der Schlupfphase benutzt
Quelle: S. Wagner & S. Birngruber 2012

Fig.9: A dead *Caretta caretta* was washed ashore on Çaliş Beach. It died of swallowing a plastic net.
Abb.9: Eine tote *Caretta caretta* wurde in Çaliş angeschwemmt. Sie starb am Verschlucken eines Plastiknetzes.
Quelle: S. Birngruber 2012

Fig.10: A *Caretta caretta* made her way through the sunbeds to make a nest in front of Caretta Beach Club.
Abb.10: Eine *Caretta caretta* bahnte sich ihren Weg, vorbei an den hinderlichen Sonnenliegen, um ein Nest vorm Caretta Beach Club anzulegen.
Quelle: M. Lambropoulos 2012

Nesting activity of the Loggerhead Sea Turtle, *Caretta caretta,* on the beaches Yaniklar and Akgöl on the Turkish Mediterranean coast, 2012

Ulrike Pilwax & Oliver Macek

KURZFASSUNG

Die Strände von Fethiye gehören zu den wichtigsten Nistplätzen der Meeresschildkröte *Caretta caretta* (Özdemir et al., 2007). 1988 wurden sie als „Special Protected Areas" ausgewiesen. Dieses Jahr, vom 1. Juli bis zum 15. September, arbeiteten österreichische Studenten der Universität Wien mit der Universität Pamukkale zusammen. Es wurden wichtige Daten über Nester, Hatchlinge und gesichtete, adulte Weibchen von *Caretta caretta* sowie anthropogene Einflüsse am Strand aufgenommen.

Obwohl nur 7 adulte *Caretta caretta*- Weibchen gesichtet wurden, konnten an den Stränden Yaniklar und Akgöl insgesamt 76 Nester gezählt werden. Angesichts der 19-jährigen Beobachtung, unterstützt diese Anzahl den sinkenden Trend der Nestpopulation. Die durchschnittliche Entfernung eines Nests zum Meer betrug ca. 20 m in Yaniklar (n= 48) und 19 m in Akgöl (n= 28). Vom Projektbeginn bis zum 29. Juli wurden insgesamt 70 Spuren von adulten *Caretta caretta*- Weibchen in Yaniklar und 47 in Akgöl gemessen. Von diesen Spuren beinhalteten 9 in Yaniklar und 10 in Akgöl einen erfolgreichen Nistversuch. Nicht nur die Anzahl, sondern auch die Verteilung der Nester (Akgöl besitzt einen Abschnitt mit hoher Nestdichte) weist möglicherweise auf die Entwicklung einer verminderten Strandqualität, auf Grund wachsenden Tourismus und vermehrter Strandveränderungen, hin.

ABSTRACT

Fethiye Beach represents one of the most important nesting sites of *Caretta caretta* (Özdemir et al., 2007) and was designated a Special Protected Area in 1988. This year, from 1 July until 15 September, Austrian students from the University of Vienna worked together with the Pamukkale University. Key data about nests, hatchlings and encountered adult females of *Caretta caretta* and also about anthropogenic disturbances were collected.

Although only 7 adult *Caretta caretta* females were encountered, a total of 76 nests were recorded at the beaches of Yaniklar (48) and Akgöl (28). The overall numbers seem to support a decline in the nesting population over the 19 years of observation. The average distance of a nest to the sea was about 20 m in Yaniklar and 19 m in Akgöl. From 1 July until

the 29 July a total of 70 tracks in Yaniklar and 47 in Akgöl were discovered. Of those tracks, 9 in Yaniklar and 10 in Akgöl included a successful nesting attempt. Not only the number, but also the distribution of the nests (Akgöl has a nesting hotspot) probably reflect a development indicating a decreasing beach quality caused by increasing tourism and anthropogenic beach modifications.

INTRODUCTION

As every year since 1994, students of the University of Vienna are invited by a Turkish university to assist in the fieldwork in Fethiye. Within the Sea Turtle Project, they work together to protect the nesting population of *Caretta caretta* (Loggerhead turtle) which is listed as globally endangered according to IUCN Red List categories (IUCN, 2012).

Fethiye Beach represents one of its most important nesting sites (Özdemir et al., 2007) and was designated a Special Protected Area in 1988. In the Mediterranean, loggerheads emerge primarily on beaches fronted by mostly sandy beaches, such as those that are still present along some parts of Yaniklar and Akgöl (Miller et al., 2003).

Nevertheless, beach furniture management, litter, light pollution and the presence of people and vehicles on the beaches at night still pose a threat to the nesting populations of the loggerhead turtle and remain unresolved (Medasset, 2011). The evidence for light pollution as a threat to the sea turtle was provided by Witherington and Martin (1996): they determined that artificial lighting on beaches tends to deter the turtles from emerging from the sea to nest. Like light pollution, vehicles on the beach and other anthropogenic disturbances were also confirmed in 2012 by the observations of students of this sea turtle field course.

In terms of the 18-year-long monitoring of the nesting population in Fethiye, the 62 nests found in 2011 makes last year the one with the lowest number of nests since 1994 (Stachowitsch & Fellhofer, 2011).

Also this year, from 1of July until 15 September, Austrian students worked together with the Pamukkale University. Key data about nests, hatchlings and encountered adult females of *Caretta caretta* and also about anthropogenic disturbances were collected. These data are useful in detecting a potnetial declining trend of loggerhead turtle nesting. At the same time, protective measures were taken in order to at least maintain the status quo of the recent nesting population.

MATERIAL AND METHODS

Two beaches, Yaniklar and Akgöl were observed by students of the University of Vienna between 1 July and 15 September. Two groups, each optimally consisting of three persons, split up at Onur camp either to monitor Akgöl Beach (1.5 km) or the other direction, Yaniklar Beach (4.8 km), which ends at Karatas Beach. We did our surveys in the early morning and at night, until the first nest hatched. After the beach work, we transcribed our collected data from our notebooks to the data sheets.

Night shifts

We monitored the two beaches every night from 10 pm until 2 am. After the first hatching nest was sighted (14 July at Akgöl and 17 July at Yaniklar), we stopped our surveys at night. This was done to reduce the risk of not seeing little hatchlings and stepping on them in the dark. Both beaches were observed four times a night. We monitored the beach for one length, waited for 30 minutes, returned to the starting point, took a second break and repeated the whole procedure. At Yaniklar, we always turned around at the "lonely tree" landmark instead of going the whole way, which would have been too long and would have required crossing a stream in the dark. The team, usually consisting of three persons, patrolled parallel to the waterline, each person at a different height. This increased our chances of finding a turtle without using any light sources. When we encountered a turtle on the beach, we observed it patiently and tried to stay out of its field of vision to avoid any disturbance. After making sure that the turtle finished nesting, one person measured curved carapace length and width with a measure and straight carapace length and width with a wooden sliding caliper. Torch lights were used only to read the values and write them down into our notebook, taking care to keep the light out of the female's field of vision. After the measurements, we counted potential epibionts or injuries on the turtle's carapace and checked its front flippers for a tag. In case we found a tag, we had to note its number and inform our Turkish partners, who would then contact the appropriate authority (based on the tag's number).

Morning shifts

Morning shifts started at 5:30 or 6:00 am and took as long as we had work to do; sometimes we returned only at 11 am. Usually two people observed the beach in a line, each at a different height.

In the morning we searched for tracks that female turtles had left at night and also for possible associated nests. We also checked nests that had already been found for stones inside and for possible hatching tracks.
If a track was found, we measured track length, track width and its distance to the sea (either from the nest or from the farthest body pit to the sea, or from the farthest track spot to the sea.) The measurements were taken with a 30-m or 50-m-long measuring tape. Additionally, based on the track shape, we made a note of body pits, swimming movements and the direction in which the turtle crawled over the beach.
When all data was collected, we smoothed over the track in order to avoid counting the same track twice. Back in the camp, we transcribed our data from the notebook to the data sheets.
Measuring and marking nests
Found nests were marked with a semicircle of stones around it and a wooden stick, stuck into the sand, behind them. On some of these stones we wrote the nesting date and the consecutive nesting number, for example A 1 for Akgöl or Y 1 for Yaniklar. We left only one labeled stone with the number facing upward because beach visitors were often attracted by the labeled stones and took them away.
Additionally, we tied two small sticks together and buried them, the string always at an angle of 90 degrees to the sea, near the nest surface. If a nest was lost, we dragged a metal rod ("Sis") through the sand where the nest was expected to be, and the string entangled itself on the Sis. The connecting string should be as long as possible, for example 40 cm, to give us the best chance of finding the nest.
On touristic beach parts we tied three wooden sticks together, like a tent, marked it with our "attention sheets" and put it over our nest. Moreover, on touristic beach parts it is very important that the nests are regularly triangulated. This helps us relocate them if visitors throw the stones or sticks away.
So-called secret nests were marked as AS for Akgöl or YS for Yaniklar. They were only called secret nests if they were detected by our Turkish colleagues prior to the arrival of the first Austrian students or were found when they started to hatch. Such nests were detected in the morning shifts because we carefully watched out for hatching tracks and traced them back to their origin.

Hatcheries

Some turtles laid their nests very close to the waterline. Unfortunately, such nests could become flooded there, so we moved these nests a few meters away from their original position.

First, we looked for a suitable new nest position. Then, we opened the nest chamber and excavated the eggs to put them in buckets. A note of the egg count and chamber dimensions was made. We then dug the new nest chamber which was as deep and wide as the original one. That should ensure that the eggs have similar brooding conditions as they had in their natural egg chamber before.

Next, we placed the eggs into the new egg chamber. While doing so, it was important to put them in the exact same position and order in which they were removed.

Finally, the new nest was named and marked the same as the old one. (see "Gimpl, this volume)

RESULTS

The raw data of all nests as well as tracks on the beaches of Akgöl and Yaniklar are included in Appendix.

Nests

In the year 2012, a total number of 76 nests were recorded at the beaches of Yaniklar and Akgöl. Compared to the 44 nests in last year (2011) 76 nests was a higher number of nests, but overall a steady decrease over the last 18 years is evident (Fig. 1).

The majority of the nests were located in Yaniklar (48), while 28 nests were discovered in Akgöl (Fig. 1). This year about 24% of those nests had a known nesting-date (Y1-Y8 & A1-A10); the other 76% were designated as "secret nests" (with an unknown date on which the nests were laid). The nests were not evenly distributed, depending on the different areas of the beaches (e.g. hotspot, near buildings, etc.)

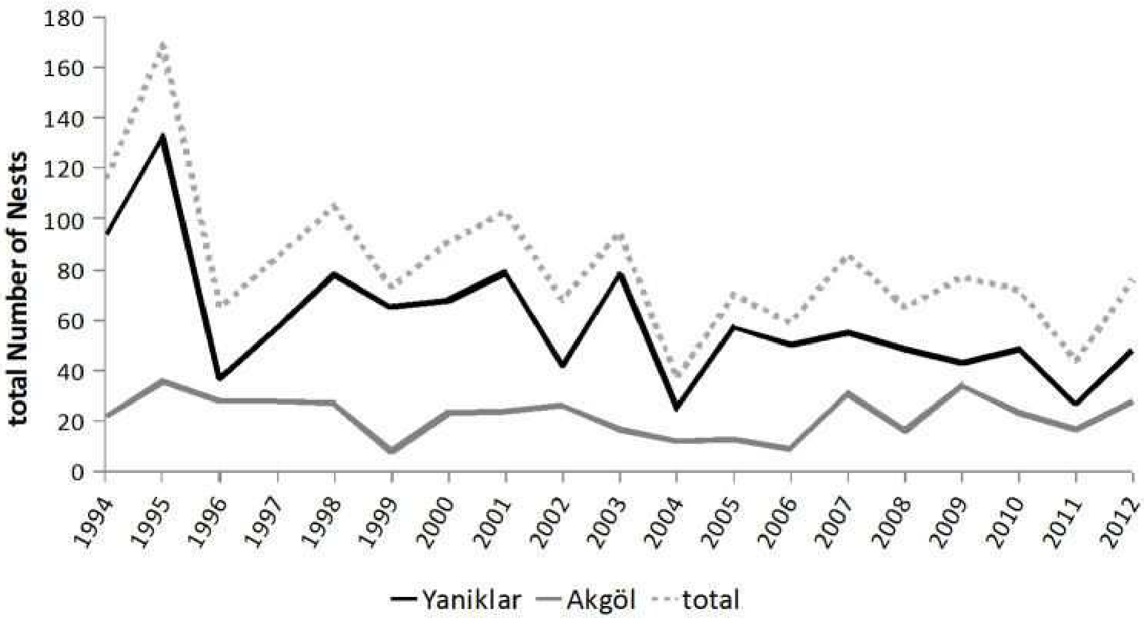

Fig. 1: Number of nests on Yaniklar and Akgöl Beach from 1994 to 2012
Abb. 1: Anzahl der Nester auf den Stränden Yaniklar und Akgöl seit 1994 bis 2012

The average distance of a nest to the sea was about 20 m in Yaniklar (n=47) and 19 m in Akgöl (n=28) (Fig. 8). The distance to the sea was divided in three different zones (wet, moist & dry). The total number of nests (73) had average distances of 1.4 m (±0.59 m) in the wet; 1.7 m (±1.29 m) in the moist and 16.6 m (±7.22 m) in the dry zone. Two of the nests were dug within only 8.3 m (A 7) and 4.3 m (A 8) distance to the sea. Those nests were relocated in the form of a hatchery to 19.4 m (A 7) and 11.1 m (A 8) distance to the sea.

The nests were not evenly distributed. Near the hotels, no nests were found. Five YS-nests near Cafe1 and AS18 (in front of Yonca Lodge) were the only nests near buildings. Beyond the "lonely tree" in Yankilar, only a few nests were located. The hotspot in Akgöl was located at the "bay" at the end of the beach. (Figs. 2-7)

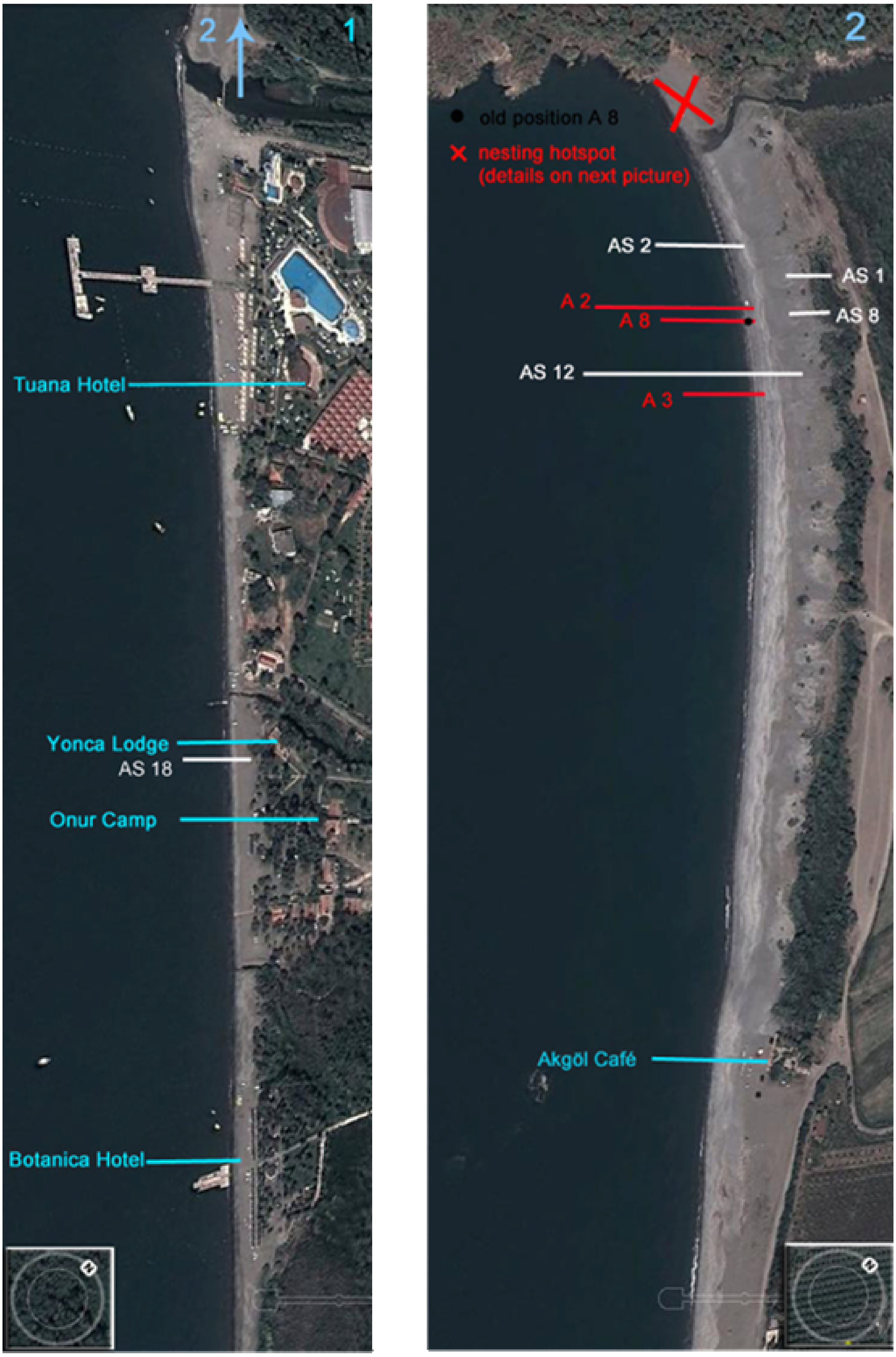

Fig. 2: Buildings (turquoise) and locations of *Caretta caretta* nests (red & white) on Akgöl Beach during the nesting season 2012. Black dot describes original location of A8 nest. Red cross describes nesting hotspot. Perspective: 500 m height. (maps.google.at)
Abb. 2: Gebäude (türkis) und Lage der *Caretta caretta*- Nester (rot & weiß) in Akgöl während der Nistsaison 2012. Schwarzer Punkt markiert alte Position des A8-Nestes. Rotes Kreuz markiert hohe Nestdichte. Ansicht aus 500 m Höhe. (maps.google.at)

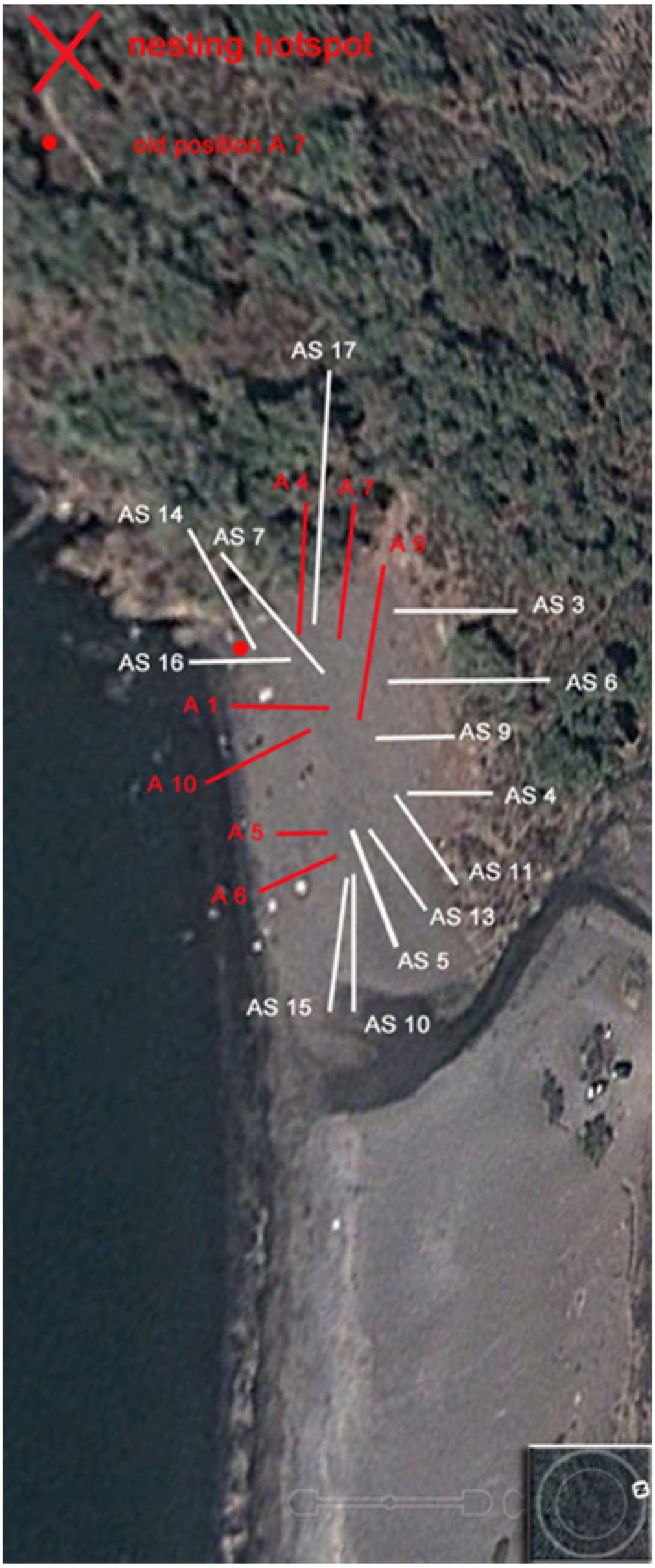

Fig. 3: Location of *Caretta caretta* nests (red & white) of the "nesting hotspot", the "bay" of Akgöl Beach. Red dot describes original position of A7 nest. Perspective: 500 m height. (maps.google.at)
Abb. 3: Lage der *Caretta caretta*- Nester (rot & weiß) des letzten Strandabschnitts (mit hoher Nestdichte) in Akgöl. Roter Punkt markiert alte Position des A7- Nestes. Ansicht aus 500 m Höhe. (maps.google.at)

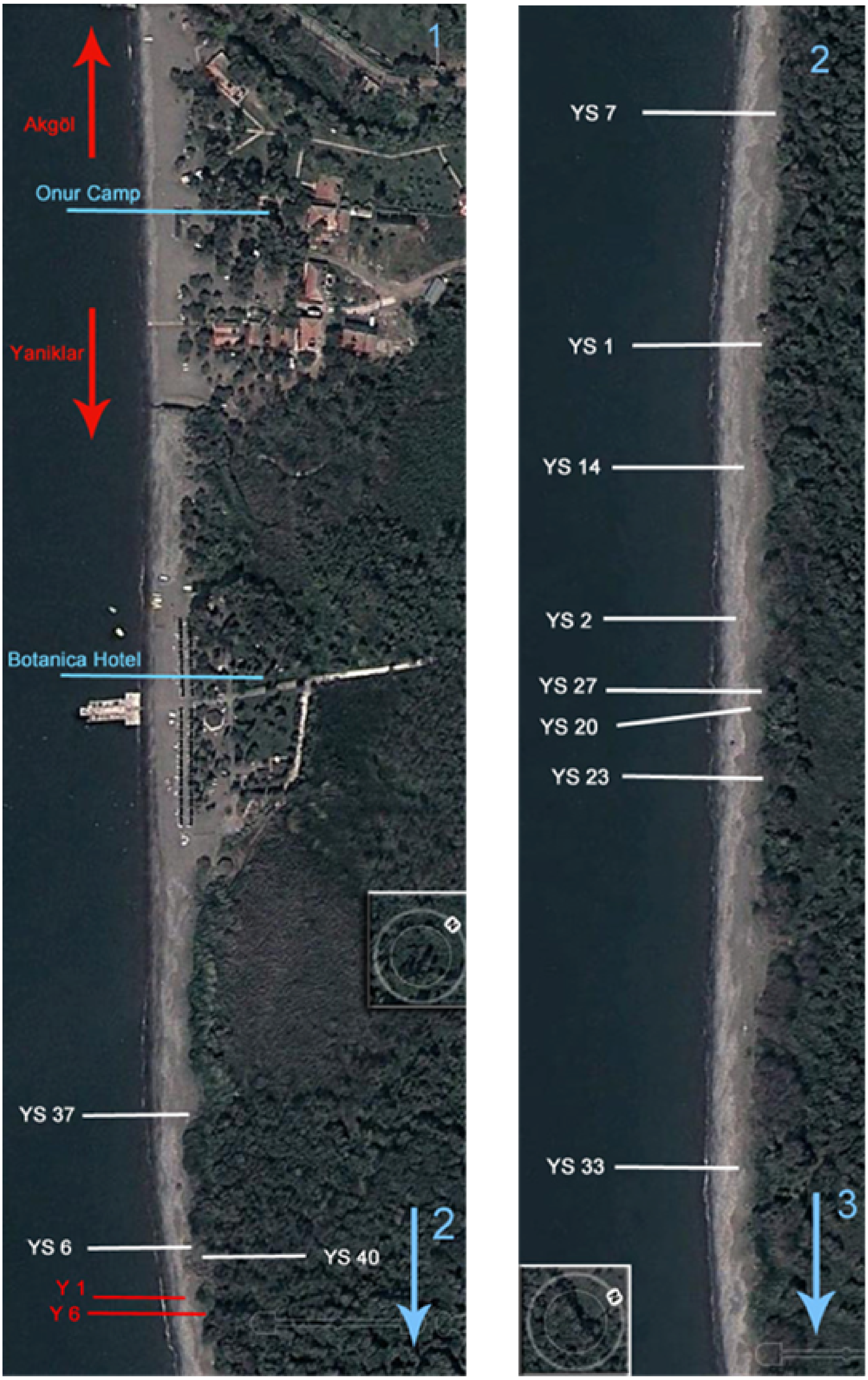

Fig. 4: Hotels (turquoise) and locations of *Caretta caretta* nests (red & white) on Yaniklar Beach during the nesting season 2012. Perspective: 500 m height. (maps.google.at)
Abb. 4: Hotels (türkis) und Lage der *Caretta caretta*- Nester (rot & weiß) in Yaniklar während der Nistsaison 2012. Ansicht aus 500 m Höhe. (maps.google.at)

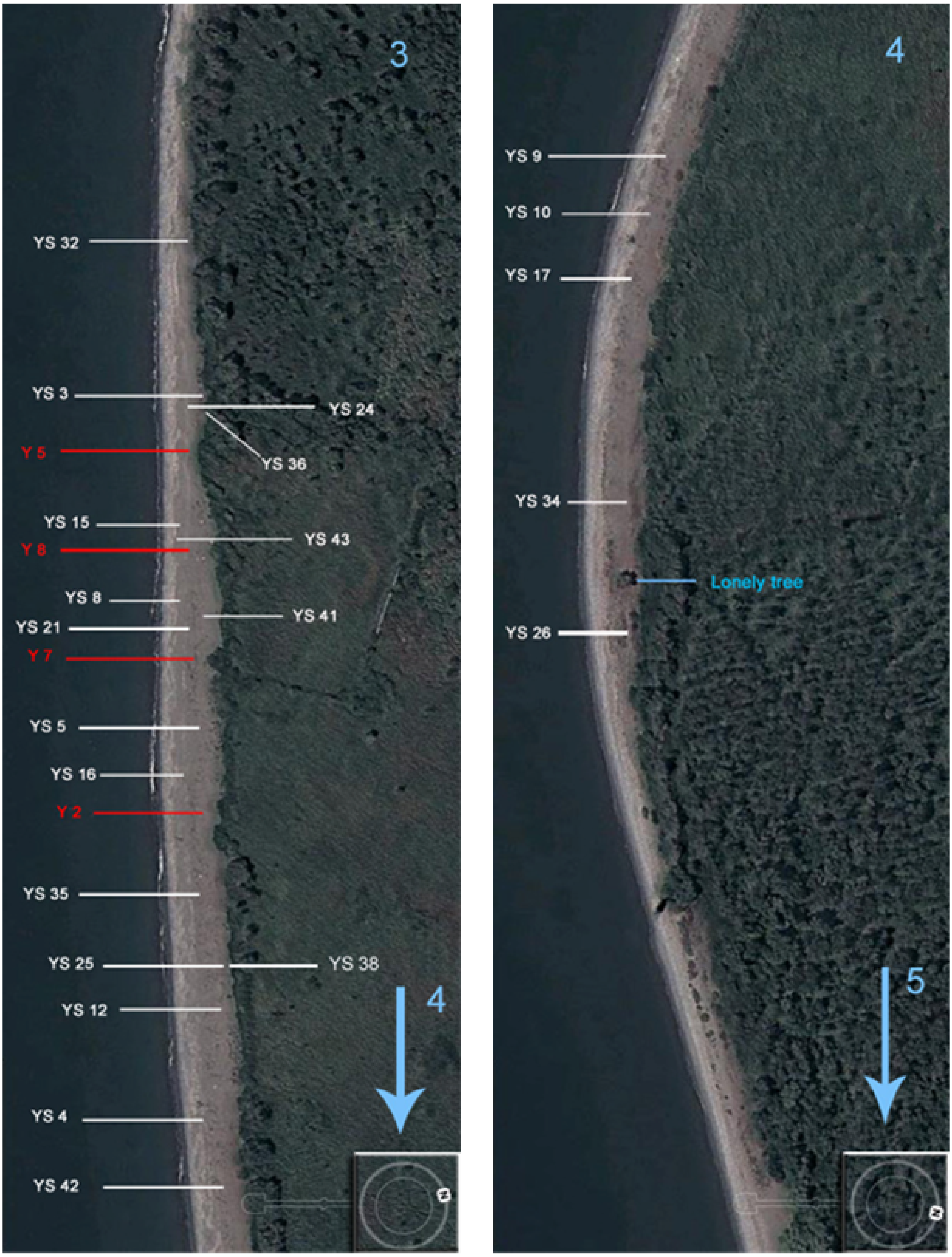

Fig. 5: Locations of *Caretta caretta* nests (red & white) & the landmark “lonely tree” (turquoise) on Yaniklar Beach during the nesting season 2012. Perspective: 500 m height. (maps.google.at)
Abb. 5: Lage der *Caretta caretta*- Nester (rot und weiß) & der Markierungspunkt „lonely tree“ (türkis) in Yaniklar während der Nistsaison 2012. Ansicht aus 500 m Höhe. (maps.google.at)

Fig. 6: Buildings (turquoise) and locations of *Caretta caretta* nests (red & white) on Yaniklar Beach during the nesting season 2012. Perspective: 500 m height. (maps.google.at)
Abb. 6: Gebäude (türkis) und Lage der *Caretta caretta*- Nester (rot & weiß) in Yaniklar während der Nistsaison 2012. Ansicht aus 500 m Höhe. (maps.google.at)

Fig. 7: Karatas coffee bar (turquoise) on Yaniklar Beach and the monitoring area Karatas Beach (red), without nests, during the nesting season 2012. Perspective: 500 m height. (maps.google.at)
Abb. 7: Karatas-Café (türkis) in Yaniklar und das Untersuchungsgebiet Karatas-Strand(rot), ohne Nester, während der Nistsaison 2012. Ansicht aus 500 m Höhe. (maps.google.at)

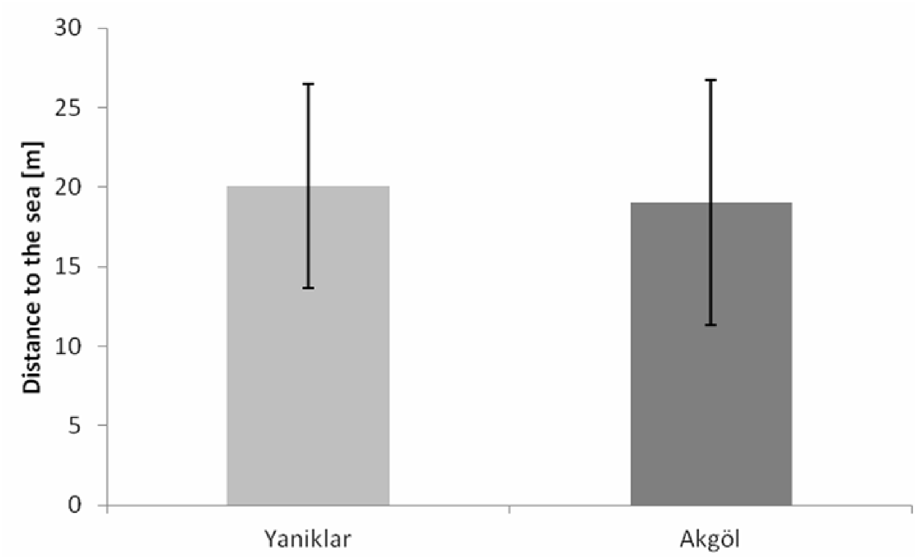

Fig. 8: Average distance to the sea of the nests including standard deviation on Yaniklar and Akgöl Beach
Abb. 8: Mittlere Entfernung der Nester zum Meer inklusive Standardabweichung auf den Stränden Yaniklar und Akgöl

Tracks

In the morning shifts from the 1 July until the 29 July we discovered a total of 70 tracks in Yaniklar and 47 in Akgöl. Only a small number (9 in Yaniklar and 10 in Akgöl) of those tracks included a successful nesting attempt (Fig. 9).

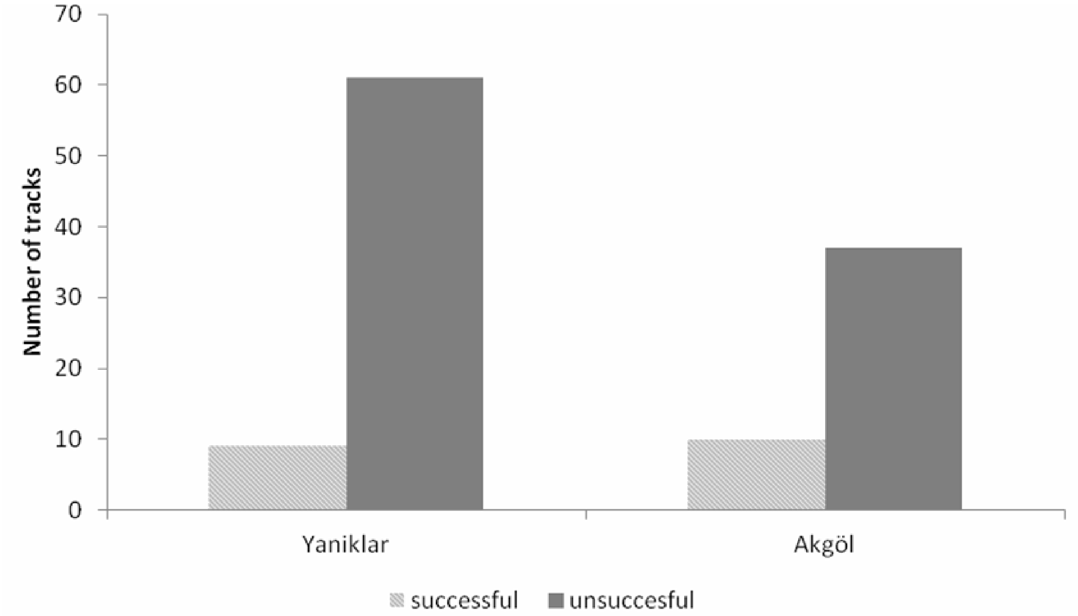

Fig. 9: Number of tracks distinguished into successful nesting attempts and without successful nesting attempts on Yaniklar and Akgöl Beach
Abb. 9: Anzahl der Spuren getrennt in erfolgreiche Nistversuche und ohne erfolgreiche Nistversuche auf den Stränden Yaniklar und Akgöl

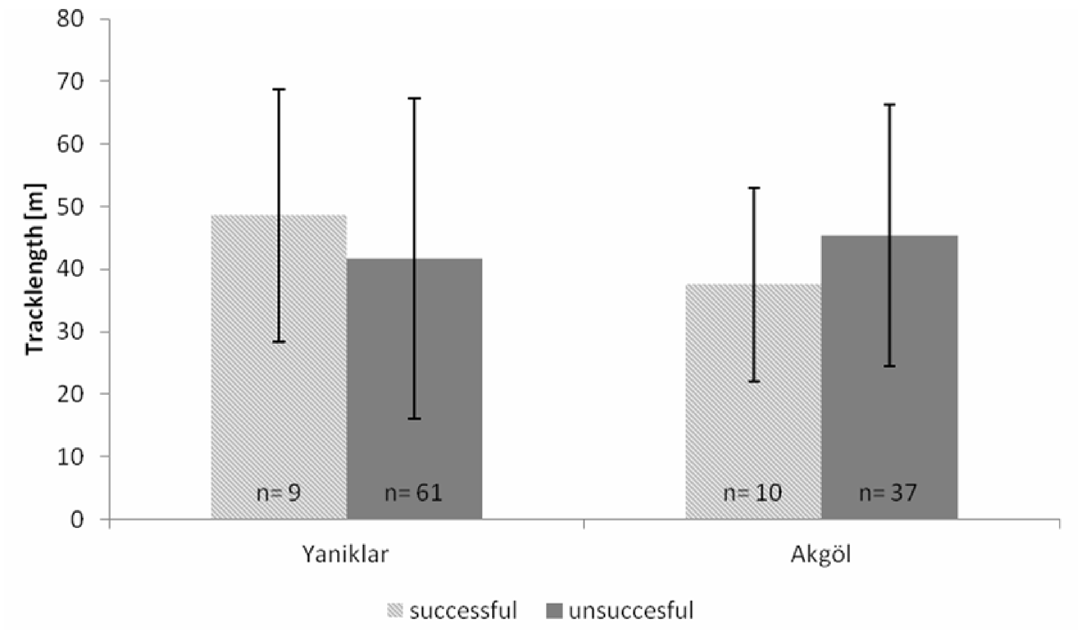

Fig. 10: Average track length including standard deviation, diistinguished into successful nesting attempts and without successful nesting attempts on Yaniklar and Akgöl Beach
Abb. 10: Mittlere Spurenlänge inklusive Standardabweichung, getrennt in erfolgreiche Nistversuche und ohne erfolgreiche Nistversuche auf den Stränden Yaniklar und Akgöl

The number of body pits and "started chambers" before the female successfully nested was higher in Yaniklar than in Akgöl, while the number of body pits was near 1 per every second track in Yaniklar and Akgöl for tracks without successful nesting. The number of "started chambers" per track was higher in Yaniklar (25%) than in Akgöl (14%) (Tab. 1).

The track width ranged from 0.36 to 0.83 m, with an average of 0.63 m.

Tab. 1: Total number of body pits and started chambers on Yaniklar and Akgöl differentiated into the categories of tracks with successful nesting attempts (= successful) and without successful nesting attempts (= unsuccessful).
Tab. 1: Gesamtanzahl der body pits und angefangenen Eigruben in Yaniklar und Akgöl, getrennt in die Kategorien- Spuren mit erfolgreichem Nistversuch (=successful) und ohne erfolgreichem Nistversuch (=unsuccessful).

beach	Trackcategorie (total)	body pits	started chamber
Yankilar	successful (n=9)	4	3
Yankilar	unsuccessful (n=61)	34	15
Akgöl	successful (n=10)	2	0
Akgöl	unsuccessful (n=37)	19	5

Adults

This year we encountered 7 adult *Caretta caretta* females during the night shift. None of those females had any tags for a clear identification of the individual. We recorded their habitus, including the carapace dimensions and possible epibionts. The average data for the straight measurements were 69.7 cm length and 47.2 m width. The curved carapace measures were 77.7 cm length and 70.6 cm width (Fig. 11).

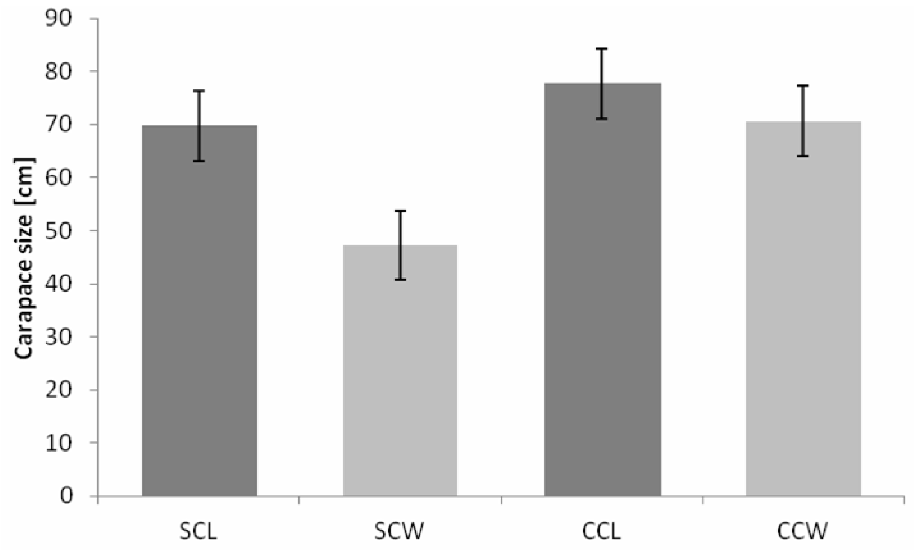

Fig. 11: Carapace measurements of adult females (in cm) including standard deviation (n=7); SCL straight carapace length, SCW straight carapace width, CCL curved carapace length, CCW curved carapace width.
Abb. 11: Panzerabmessungen der adulten Weibchen (in cm) inklusive Standardabweichung (n=7); SCL gerade Panzerlänge, SCW gerade Panzerbreite, CCL gekrümmte Panzerlänge, CCW gekrümmte Panzerbreite.

DISCUSSION

The 2011 report of the sea turtle field course stated: "As a result of the 18-year long monitoring of the nesting population in Fethiye, a declining trend of loggerhead turtle nesting population is observable" (Schraml, 2011). Those results still match this year's observation. Last year (2011) we had the second lowest number of nests (46) in 19 years of monitoring. Although this year's nest number is higher (76), it is the same amount as in the poor years before the major drop in 2004 (Fig. 1). It is known that *Caretta caretta* lays eggs every 3-4 years, so probably this natural phenomenon explains a part of those fluctuations (Margaritoulis, 2005). Other potential reasons for the decreasing numbers of nests and adult turtles are most likely industrial fishing, marine pollution, tourism and destruction of the nesting habitats. One key problem is commercial fishing, which kills adult turtles and reduces the odds of survival for juvenile ones as well. Due to by-catch in the Mediterranean, probably over 44,000 sea turtles are killed each year (Casale, 2011). As part of the marine pollution, plastic bags pose a big problem because *Caretta caretta* confuses them with jellyfish, an important food item. Our monitoring mainly dealt with the nesting behaviour of *Caretta caretta* and the problems of tourism which contributes to the destruction of the nesting habitat.

During night shifts we encountered 7 turtles emerging onto the beach and searching for a nest position. The 117 tracks also provide information about the nesting behaviour by *Caretta caretta* (Fig. 9). Only every seventh track included a nest on Yaniklar; in Akgöl it was about every fifth track. The tracks also provided information based on their length. "Successful tracks" (including a nest) in Akgöl were quite short (average 37.6 m) compared to Yaniklar (average 48.6 m), whereas the "unsuccessful tracks" (without nest) varied strongly, peaking at 158.3 m in Yaniklar (Fig. 10). Moreover, the number of body pits and started chambers also showed a difference in the beaches: Yaniklar had a higher number of such activities (Tab. 1).

The above information helps describe the complexity of finding an optimal nesting spot. It has to be a place far enough from the tidal zone to protect the nest from wave erosion and from too much humidity in the nest chamber, caused by high tides. The other component regarding distance is that, because the hatchlings emerge from the nest and must crawl to the sea, the distance should not be too long, to avoid predators (Miller et al., 2003). The nest efficiency depends on the moisture of the substrate and particle size of the sand, two factors contributing to the best environment for hatchling development (Ilgaz et al., 2012). All those factors were tested by the female individuals, mainly by body pits and swimming movements on the sand surface. When the right location was found, the turtle would start digging the chamber. Still, sea turtles will abandon nesting attempts when they encounter digging impediments, large structures, unsatisfactory thermal cues, or human disturbance (Witherington & Martin, 1996).

A 7-year observation by Kaska et al. (2010) indicates that most females nest on "undeveloped" parts of the beach. Negative factors such as water sports, light from hotels, beach rocks and vegetation direct the turtles to undisturbed places on the beach. Those factors are quite differently present on Yaniklar and Akgöl Beach areas. This leads to a wide-ranging distribution of nests (Figs. 2-7). In Akgöl over 70% of the nests were located at the nesting hotspot in the "bay" (Fig. 3); some had even less than 1 meter distance between each other. In Yaniklar the majority were before the lonely tree (Figs. 4-7). In front of the hotels no nest or track was found during the whole observation period. Only seven nests were located near the few smaller buildings on the beach. This year, Karatas Beach was free of nests (as opposed to most past years), which could be interpreted as an effect of the changing beach quality. Factors that discourage nesting include: artificial lighting (Witherington & Martin, 1996**)** and sand introduced as part of beach “renourishment” programs, which increase compaction or hardness of the substrate (Miller et al., 2003). Such factors were evident in front of the hotels, where no nests were found. Also the substrate quality is one important indicator of nesting activity, in particular the particle size of the sand (Ilgaz et al., 2012). Since the beach of Yaniklar had many large stones in the initial zone and only the second zone was sandy, the the nest distance to the sea ranged from 10.7 m (Y 1) to 42.0 m (YS 13) with an average of 20 m. In Akgöl the average nest distance to the sea was 19 m (Fig. 8). Two of the nests were placed in the moist zone (A 7, A 8). Those nests were relocated as a hatchery to increase the chance for the hatchlings’ survival and avoid a flooding of these nests.

There were many disturbances on the beach that could influence the behaviour and decisions of the female turtles. Of the seven adults we observed, only one showed successful nesting (A 4). The others were apparently disturbed by litter, tourists, cars, or reasons that are not obvious. While searching for a nesting place on the beach, a loggerhead is easy disturbed by activity on the beach (Miller et al., 2003). Whatever the cause(s), the turtle usually returns the same night or a following night for a further nesting attempt.

Caretta caretta is considered to be a philopatric animal, meaning it will tend to re-nest in relatively close proximity (0–5 km) to the region of its birth (Miller et al., 2003). We took measurements and information about the carapace condition (Fig. 5). That information could be used for a long-term observation and potential recognition of individual animals.

Our project shows the importance of suitable nesting-places for *Caretta caretta*, which should contain a natural sandy beach zone in close distance to the sea, be free of tourism (at least for the night), have no (artificial) lights towards the sea and no litter on the beach.

Especially such places (for example Akgöl bay) need protection and maintenance for the sake of the *Caretta caretta* population. Protection starts with knowledge and its transmission. To mention one example: One information sign was installed on the nesting beach in Yaniklar in 2011. Instead, a more appropriate location would be at the entrance of the beach or at the hotels so that the public is informed about the existing regulations of the Special Protected Area prior to their entry (Medasset, 2011). At the 2012 nesting season, all signs were either damaged or, as in Yaniklar, had disappeared completely and were not reintroduced.

Until now, several protection measures have been taken in Yaniklar and Akgöl.

To increase their efficiency, permanent maintenance and monitoring is required.

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APPENDIX

Tab. 2: Annual number of nests in Akgöl and Yaniklar from 1994-2012.
Tab. 2: Jährliche Anzahl der Nester in Akgöl und Yaniklar von 1994 bis 2012.

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

Tab. 3: Nesting data Yaniklar; Y = nest Yaniklar; YS = secret nest Yaniklar; - = no data available
Tab. 3: Nestdaten von Yaniklar; Y = Nest Yaniklar, YS = secret nest Yaniklar; - = keine Daten vorhanden

		Distance to the sea [m]			
Date	Nest Nr	total	Wet	Moist	Dryzone
02.07.12	Y 1	10,7	1,0	1,0	8,7
04.07.12	Y 2	24,2	1,4	1,5	21,3
04.07.12	Y 3	43,4	1,3	0,9	41,2
05.07.12	Y 4	27,5	1,1	2,4	24,1
09.07.12	Y 5	21,5	1,3	1,2	19,0
12.07.12	Y 6	15,1	1,3	1,4	12,4
16.07.12	Y 7	22,8	1,7	1,3	19,8
24.07.12	Y 8	19,8	0,8	0,8	18,3
-	YS 1	15,2	0,9	1,0	13,3
-	YS 2	14,5	1,0	0,5	13,0
-	YS 3	16,5	1,0	0,5	15,0
-	YS 4	18,7	0,7	1,2	16,8
-	YS 5	21,0	0,8	0,4	19,8
-	YS 6	18,8	1,0	1,5	16,3
-	YS 7	30,3	1,0	1,3	28,0
-	YS 8	16,0	1,2	2,2	12,6
-	YS 9	18,7	0,7	2,1	15,9

Tab. 3: Nesting data Yaniklar; Y = nest Yaniklar; YS = secret nest Yaniklar; - = no data available
Tab. 3: Nestdaten von Yaniklar; Y = Nest Yaniklar, YS = secret nest Yaniklar; - = keine Daten vorhanden

		Distance to the sea [m]			
Date	Nest Nr	total	Wet	Moist	Dryzone
-	YS 10	16,6	1,2	1,4	14,0
-	YS 11	21,6	1,0	0,7	19,9
-	YS 12	24,0	1,4	2,0	20,6
-	YS 13	42,0	1,0	1,2	39,8
-	YS 14	18,5	0,7	0,9	16,9
-	YS 15	12,0	1,3	2,0	8,7
-	YS 16	21,4	1,0	0,9	19,5
-	YS 17	13,3	1,2	2,0	10,0
-	YS 18	20,0	1,1	1,3	17,6
-	YS 19	21,9	2,6	1,0	18,3
-	YS 20	15,0	1,1	1,3	12,6
-	YS 21	12,5	1,9	2,8	7,9
-	YS 22	21,0	0,8	2,8	17,4
-	YS 23	23,6	2,1	1,9	19,6
-	YS 24	15,0	1,2	1,2	12,6
-	YS 25	22,7	1,2	1,2	20,3
-	YS 26	18,0	1,3	1,4	15,3
-	YS 27	21,6	-	-	-
-	YS 28	23,8	1,1	1,2	21,5
-	YS 30	24,8	1,0	0,4	23,4
-	YS 32	16,4	1,2	1,0	14,2
-	YS 33	20,4	1,2	1,0	18,2
-	YS 34	20,0	1,5	0,1	18,4
-	YS 35	22,3	0,6	0,1	-
-	YS 36	13,4	1,2	0,8	11,4
-	YS 37	16,8	1,9	1,3	13,6
-	YS 38	14,3	2,2	1,3	10,8
-	YS 40	-	-	-	-
-	YS 41	24,4	1,7	9,5	13,2
-	YS 42	15,0	-	-	-
-	YS 43	16,6	1,3	4,1	11,2

Tab. 4: Nesting data Akgöl; A = nest Akgöl; AS = secret nest Akgöl; - = no data available; * =nest got relocated
Tab. 4: Nestdaten von Akgöl; A = Nest Akgöl, AS = secret nest Akgöl; - = keine Daten vorhanden; * =Nest wurde verlegt

		Distance to the sea [m]			
Date	Nest Nr	total	Wet	Moist	Dryzone
01.07.12	A 1	17,0	1,5	1,0	14,5
02.07.12	A 2	11,2	1,1	2,1	8,0
03.07.12	A 3	14,6	1,2	1,1	12,3
07.07.12	A 4	13,7	2,1	1,2	10,4

Tab. 4: Nesting data Akgöl; A = nest Akgöl; AS = secret nest Akgöl; - = no data available; * =nest got relocated

Tab. 4: Nestdaten von Akgöl; A = Nest Akgöl, AS = secret nest Akgöl; - = keine Daten vorhanden; * =Nest wurde verlegt

		Distance to the sea [m]			
Date	Nest Nr	total	Wet	Moist	Dryzone
10.07.12	A 5	14,4	1,1	1,5	11,8
11.07.12	A 6	16,0	1,6	3,4	11,0
11.07.12	A 7 *	8,3	1,3	1,2	5,8
14.07.12	A 8 *	4,3	1,8	1,7	0,8
15.07.12	A 9	23,5	1,1	1,8	20,6
27.07.12	A 10	14,6	2,5	2,0	10,1
-	AS 1	28,2	1,0	2,4	24,8
-	AS 2	12,6	0,6	3,0	9,0
-	AS 3	27,5	1,9	2,3	23,3
-	AS 4	30,0	1,3	1,5	27,2
-	AS 5	16,0	1,5	3,1	11,4
-	AS 6	26,2	1,1	1,8	23,3
-	AS 7	19,0	1,0	1,5	16,8
-	AS 8	29,1	0,4	1,1	27,6
-	AS 9	26,7	1,7	2,7	22,3
-	AS 10	17,0	1,6	2,3	13,1
-	AS 11	29,5	2,9	1,8	24,8
-	AS 12	36,0	1,1	1,4	33,5
-	AS 13	21,8	2,6	4,6	14,6
-	AS 14	10,2	4,0	0,6	5,6
-	AS 15	18,2	2,3	3,4	12,8
-	AS 16	13,4	1,3	3,4	8,8
-	AS 17	13,5	1,2	1,4	10,9
-	AS 18	20,1	1,1	3,2	15,8

Table 5: Emergences in Yaniklar; Y = nest Yaniklar; YS = secret nest Yaniklar; - = no data available

Tab. 5: Landgänge in Yaniklar. Y = Nest Yaniklar, YS = secret nest Yaniklar; - = keine Daten vorhanden

Date	Nest Nr	Total track length [m]	Distance to the sea [m]	Nr of body pits	started chamber	Tack width [m]
02.07.12	Y 1	21.4	10.7	0	0	0.65
04.07.12	Y 2	62.2	24.2	2	0	0.65
04.07.12	Y 3	85.8	43.4	0	0	0.67
05.07.12	Y 4	63.5	27.5	1	2	0.70
09.07.12	Y 5	42.7	21.5	1	0	-
12.07.12	Y 6	31.4	15.1	0	0	0.59
16.07.12	Y 7	49.0	22.8	0	1	0.62
24.07.12	Y 8	52.0	19.8	2	1	0.56
-	YS 2	29	14.5	0	0	0.70

Date	Nest Nr	Total track length [m]	Distance to the sea [m]	Nr of body pits	started chamber	Tack width [m]
01.07.12	-	17.0	8.0	1	0	0.40
01.07.12	-	21.1	11.0	0	1	-

Table 5: Emergences in Yaniklar; Y = nest Yaniklar; YS = secret nest Yaniklar; - = no data available
Tab. 5: Landgänge in Yaniklar. Y = Nest Yaniklar, YS = secret nest Yaniklar; - = keine Daten vorhanden

Date	Nest Nr	Total track length [m]	Distance to the sea [m]	Nr of body pits	started chamber	Tack width [m]
01.07.12	-	23.8	11.9	1	0	-
01.07.12	-	31.0	16.5	0	0	0.73
01.07.12	-	42.0	21.0	1	0	-
02.07.12	-	15.1	-	0	0	0.60
02.07.12	-	18.0	-	0	0	0.62
02.07.12	-	34.3	-	1	0	0.80
02.07.12	-	61.2	-	0	0	0.53
03.07.12	-	34.9	-	0	0	0.80
03.07.12	-	67.6	-	1	1	0.67
03.07.12	-	158.3	-	2	0	0.70
04.07.12	-	37.9	-	0	1	0.65
04.07.12	-	39.6	-	1	0	0.70
04.07.12	-	47.3	-	1	0	0.61
06.07.12	-	39.0	-	2	0	0.61
07.07.12	-	8.0	4.2	0	0	0.70
08.07.12	-	32.8	-	0	0	0.59
09.07.12	-	27.7	-	0	0	-
09.07.12	-	38.8	-	1	0	0.80
09.07.12	-	43.5	-	0	0	-
09.07.12	-	43.5	-	2	0	0.83
11.07.12	-	22.5	-	0	0	0.54
11.07.12	-	24.0	-	0	0	0.55
11.07.12	-	35.0	-	0	0	0.55
11.07.12	-	37.5	-	1	1	0.60
11.07.12	-	43.4	-	1	0	0.58
11.07.12	-	54.2	-	1	1	0.62
11.07.12	-	65.0	-	4	3	0.60
12.07.12	-	39.4	-	0	1	0.59
15.07.12	-	39.6	-	1	0	0.55
15.07.12	-	40.8	-	0	0	0.58
16.07.12	-	29.9	18.1	1	0	0.58

Date	Nest Nr	Total track length [m]	Distance to the sea [m]	Nr of body pits	started chamber	Tack width [m]
16.07.12	-	38.0	16.0	0	2	0.56
16.07.12	-	42.0	21.2	2	0	0.63
16.07.12	-	53.5	25.6	2	0	0.63
16.07.12	-	107.0	-	0	0	0.56
17.07.12	-	16.0	7.4	0	0	0.70
17.07.12	-	23.4	11.0	0	1	0.58

Table 5: Emergences in Yaniklar; Y = nest Yaniklar; YS = secret nest Yaniklar; - = no data available
Tab. 5: Landgänge in Yaniklar. Y = Nest Yaniklar, YS = secret nest Yaniklar; - = keine Daten vorhanden

Date	Nest Nr	Total track length [m]	Distance to the sea [m]	Nr of body pits	started chamber	Tack width [m]
17.07.12	-	26.4	12.0	0	0	0.61
17.07.12	-	28.7	15.0	0	0	0.50
17.07.12	-	32.7	16.0	0	0	0.59
17.07.12	-	121.6	40.5	2	2	0.55
18.07.12	-	26.0	11.8	2	0	0.52
18.07.12	-	28.6	14.2	1	1	0.53
18.07.12	-	39.4	17.4	1	0	0.50
18.07.12	-	67.0	27.0	2	0	0.60
18.07.12	-	83.8	37.4	0	1	0.60
19.07.12	-	25.0	12.0	0	0	0.64
19.07.12	-	39.5	20.0	2	0	0.70
22.07.12	-	13.0	5.6	0	0	0.54
22.07.12	-	25.0	12.0	1	0	0.60
22.07.12	-	36.5	17.8	2	0	0.65
22.07.12	-	41.2	20.2	2	0	0.55
23.07.12	-	26.2	12.3	1	0	0.59
23.07.12	-	26.8	13.2	0	0	0.57
24.07.12	-	37.9	16.8	1	1	0.70
26.07.12	-	44.5	18.5	2	1	0.58
26.07.12	-	81.4	17.0	1	0	0.52
28.07.12	-	53.9	26.5	1	0	0.55
29.07.12	-	50.0	22.6	0	1	0.70

Tab. 6: Emergences in Akgöl; A = nest Akgöl; AS = secret nest Akgöl; - = no data available; * =nest relocated
Tab. 6: Landgänge in Akgöl; A = Nest Akgöl, AS = secret nest Akgöl; - = keine Daten vorhanden; * =Nest verlegt

Date	Nest Nr	Total track length [m]	Distance to the sea [m]	Nr of body pits	started chamber	Tack width [m]
01.07.12	A 1	4.6	17.0	0	0	-
02.07.12	A 2	54.9	11.2	0	0	0.57
03.07.12	A 3	40.3	14.6	1	0	0.78
07.07.12	A 4	38.2	13.7	0	0	0.50
10.07.12	A 5	37.5	14.4	0	0	0.62
11.07.12	A 6	40.7	16.0	4	0	0.67
11.07.12	A 7*	20.0	8.3	0	0	-
14.07.12	A 8*	42.6	4.3	0	0	0.70
15.07.12	A 9	57.7	23.5	0	0	0.54

Tab. 6: Emergences in Akgöl; A = nest Akgöl; AS = secret nest Akgöl; - = no data available; * =nest relocated
Tab. 6: Landgänge in Akgöl; A = Nest Akgöl, AS = secret nest Akgöl; - = keine Daten vorhanden; * =Nest verlegt

Date	Nest Nr	Total track length [m]	Distance to the sea [m]	Nr of body pits	started chamber	Tack width [m]
27.07.12	A 10	39.4	14.6	0	0	0.50
01.07.12	-	55.6	-	2	0	-
01.07.12	-	55.0	-	1	0	-
01.07.12	-	37.7	-	1	0	0.82
02.07.12	-	34.5	-	0	0	0.62
02.07.12	-	44.0	-	0	0	0.64
02.07.12	-	67.5	-	2	1	0.75
07.07.12	-	84.3	-	1	0	0.61
07.07.12	-	34.3	-	0	0	0.50
07.07.12	-	58.0	-	4	0	0.75
09.07.12	-	61.2	-	1	0	0.69
09.07.12	-	74.7	-	1	0	0.70
09.07.12	-	29.0	-	1	0	0.79
09.07.12	-	46.1	-	5	0	0.62
10.07.12	-	101.1	-	1	0	0.74
10.07.12	-	36.0	-	3	0	0.60
11.07.12	-	84.3	-	0	0	-
11.07.12	-	67.0	-	3	0	0.71
11.07.12	-	42.8	-	0	0	0.69
11.07.12	-	21.8	-	0	0	0.66
11.07.12	-	29.1	-	0	0	0.73

Date	Nest Nr	Total track length [m]	Distance to the sea [m]	Nr of body pits	started chamber	Tack width [m]
11.07.12	-	29.3	-	0	0	0.64
13.07.12	-	39.0	-	0	0	0.70
14.07.12	-	36.0	-	1	0	0.36
14.07.12	-	56.3	-	0	0	0.68
14.07.12	-	12.0	-	0	0	0.70
14.07.12	-	63.3	-	1	0	0.55
15.07.12	-	42.2	-	2	0	0.68
15.07.12	-	21.4	-	0	1	0.64
17.07.12	-	43.0	20.8	0	1	0.72
17.07.12	-	37.9	7.8	0	0	0.73
17.07.12	-	18.8	8.0	1	0	0.63
19.07.12	-	15.0	4.4	0	0	0.60
26.07.12	-	40.6	11.4	0	1	0.55
27.07.12	-	43.4	12.2	0	1	0.59
27.07.12	-	59.7	22.7	0	0	0.57

Tab. 6: Emergences in Akgöl; A = nest Akgöl; AS = secret nest Akgöl; - = no data available; * =nest relocated
Tab. 6: Landgänge in Akgöl; A = Nest Akgöl, AS = secret nest Akgöl; - = keine Daten vorhanden; * =Nest verlegt

Date	Nest Nr	Total track length [m]	Distance to the sea [m]	Nr of body pits	started chamber	Tack width [m]
27.07.12	-	45.4	21.8	1	0	0.67
29.07.12	-	11.6	4.4	1	0	0.78

Table 7: Carapace measurements of adult females (in cm). SCL straight carapace length, SCW straight carapace width, CCL curved carapace length, CCW curved carapace width; * laid nest A4
Tab. 7: Panzerabmessungen der adulten Weibchen (in cm). SCL gerade Panzerlänge, SCW gerade Panzerbreite, CCL gekrümmte Panzerlänge, CCW gekrümmte Panzerbreite; * legte Nest A4

Date	SCL	SCW	CCL	CCW	Epibionts	Deformations
Yaniklar						
09.07.12	75	50	84	79	3	0
16.07.12	68	48	79	73	0	0
Akgöl						
07.07.12 *	75	43	75	66	-	-
09.07.12	70	52.5	78	70	4	0
10.07.12	64	38	78	62	3	0
11.07.12	68	48	76	76	9	0
14.07.12	68	51	74	68	0	0

Caretta caretta hatchlings in Çalış 2012

Natalie Beißmann, Stefan Birngruber

KURZFASSUNG

Dieser Bericht entstand als Teil eines Projektpraktikums der Universität Wien zum Schutz und Erforschung der Unechten Karettschildkröte (*Caretta caretta*) in Fethiye (Türkei). Im Rahmen des Projektes arbeiten seit mehr als 19 Jahren türkische und österreichische Studenten zusammen. Die Strände von Çalış und Yaniklar dienen *Caretta caretta als* Niststrände, während sie gleichzeitig auch touristisch genutzt werden. Drei der insgesamt 14 Niststrände von *Caretta caretta* im östlichen Mittelmeerbecken, darunter auch der Projektstrand Fethiye, sind als sogenannte „Specially Environment Protected Areas" (SEPAs) deklariert. Von Anfang Juli bis Mitte September wurden die Strände in Çalış und Yaniklar von 20 österreichischen Studenten überwacht. Während diesen 11 Wochen wurden alle Ereignisse die Schildkröten betreffend dokumentiert. Durch die langjährige Datenerhebung lassen sich die Ergebnisse der einzelnen Jahre gut miteinander vergleichen und Schlussfolgerungen anstellen. Im Untersuchungsjahr 2012 wurden in Çalış insgesamt 10 Nester der Unechten Karettschildkröte gefunden und betreut. Mit Ausnahme eines Nests, waren alle Nester sogenannte „secret nests". Diese wurden erst durch Laufspuren oder durch das Finden junger Schildkröten (Hatchlinge) entdeckt. Seit Beginn des Projekts 1995 ist dies der niedrigste Stand an Nestern. Darüber hinaus wurden 2012 am Strand einige Duschkabinen aufgebaut, wofür man an manchen Stellen den Strand aufgraben musste. Dies und andere Änderungen im Strandbereich wären eine potentielle Erklärung für die geringe Anzahl der Nester. Insgesamt wurden hier dieses Jahr 689 Eier gezählt und mindestens 336 Hatchlinge erreichten unter Beaufsichtigung durch Studenten das Meer. In Çalış lag die maximale Erfolgsrate bei 56,6 Prozent, was 390 Hatchlingen entspricht. Obwohl es in den letzten vier Jahren einen negativen Trend gab, lag im Jahr 2012 die maximale Erfolgsrate nur geringfügig unter dem Durchschnitt. Darüber hinaus wurden 76 unbefruchtete Eier gefunden, sowie 171 Abgestorbene im Embryonalstadium. Außerdem gab es 52 tote Hatchlinge (Prädation, Austrocknung durch Sonneneinstrahlung, im Ei steckengeblieben).

ABSTRACT

This report was produced as a part of the conservation and research field course of the University of Vienna on *Caretta caretta* in Fethiye, Turkey. Turkish and Austrian students

have been working together in this project for more than 19 years. The beaches of Çalış and Yaniklar are used by *Caretta caretta* as nesting areas, but they are both touristic areas too. In the eastern Mediterranean Sea, three of 14 nesting beaches of *Caretta caretta* are declared as „Specially Environment Protected Areas" (SEPAs), including the beaches of Fethiye. From the beginning of July to mid-September, 20 Austrian students monitored the beaches in Çalış and Yaniklar and documented their findings during these 11 weeks. The fact that this course is a long-time project enables comparing the results of the single years and drawing general conclusions. In 2012, 10 nests of *Caretta caretta* were found and monitored in Çalış. Except for one nest, all were so-called "secret nests", which means that they were found by following tracks of young turtles or by detecting the hatchlings (young turtles) on their way to the sea. Ten nests are the lowest number since the project launch in 1995. Furthermore, shower cubicles were established at the beach this year, whereby. The beach was dug over in some places. This and other human activities on and next to the beaches can potentially explain the low number of nests, although natural rhythms in the number of nests (and therefore eggs) may also play a role. In total, 689 eggs were laid and a minimum of 336 hatchlings visibly reached the sea (the number of individuals released to the sea by the students). In Çalış the maximum success rate was 56.6 percent, which were 390 hatchlings. Although there was a negative trend in the last four years, the total success rate in 2012 was somewhat below the average. Furthermore, 76 unfertilized eggs were found and 171 died during an embryonic stage. 52 hatchlings died due to predation (e.g. dogs, cats), sun or were stuck in the egg.

INTRODUCTION

With about 5000 individuals the loggerhead sea turtle (*Caretta caretta*) (Demetropoulus & Hadjichristophorou 1995) is the most common turtle species in the Mediterranean Sea. While they inhabit the whole Mediterranean Sea, *Caretta caretta* nests only on the eastern beaches, e.g. Greece, Cyprus or the coasts of Turkey (Stachowitsch & Fellhofer 2012). The nesting season in Turkey starts in late May.

The adult female turtles return to the same beach where they hatched (natal homing) (Bowen et al. 2004) every two to four years. Within two weeks they can lay up to four nests. In Çalış (Turkey) the number of eggs per nest can vary from 23 to 134 eggs (Stachowitsch & Fellhofer 2012). The incubation time of the eggs spans from 44 to 64 days and depends on different external factors such as, (sand)-temperature, humidity; sand composition, nest location and depth of the egg chamber (Stachowitsch & Fellhofer 2012). The nest temperature determines the sex of the hatchlings (Maxwell et al. 1988), i.e. a nest temperature below 30°C leads to male turtles, whereas above 30°C leads to female turtles. The juvenile sea turtles usually hatch at night (Salmon & Wyneken 1987) over a period of one to five days. After emerging from their nest, the hatchlings orientate toward the brightest point, which is normally the horizon over the sea. In case, the land is too brightly lit, the young turtles cannot find their own way to the sea and crawl inland. While running in the wrong direction the hatchlings can die due to exhaustion or predation for example dogs and cats (Stachowitsch & Fellhofer 2012).

MATERIAL AND METHODS

The 3.5-km-long beach in Çalış was monitored from 1 July to 28 August by altogether 11 students from the University of Vienna. Basically, the monitoring was divided in a morning shift and a night shift. The morning shift started at 6 a.m. at the "Çadiri Restaurant" (at the end of the promenade facing Fethiye) and ended about 8 a.m. in front of the cliffs at the northern end of the beach. During the morning shift the beach was controlled once, whereas it was controlled four times during the night shift. In the night shift the students patrolled the same stretch from 10 p.m. to about 2 a.m., but only extending up to the "Surf Center". Small groups of at least three students of an international team (Turkish, British and Austrian students) patrolled the beach in both shifts. In early August, the nesting time of adult loggerhead turtles ends and therefore only the nests were controlled in the night shifts from 5 August to 28 August. (i.e. not the entire beach)

While the students patrolled the beach, they searched for adult and juvenile tracks, adult females laying their nests or new hatchlings. Encountering a female sea turtle, the task of the students was to measure and tag the sea turtles after oviposition and determine the location of the new nest. In Çalış the nests were marked with two different types of cages. On the one hand there were new pyramid-shaped metal cages, which are open at the front side (Fig.7) and on the other hand older yellow triangular metal cages with green plastic net wrapped around and no open front side (Fig. 8). The net around the yellow triangular cages could be lifted up or down. Both types of cages have a sign in three languages (Turkish, English and German) on the top, so that people would recognize it as a sea turtle nest. Because of the open front side the new pyramid-shaped metal cages did not offer complete protection against predators (e.g. dogs at the beach). The cages were also used due to the risk that newly hatched turtles run into the wrong direction because of the bright lights of the promenade. Hence, the students changed the new pyramid-shaped cages against older yellow triangular cages a few days before the expected hatch date.

During the morning shift the nets were pulled up approximately 10 cm to prevent newly hatched turtles from dying due to heat if they emerged later in the day. If hatchlings were found in the morning shift they were either released immediately to the sea (if the sand temperature was still low) (Fig. 11) or taken to the sea turtle camp in a plastic bucket filled with some moist sand and covered with a moist towel. In the following night shift these hatchlings were released to the sea.

Before the night shift, the nets of all cages were pulled down to prevent emerging hatchlings from crawling into the wrong direction. This procedure was necessary because of the bright lights along the promenade at night. If newly hatched turtles were found during the night shift, they were put into a plastic bucket with some moist sand and covered with a towel. Subsequently the students moved to a darker beach section and set them free a few meters away from the water line in small groups of up to 4 hatchlings. The students waited until every hatchling reached the sea. To discover potential secret nests the students searched for new hatchling tracks in both shifts. At night a weak red light was used for this purpose. If new tracks were found, they were counted and recorded. Furthermore, the presence of predators and the direction (to the ocean or landward) of the tracks was noted.

The nests were excavated approximately five days after the last hatchling emerged. The empty eggshells (Fig. 10), fertilized and unfertilized eggs and dead and living turtles were counted and noted. According to the embryo development and the appearance, the fertilized eggs were divided into three stages: early embryonic stage (< 1cm), middle embryonic stage (1 – 2 cm) and late embryonic stage (> 2 cm) (Fig. 9). Moreover, the nests were measured, including the depth from the sand surface to the top of the eggs, the diameter and depth of the egg chamber and the distance to the sea.

The minimal number of successful hatchlings is based on the number of hatchlings, which were released by the students plus visible hatchling tracks leading to the sea. The maximum number of successful hatchlings was calculated as follows: total number of empty egg shells minus dead hatchlings. The minimal and maximal success rates in percent were calculated in relation to the total number of eggs.

RESULTS

In 2012, ten nests of *Caretta caretta* were found in Çalış. Nine of these nests were so called "secret nests", which means that there are no data about the nesting date. Only for one nest (C1) could the exact nest date and therefore the incubation time is determined, which is 44 days. Hence, it is not possible to determine the average incubation time of the nests in Çalış.

In total, 689 eggs were laid and the maximum number of hatchlings reaching the sea was 390, while the minimum was 336. The difference reflects some unknown factors, e.g. where empty shells were present but the tracks not clearly discernible. Furthermore, 76 unfertilized eggs were found and 171 died during an embryonic stage. 52 hatchlings died due to predation, the heat of the sun (they were found desiccated on the beach) or were stuck in the egg (Table 1).

Table 1: Overview of all nests Çalış 2012. r.t.s. = reached the sea

Tabelle 1: Übersicht aller Nester und deren Daten, Çalış 2012

Nest Nr.	Nest date	Incubation time (days)	Hatchlings r.t.s. MIN	Hatchlings r.t.s. MAX	Still living inside	Empty egg shells	Unfertilized eggs	Fertilized eggs	Dead Embryos	Dead hatchlings	Total Nr. of eggs
C1	06.07.	44	21	24	0	28	0	52	28	4	56
CS1	secret	-	13	35	2	36	31	58	16	1	83
CS2	secret	-	46	46	0	52	5	35	6	6	63
CS3	secret	-	32	32	6	32	18	64	3	0	53
Cs4	secret	-	51	59	0	59	2	58	5	0	66
CS5	secret	-	2	23	1	36	2	55	22	13	60
CS6	secret	-	28	28	0	39	2	95	16	11	57
CS7	secret	-	94	94	1	94	3	63	1	0	98
CS8	secret	-	29	29	2	31	7	77	32	2	70
CS9	secret	-	20	20	1	35	6	56	42	15	83
Total			**336**	**390**	**13**	**442**	**76**	**613**	**171**	**52**	**689**

As seen in Figure 1, the total number of eggs in the single nests showed a high variation. With 98 eggs, nest CS7 had the largest number of eggs, whereas CS3 had the fewest (53). Therefore the average number of eggs per nest was 69, which lies in the normal range for *Caretta caretta* nesting in Turkey (Stachowitsch & Fellhofer 2012).

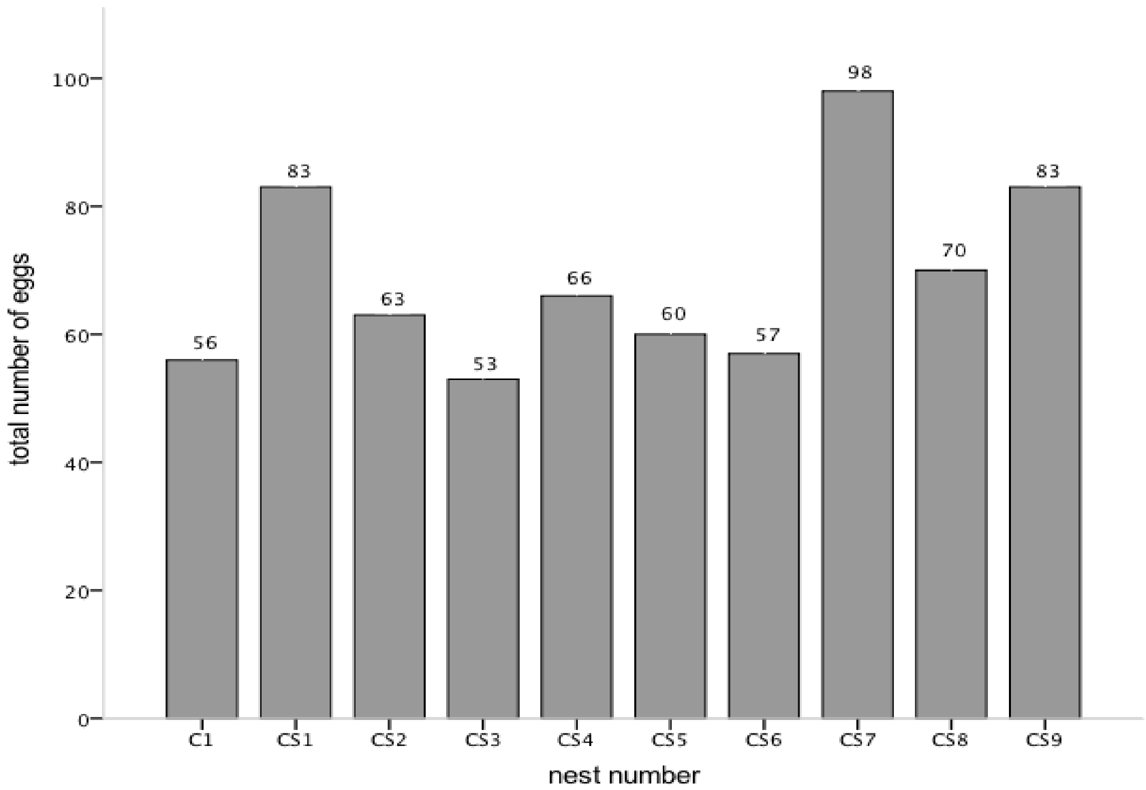

Figure 1: Total number of eggs per nest in Çalış 2012 (CS: secret nests)
Abbildung 1: Gesamtzahl der Eier pro Nest in Çalış 2012 (CS verweist auf secret nests)

Figure 2 depicts the minimal and maximal success rate in percent of each single nest. The maximum success rates indicate how successfully the single nests hatched, while the minimal success rates contain only the number of hatchlings that were hand-released by the students. The difference between these two rates for the nests shows the extent of hatchlings with uncertain fates.

In more than half of the nests, both rates are equal. CS7 had the highest success rate, while CS5 had the lowest one because of a high number of dead embryos and hatchlings.

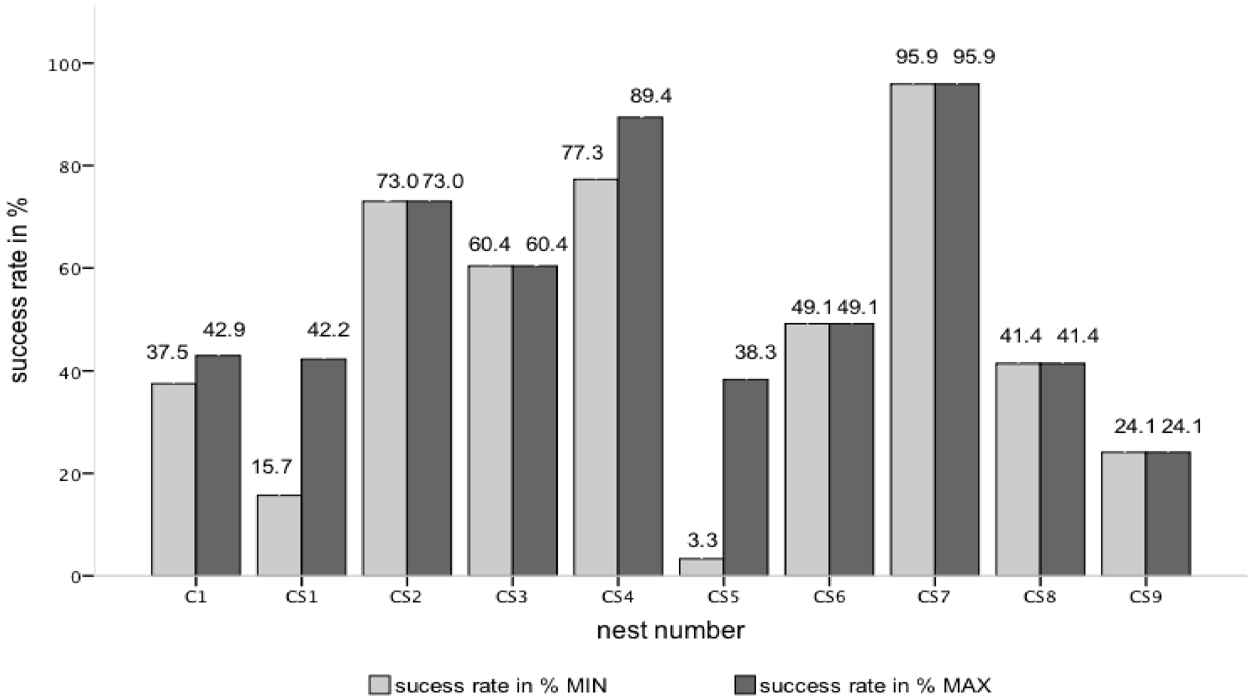

Figure 2 : Minimal and maximal success rate (%) of each nest in Çalış 2012
Abbildung 2: Minimale und maximale Erfolgsrate (%) der einzelnen Nester in Çalış 2012

Figure 3 displays the success rate over the years. The total maximum success rate was 56.6 percent in 2012. Although there was a significant negative trend in the last four years, the total success rate in 2012 was somewhat below the average. Since 1995, the average maximal success rate was 60 percent.

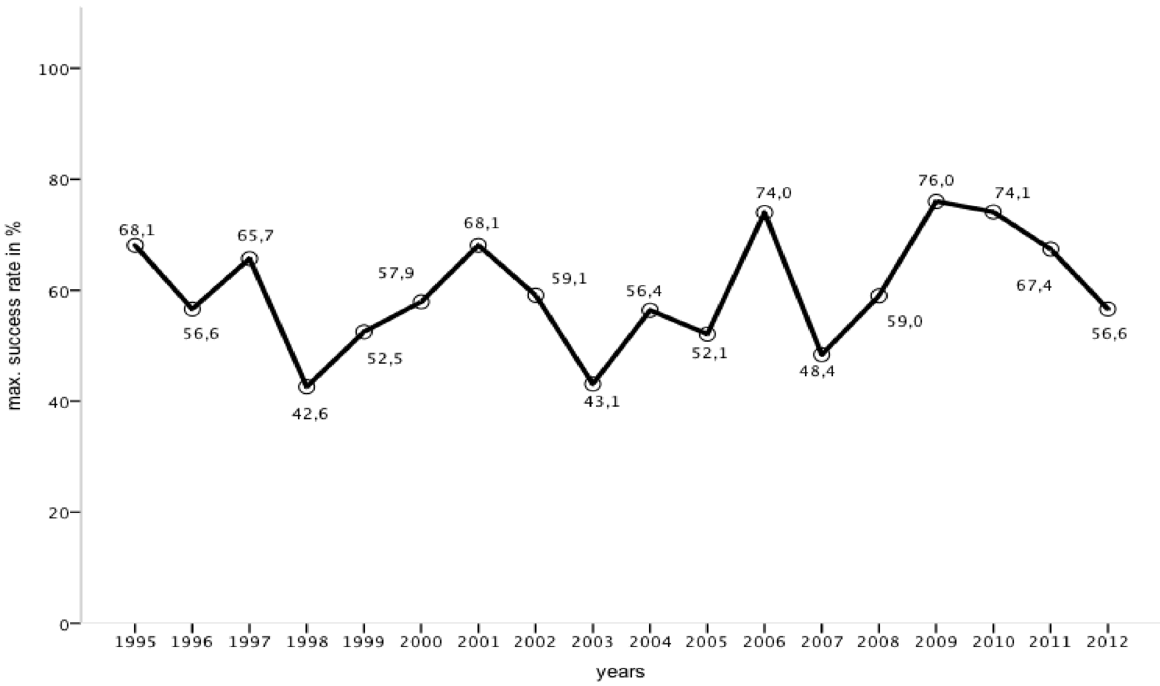

Figure 3: Maximal success rate (%) from 1995 to 2012 in Çalış
Abbildung 3: Minimale Erfolgsrate (%) von 1995 bis 2012 in Çalış

Five days after the last hatch-event the nests were excavated. During the excavations all remaining eggs in the nest were opened and analyzed. It was examined whether the eggs were fertilized or unfertilized. The fertilized eggs already contained an embryo. Furthermore, the exact stage of the dead embryos was observed. Generally the dead embryos were categorized into three main stages: early, middle and late stage.

Figure 4 shows the three different embryo stages of each single nest in 2012.
As already mentioned, CS7 was the most successful nest because of a high success rate and only one dead embryo in the nest. CS2, CS3 and CS4 were also successful nests because of a low number of dead embryos. In contrast, nests CS8 and CS9 had the largest number of dead embryos. Fig. 4 shows that most of the embryos died during the late embryonic stage.

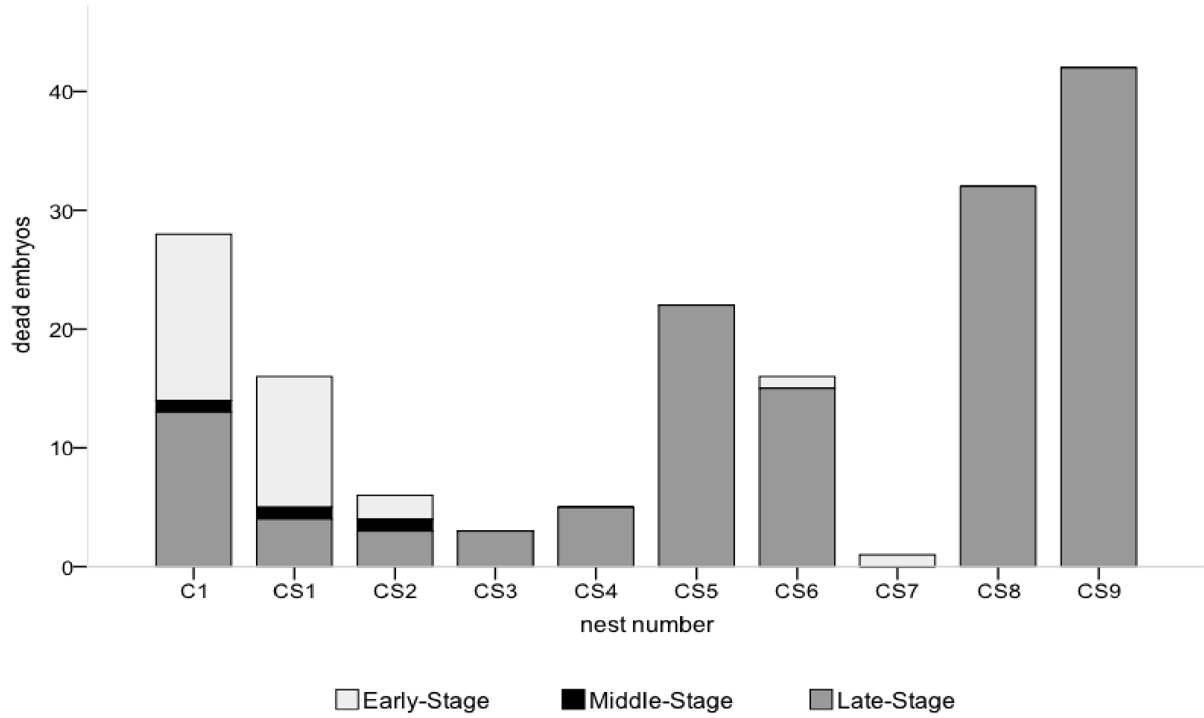

Figure 4: Development stages of dead embryo per nest in Çalış

Abbildung 4: Entwicklungsstadien der toten Embryonen pro Nest in Çalış

Nest description

In Çalış the first hatchling hatched on 24 July and the last one on 28 August. During this period probably more than 336 hatchlings reached the sea.

Table 2: Nest data of C1 (r.t.s.: reaching the sea)

Tabelle 2: Nestdaten von C1

Nest: C1	
Total number of eggs	**56**
Nr. of empty egg shells	28
Nr. of hatchlings r.t.s. (minimum)	**21**
Nr. of hatchlings r.t.s. (maximum)	**24**
Nr. of unfertilized eggs	0
Nr. of dead embryos	28
Nr. of dead hatchlings	4
Nr. of predated eggs	0

Nest C1 was the only nest which was observed by the students while the adult turtle dug it. It was laid in front of the "Caretta Beach Club" on 6 July. The distance to the sea was 23 m and the nest was protected with four cages against the dogs on the beach (Fig. 12). The first hatchling emerged on 18 August. Three days later one dead hatchling was found in the sand. On the 23 August the nest was briefly opened because of the compressed sand. During the excavation, on the 28 August, four hatchlings were found dead in the nest and 28 dead embryos were counted, whereby 14 were early-embryonic stage, 1 mid.-embryonic stage and 13 late-embryonic stage.

Table 3: Nest data of CS1 (r.t.s.: reaching the sea)
Tabelle 3: Nestdaten von CS1

Nest: CS1	
Total number of eggs	**83**
Nr. of empty egg shells	36
Nr. of hatchlings r.t.s. (minimum)	**13**
Nr. of hatchlings r.t.s. (maximum)	**35**
Nr. of unfertilized eggs	31
Nr. of dead embryos	16
Nr. of dead hatchlings	1
Nr. of predated eggs	0

The secret nest CS1 was laid between the "Hotel Idee" and the "Taxi Office" and the nest date is unknown. It was located 16 m away from the sea. This nest had the highest number of unfertilized eggs (31), which lead to a low success rate of hatchlings reached the sea (15.7 %). The excavation took place on 19 August. Eleven embryos in the early-embryonic stage, one in the mid-embryonic stage and four in the late-embryonic (Fig. 9) stage were counted.

Table 4: Nest data of CS2 (r.t.s.: reaching the sea)
Tabelle 4: Nestdaten von CS2

Nest: CS2	
Total number of eggs	**63**
Nr. of empty egg shells	52
Nr. of hatchlings r.t.s. (minimum)	**46**
Nr. of hatchlings r.t.s. (maximum)	**46**
Nr. of unfertilized eggs	5
Nr. of dead embryos	6
Nr. of dead hatchlings	6
Nr. of predated eggs	0

CS2 was located between the "Taxi Office" and the "Mado", 10.1 m from the sea. Due to the short distance to the sea, the nest was flooded in late July. Therefore the students exchanged the wet sand above the egg chamber for dry sand. On 10 August the first hatchlings reached the sea, while eight days later the last hatching event took place. During this time 46 hatchlings reached the sea.

This nest had a high success rate of hatchlings reaching the sea (73 %). During the excavation, on 18 August, six dead hatchlings were found, whereby one was stuck in the egg. Furthermore, six dead embryos were counted, whereby two were early-embryonic stage, one was mid-embryonic stage and three were late-embryonic stage.

Table 5: Nest data of CS3 (r.t.s.: reaching the sea)
Tabelle 5: Nestdaten von CS3

Nest: CS3	
Total number of eggs	**53**
Nr. of empty egg shells	32
Nr. of hatchlings r.t.s. (minimum)	**32**
Nr. of hatchlings r.t.s. (maximum)	**32**
Nr. of unfertilized eggs	18
Nr. of dead embryos	3
Nr. of dead hatchlings	0
Nr. of predated eggs	0

CS3 was laid next to the “Hotel Area”, only 11.5 m away from the waterline. The first hatchling emerged on 26 July. One day later, the wet sand above the egg chamber was exchanged for dry sand and 20 hatchlings were dug out and reached the sea. This nest had the lowest total number of eggs (53) and the nest was flooded in late July. At the excavation, 18 unfertilized eggs and three dead embryos (late-embryonic stage) were recorded.

Table 6: Nest data of CS4 (r.t.s.: reaching the sea)
Tabelle 6: Nestdaten von CS4

Nest: CS4	
Total number of eggs	**66**
Nr. of empty egg shells	59
Nr. of hatchlings r.t.s. (minimum)	**51**
Nr. of hatchlings r.t.s. (maximum)	**59**
Nr. of unfertilized eggs	2
Nr. of dead embryos	5
Nr. of dead hatchlings	0
Nr. of predated eggs	0

CS4 had the second highest success rate in 2012. This nest was directly in front of the “Hotel

Dolphin" and around 12.5 m from the sea. At the end of July the nest was flooded and the sand above the egg chamber was exchanged by the students. During a period of four days, more than 51 hatchlings reached the sea. The first turtle hatched on 2 August. Five days after the last hatch, the excavation took place. Two unfertilized eggs and five dead embryos (all late-embryonic stage) were found.

Table 7: Nest data of CS5 (r.t.s.: reaching the sea)
Tabelle 7: Nestdaten von CS5

Nest: CS5	
Total number of eggs	**60**
Nr. of empty egg shells	36
Nr. of hatchlings r.t.s. (minimum)	**2**
Nr. of hatchlings r.t.s. (maximum)	**23**
Nr. of unfertilized eggs	2
Nr. of dead embryos	22
Nr. of dead hatchlings	13
Nr. of predated eggs	0

CS5 (secret nest) was located in front of the "Caretta Beach Club", 20 m from the waterline. The first hatchling emerged on 7 August. On the same day, one dead hatchling was found next to the cage. The next and last observed hatching event was seven days later. CS5 was the nest with the lowest minimum success rate of hatchlings reached the sea this year (3.3 %). Perhaps this can be explained by predators on the beach (e.g. dogs) but there is no evidence. During the excavation, on 14 August, two unfertilized eggs and 22 dead embryos (late-embryonic stage) were counted. Furthermore, eight hatchlings were stuck in their eggs and four hatchlings were found dead in the nest.

Table 8: Nest data of CS6 (r.t.s.: reaching the sea)
Tabelle 8: Nestdaten von CS6

Nest: CS6	
Total number of eggs	**57**
Nr. of empty egg shells	39
Nr. of hatchlings r.t.s. (minimum)	**28**
Nr. of hatchlings r.t.s. (maximum)	**28**
Nr. of unfertilized eggs	2
Nr. of dead embryos	16
Nr. of dead hatchlings	11
Nr. of predated eggs	0

It was not possible to determine the exact nest date of CS6 (secret nest). The nest was located close to the "Otogar" (bus stop) and the distance to the sea was 32.6 m. The first hatchlings emerged on 25 July and the last observed hatching was just one day later. On 26 July the nest was briefly opened because of the compressed sand and eight dead hatchlings were found in the nest. Five days after the last hatchling emerged, the nest was excavated. Three dead hatchlings, two unfertilized eggs and 16 dead embryos were counted. One of the 16 embryos died in the early and 15 in the late stage. One hatchling was still alive inside the nest. Moreover, maggots were found in the nest.

Table 9: Nest data of CS7 (r.t.s.: reaching the sea)

Tabelle 9: Nestdaten von CS7

Nest: CS7	
Total number of eggs	**98**
Nr. of empty egg shells	94
Nr. of hatchlings r.t.s. (minimum)	**94**
Nr. of hatchlings r.t.s. (maximum)	**94**
Nr. of unfertilized eggs	3
Nr. of dead embryos	1
Nr. of dead hatchlings	0
Nr. of predated eggs	0

CS7 was the nest with the highest number of eggs this year. It was laid between the "Hotel Güneş" and the "Seçil Market" and the exact nest date was not possible to determine (secret nest). CS7 was just 9.8 m away from the sea and therefore it was also flooded in late July. In the days following the flood, the wet sand above the egg chamber was exchanged for dry sand by students several times. The first hatchling reached the sea on 24 July and the last hatching event was three days later. During that period 94 hatchlings reached the sea. The excavation took place five days after the last hatch. Three unfertilized eggs and one dead embryo (early-embryonic stage) were found.*Table 10: Nest data of CS8 (r.t.s.: reaching the sea)*

Tabelle 10: Nestdaten von CS8

Nest: CS8	
Total number of eggs	**70**
Nr. of empty egg shells	31
Nr. of hatchlings r.t.s. (minimum)	**29**
Nr. of hatchlings r.t.s. (maximum)	**29**
Nr. of unfertilized eggs	7
Nr. of dead embryos	32
Nr. of dead hatchlings	2
Nr. of predated eggs	0

The secret nest CS8 was laid next to the "Surf Center". The hatching period lasted two days and started on 28 July. In this period 29 hatchlings reached the sea. During the excavation, seven days after the last hatchling emerged, seven unfertilized eggs, one hatchling still living inside the nest and one dead hatchling were counted. Furthermore, 32 embryos in the late-embryonic stage were found. The distance to the sea was 35.1 m. One of the two dead hatchlings died due to sun and heat. Moreover, there were insect larvae inside the eggs.

Table 11: Nest data of CS9 (r.t.s.: reaching the sea)
Tabelle 11: Nestdaten von CS9

Nest: CS9	
Total number of eggs	**83**
Nr. of empty egg shells	35
Nr. of hatchlings r.t.s. (minimum)	**20**
Nr. of hatchlings r.t.s. (maximum)	**20**
Nr. of unfertilized eggs	6
Nr. of dead embryos	42
Nr. of dead hatchlings	15
Nr. of predated eggs	0

This nest was located directly in front of the "Surf Center", 36.3 m from the sea. Maybe the sand composition was less optimal for embryonic development because of the high distance to the sea. This could be the reason for the low success rate. It was not possible to determine the exact nest date of CS9 (secret nest). The first hatchlings reached the sea on 8 August and the last hatching event was four days later. During this period 20 hatchlings reached the sea. On 8 August, 13 dead hatchlings were found in the nest. At the excavation, two dead hatchlings, six unfertilized eggs and 42 dead embryos (late-embryonic stage) were counted. Moreover, two hatchlings still living inside the nest were found. The excavation took place just one day after the last hatching event.

DISCUSSION

Since the sea turtle project started in 1995, students have been collected data about the nesting behavior and nesting success of *Caretta caretta* in Çalış. (Turkey) Because of this long-term study, it is possible to compare and discuss the developments over a period of the last 18 years. Regarding the protection of *Caretta caretta* the project year 2012 was less successful than in previous years based on several parameters.

Fig. 5 shows the total number of eggs from 1995 to 2012. The highest number of eggs were found in 1996 (1769 eggs), followed by the years 2004 and 2007. In contrast to these successful years, in 2005 and 2012 only 689 eggs were counted. On average, 1258 eggs were laid per year. Accordingly, in 2012 the total number of eggs was 54.8 percent lower than the average over the last 18 years. As shown in Fig. 5 and Fig. 6 the number of eggs and nests underlies fluctuations over the years. Successful years (e.g. 1994, 2004, 2007 and 2010) are often followed by years with a relatively low number of nests and eggs (e.g. 2003, 2005 and 2012).

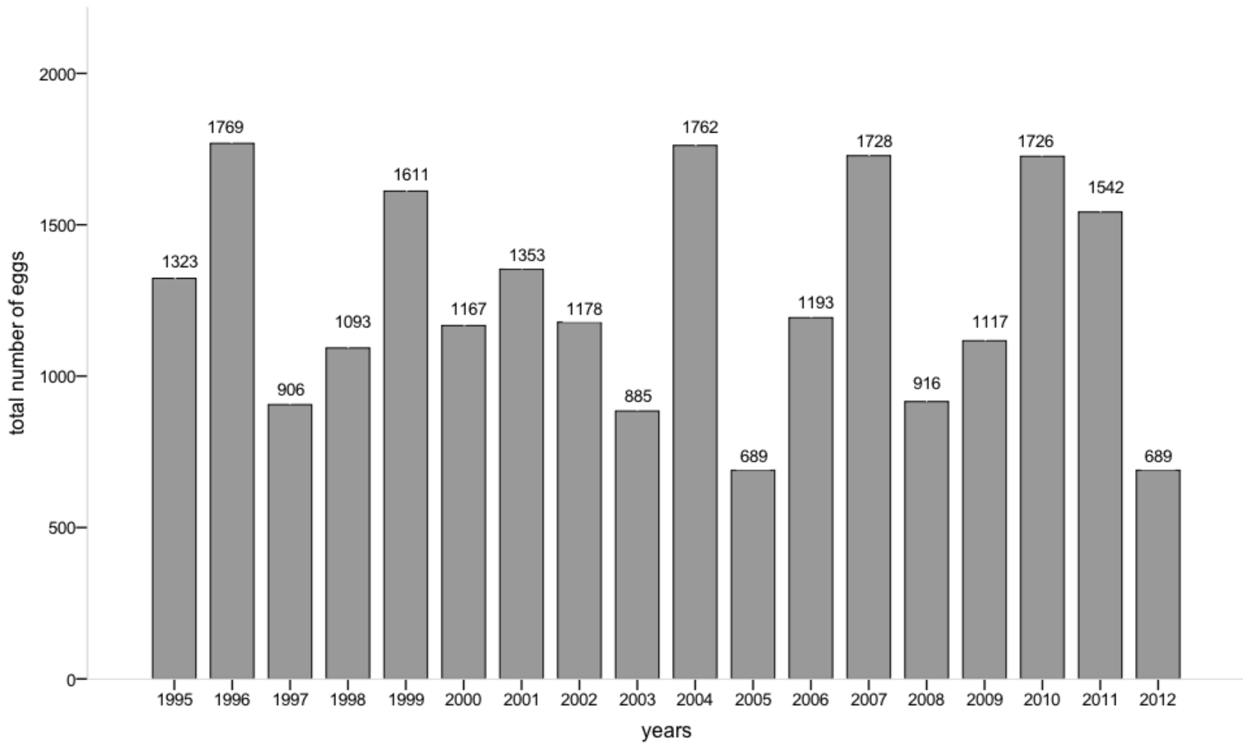

Figure 5: Total number of eggs in Çalış from 1995 to 2012
Abbildung 5: Gesamtzahl der Eier in Çalış von 1995 bis 2012

In the field season 2012, ten nests were recorded in Çalış beach, as illustrated in Fig. 6. This is the lowest number of nests since the project launch in 1995. Fig. 6 points to a decline in the number of nests laid by *Caretta caretta* over the years. The most important reason for this negative trend is probably that Çalış has experienced a continued growth of beach-related tourism in the last twenty years. Due to this development there are more sources of disruptions than in the past. These disturbances consist mainly of party noise, bonfires and picnics on the beach, beach furniture and bright lights. Furthermore, this year shower cubicles were installed at the beach, and for this and other reasons the beach was dug in some places.

Hence, there is the possibility that some nests were destroyed during the excavation work or that the sand texture was altered. These factors are potential reasons for the low number of nests this year.

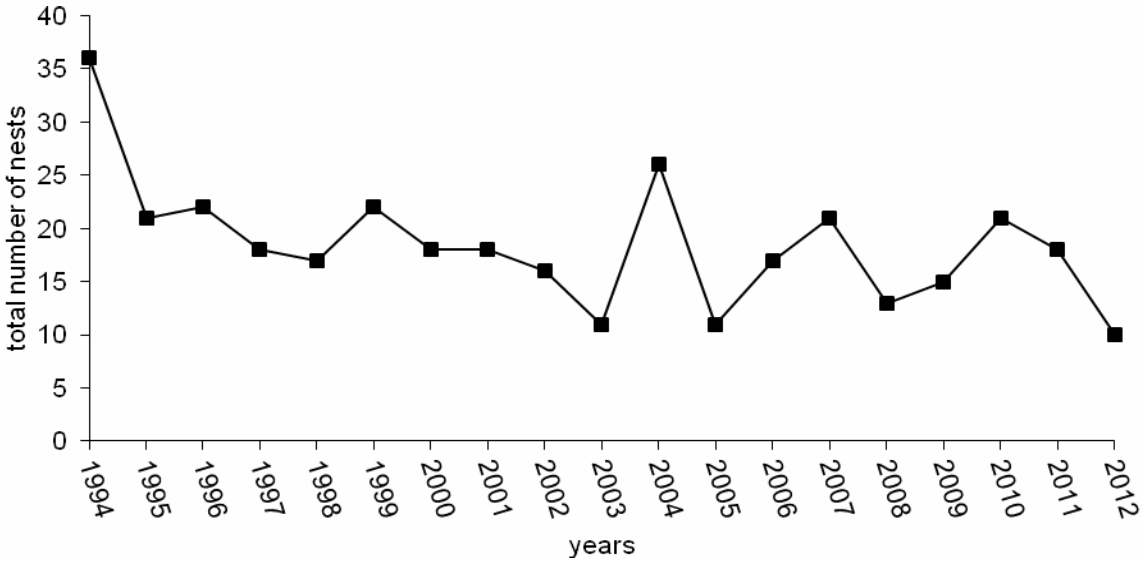

Figure 6: Total number of nests in Çalış from 1995 to 2012
Abbildung 6:Anzahl der Nester in Çalış von 1995 bis 2012

The nesting season 2012 presumably started in early June and ended in mid-July. Nine of ten nests were so-called secret nets. This means that they are probably all laid in June, before the Austrian students arrived. In these cases it was not possible to determine the exact nest date. Only for one nest could the exact date regarding egg-laying be determined. According to Baran & Türkozan (1996), June is the month with the highest overall nesting activity in Fethiye. This would be an important argument that future field courses should start earlier.

On average 69 eggs per nest were observed, which is a normal number of eggs for *Caretta caretta* in Turkey (Stachowitsch & Fellhofer 2012). In other nesting areas in the Mediterranean Sea, such as in Zakynthos (Greece), the number of eggs per nest is significantly higher than in Çalış (Skoufas 2005). This year, it was possible to estimate the incubation time for just one nest (C1). According to Stachowitsch & Fellhofer (2012) the incubation time of C1 (44 days) is within the expected range, albeit at the shorter end. Differences in incubation times could be explained by environmental conditions (e.g. temperature, nest location or consistence of the sand). To calculate an average incubation time, a higher sample size would be necessary.

Compared to last year, the number of unfertilized eggs inside all nests was lower in 2012. Overall, 11 percent of all eggs were unfertilized. In 2011 the average number of unfertilized eggs of all nests was 15 percent, in 2010 just 10 percent. In 2009, only 4 percent of all eggs were unfertilized. Moreover, in 2010 the highest number of unfertilized eggs of a nest was 66 percent. One year later, in 2011 a high number of 73 percent unfertilized eggs were found in one nest. In the field season 2012 the highest number of unfertilized eggs was found in the nest CS1 (37 %). For such high numbers of unfertilized eggs there are several possible reasons, including marine pollution. Heavy metals, crude oil or halogenated hydrocarbons can impact marine animals by distorting the pheromone system or leading to infertility. More detailed research would be necessary to examine the exact cause of unsuccessful nests (Power 2011).

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APPENDIX

Figure 7: New cage for nest protection
Abbildung 7: Neuer Käfig für Nestschutz
Photo: Stefan Birngruber

Figure 8: Old, yellow cages
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Hatchling data on *Caretta caretta* in Yaniklar 2012

Sigrid Prader, Isabel Rabl

KURZFASSUNG

Das Meeresschildkrötenprojekt wurde auch dieses Jahr in Zusammenarbeit mit einer türkischen Universität an der Mittelmeerküste in Fethiye, Türkei, durchgeführt. Seit 19 Jahren werden in dieser Special Protected Area die Nistaktivitäten der Unechten Karettschildkröte (*Caretta caretta*) studiert. Adulte-, Hatchlings- und Nestdaten wurden durch das tägliche Abgehen des Strandes gesammelt und gemessen, sowie Veränderungen am Strand beobachtet und dokumentiert. Die Datenaufnahme diente dazu, um Informationen über Nest, Schlüpferfolg, Mortalitätsrate, Predation, Evertebratenbefall im Nest, Inkubationszeit, und Schlüpfdauer zu bekommen, welche mit den Vorjahren verglichen werden konnten.

In dieser Nistsaison wurden insgesamt 76 Nester und 6299 gelegte Eier in Yaniklar und Akgöl verzeichnet. Somit konnte 2012 nach 3 Jahren, zuletzt im Jahr 2009, wieder eine Zunahme der Nester und der gelegten Eier dokumentiert werden. Im Durchschnitt wurden 86,2 Eier pro Nest gelegt (Spannweite: 17-153 Eier). Dieses Jahr (2012) war die durchschnittliche Inkubationszeit 48,2 Tage (Spannweite: 37-59 Tage) Die durchschnittliche Schlüpferfolgsrate betrug 73,3% (Inkludiert: tote Hatchlinge und Hatchlinge die das Meer erreicht haben) und die Mortalitätsrate lag bei 15,1%. Die Anzahl der gelegten Nester ist im Vergleich zum Vorjahr 2011 erheblich gestiegen.

ABSTRACT

The sea turtle field course took place at the Mediterranean coast in Fethiye, Turkey (Special Protected Area), at the beaches Yaniklar and Çaliş, in cooperation with a Turkish University. The aim of this project was to monitor and preserve the Loggerhead sea turtle (*Caretta caretta*) and its habitat. To do so, nesting activity has been studied for the past 19 years. Adult, hatchling and nest data were collected on a daily basis. Changes on the beach were monitored and documented. The aim of the data acquisition was to collect information on the nests, hatching success, mortality rate, predation, invertebrate infestation, incubation period and the emerging rate. The data was then compared to previous years.

This nesting season 76 nests and 6299 eggs were laid. This is the first increase in the nest number since three years ago. The last increase could be documented in 2009. On average 86.2 eggs per nest were laid (range: 17-153 eggs). This year (2012) the average incubation

time was 48.2 days (range: 37-59 days). The average hatching rate (includes: dead hatchlings and hatchlings reaching the sea) amounted to 73.3% and the mortality rate was 15.1%. The number of nests has increased substantially compared to 2011.

INTRODUCTION

At an age of 15-25 years, *Caretta caretta* females are ready to mate and henceforth return to their beach of birth every 2-4 years to lay eggs up to 2-5 times. Peak-mating season is in the early summer months, which is when nests are also laid. Nests can contain 80-100 eggs. Typical egg chambers are approximately 50 cm deep at the centre and 25 cm in diameter (http://animaldiversity.ummz.umich.edu, Hailman & Elowson 1992).

Incubation time is influenced by temperature and oxygen levels and may take 50-70 days. Temperature also has a significant influence on the gender development. Yntema and Mrosovsky (1980) determined that hatching occurred at temperatures of 26°- 30°C and that both males and females develop at 30°C. Temperatures above 30°C result in females and below 30°C induce male hatchlings (Hays et al. 1992)

After the embryos have fully developed, hatchlings make their way to the sand surface, which can take up to 4 days. Emergence of hatchlings generally takes place during night time. Though some may come out during the day, these hatchlings are believed to be more vulnerable due to increased heat stress and predation and are thus more likely to die on the beach (www.archelon.gr, Hays et al. 1992).

Individual nests usually hatch in batches. For instance, in Greece, a successful nest of 110 eggs will quite likely produce 35 to 50 hatchlings when it first "breaks", then for another 2 to 10 days produce two to three smaller batches of 5 to 20 hatchlings' (www.archelon.gr). After emerging to the surface, hatchlings use optical cues, such as light, to determine the direction of the sea. Light pollution (e.g. from café's, hotels) can cause severe disorientation, causing the hatchlings to head in the wrong direction (www.archelon.gr, Peters et al. 1994).

Turkey has 21 major nesting sites of the loggerhead sea turtle (*Caretta caretta*). Fethiye (Muğla Province) is one of three sites which have been proclaimed as Special Protected Areas (SPAs). Çaliş, Yaniklar and Akgöl are three nesting beaches near Fethiye. The main focus of this report will be Yaniklar (4 km) and Akgöl (1.5 km), located north-west of Fethiye. These two beaches are historically adjoined wetlands and forests, but drainage, construction and sand removal has altered these sites

(Ilgaz et al 2007). The sand has been replaced by cobbles in most parts, which may have been due to natural causes. The cobbles sizes vary from 2 mm to approximately fist size.

Akgöl and Yaniklar are popular beaches for Turkish people who use these beaches especially on weekends and holidays. Their activities may cause disturbance on the nesting ground, potentially influencing the gas exchange, compressing the sand and altering the temperature regime. The result is possible failure in the embryonic development. Other factors causing hatching failure may be natural such as flooding, predation or microbial infections.
The University of Vienna works in cooperation with different Turkish Universities (2012 – Pamukkale University) in order to preserve the natural habitat of the Loggerhead turtle (*Caretta caretta)* and to obtain information by collecting data on nesting, hatching and mortality.

MATERIAL AND METHODS

Project participants from the University of Vienna arrived on July 30 and stayed until September 15. Two shifts were walked on a daily basis, the morning shift starting at around 5:30 a.m. and night shifts starting at around 10 p.m. Night shifts, in Akgöl, stopped on July 14, when hatching started and in Yaniklar on July 17. Groups of two or three persons walked along the beach in a parallel line, one walking along the waterline, one in the middle, and the third close to the vegetation.
Tasks of the morning shift included recording nesting and hatching data, clearing the path off debris to the sea, and documenting unusual occurrences (photos of car tracks, see Bernolle & Schweiger, this volume). Hatchling tracks were counted and followed, checking if the tracks reached the sea or whether the hatchlings were lost, caught in driftwood or debris, or were predated.
Nests were inspected every morning. Special attention was focused on nests that were in the hatching process. This was done by digging a few centimetres into the nest by hand to check for living hatchlings that might have problems emerging due to dead hatchlings, stones, roots or litter blocking the way. In such cases, those obstacles were removed. Dead hatchlings in nests were buried away from the nest to prevent attraction of predators. Living hatchlings were released to the sea depending on the condition of the hatchlings, the time and the position of the sun. If hatchlings were in a weak condition or it was too late during the day, they were taken to the camp to be released during the night, at a dark beach section to avoid disorientation through light pollution. These were kept in a bucket with moist sand covering the bottom surface, closed by a dark cloth. These hatchlings were counted to the hatchlings reaching the sea.
Tracks could also indicate a previously unknown, so-called “secret nest”. Stones laid in a

semicircular shape, having the opening towards the water, marked newly found nests. To be able to locate the egg chambers, two small twigs were connected by a string, laying one twig above the opening. In addition, nests in frequently visited beach sections were triangulated. This was a precaution against the loss of nests. For this purpose, three different arbitrary landmarks were chosen (e.g.-monk`s pepper tree, pine, rock niche etc.), to measure the distances to the nest position. The distance to the sea was also measured (Fig. 1).

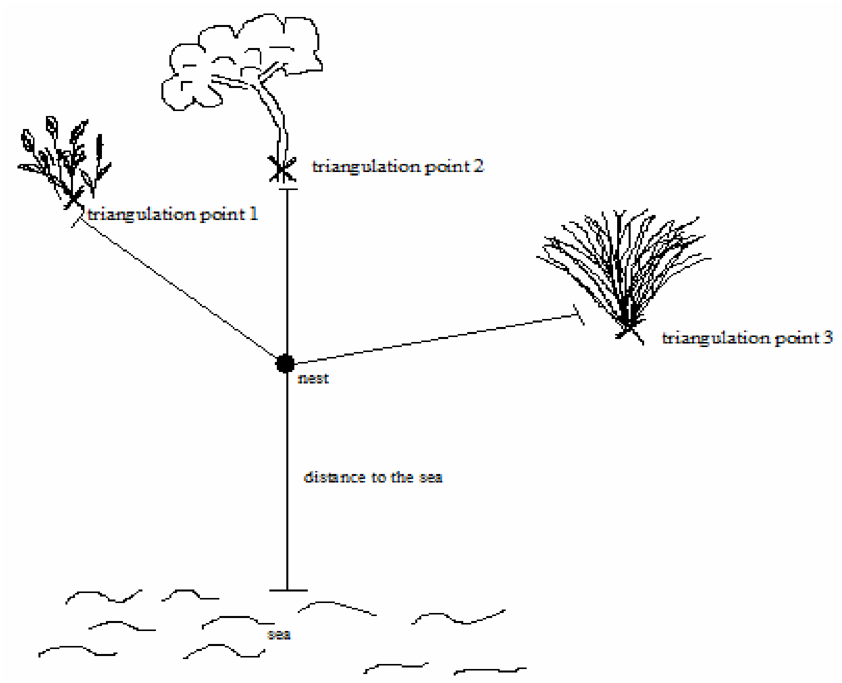

Fig. 1: Exact position of a nest based on triangulation
Abb. 1: Exakte Nestposition der Triangulationsvermessung

After a period of three to five days after the last hatch of a nest, an excavation was performed. The complete nest content was removed and sorted into different categories: empty shells, intact eggs, and dead hatchlings. To categorize the development of the intact eggs, they were opened and grouped into unfertilized or fertilized eggs, the latter distinguished into early, middle or late embryonic stage (Fig. 9, Fig. 13, Fig. 14). Living hatchlings in the nest were released to the sea, invertebrates were documented. Additional measurements included the depth to the top eggs, to the bottom eggs and the diameter of the egg chamber. The distance to the sea was also measured.

RESULTS

This year a total of 76 nests were found: 48 were in Yaniklar and 28 in Akgöl. One nest (YS2) could not be relocated due to vehicle tracks.

Two hatcheries were made in Akgöl for nests A7 and A8. Regarding a study by Serp 2011, nests that are located less than 10m to the waterline, should be relocated. A7 and A8 were expected to be flooded due to the short distance to the sea (A7 – 8.3 m, A8 – 4.3 m). They were placed at the same height of the closest nest nearby (A7 – 19.4 m, A8 – 11.1 m). Both nests did not hatch. Most hatchlings died in the early embryonic stage (see Gimpl, this volume).

Three nests (Y7, Y8, A10) hatched after the Austrian participants left and were excavated by Turkish colleagues. YS29 and YS31 were mistaken as nests as a result of predatory birds carrying off a hatchling. Altogether, there were 18 secret nests in Akgöl and 40 in Yaniklar, giving a total of 76.3% secret nests that were laid before the observation period started on July 30. 23.7% were regular nests, found after the arrival of the project participants. During the entire breeding season a total number of 6299 eggs were laid, 4052 in Yaniklar and 2247 in Akgöl, yielding an average of 83.9 (SD ± 24.1) eggs per nest. The lowest number of eggs per nest was 17 (YS35) and the highest 143 (YS8). On average, 86.2 (SD ± 24.1) eggs per nest were laid. 10% (606) of all eggs were unfertilized, 90% (5694) fertilized. Of the latter, the dead embryos included 603 early stage, 59 middle stage and 411 late stage embryos. 4620 empty shells were counted (Fig. 2 and Fig. 3).

Unusual eggs with a diameter of about 1-2 cm were discovered in nests AS2 (2 eggs), YS21 (1 egg). One of these eggs was connected with a normal-sized egg (Fig. 10 and Fig. 11).

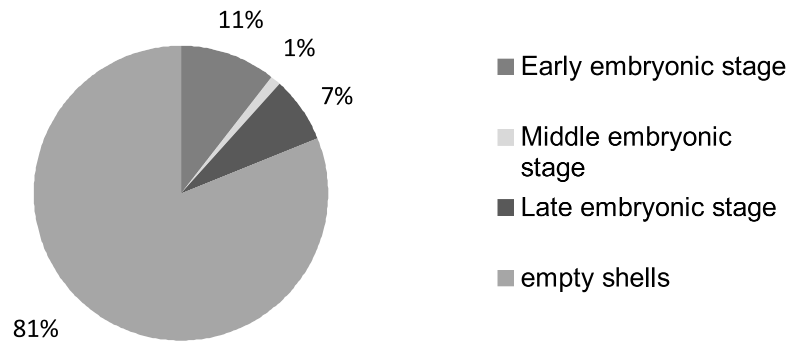

Fig. 2: Categories of the total number of fertilized eggs in percentage.
Abb. 2: Kategorien von der Gesamtanzahl der befruchteten Eier in Prozent.

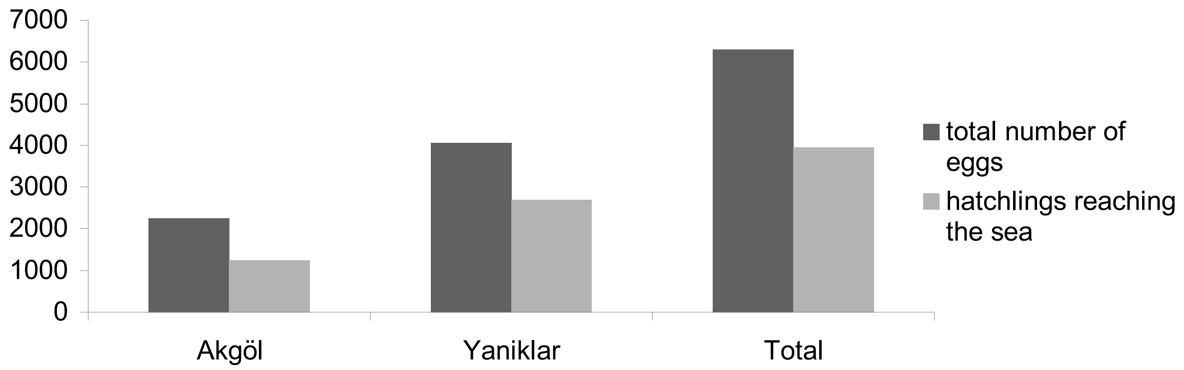

Fig. 3: Relation of the total number of eggs and hatchlings reaching the sea in Yaniklar, Akgöl and Total.
Abb. 3: Gesamtanzahl der Eier und Hatchlinge, die das Meer erreichten in Yaniklar, Akgöl und insgesamt.

Altogether, 4620 of 5693 fertilised eggs hatched (Yaniklar: 3019, Akgöl: 1601), which yields an average of 60.8 eggs hatching per nest. The number of empty shells is equated here with the maximum number of hatchlings reaching the sea (minus dead hatchlings). This value is more accurate than hatchling tracks, which are subject to miscounts. The total hatching rate was 73.3% (includes: dead hatchlings and hatchlings reaching the sea), whereby the value was 74.5% in Yaniklar and 71.3% in Akgöl. The highest number of hatches from a nest was 115 (YS8).

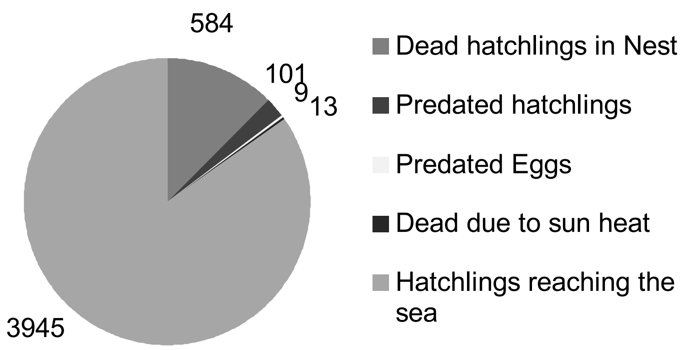

Fig. 4: Number of dead hatchlings in the nest, predated hatchlings, dead hatchlings due to sun heat, lost hatchlings and maximum number of hatchlings reaching the sea
Abb. 4: Zahl der toten und erbeuteten Hatchlinge, tote Hatchlinge aufgrund von der Sonne, verlorenen Hatchlinge und der maximalen Anzahl der Hatchlinge die das Meer erreichten.

Figure 4 shows that 707 hatchlings were found dead. Of those, 584 (82.6%) were found dead in the nests, 101 (14.3%) predated, 9 (1.3%) predated eggs and 13 (1.8%) hatchlings died due to sun heat. Six hatchlings coming from four nests (YS3, YS13, YS22 and YS28) were lost. Four of the lost hatchlings were disoriented due to light pollution of a nearby café.

On one occasion a hatchling was found caught in a fishing net (Fig. 8)

The most common predators for hatchlings on land were vertebrates such as birds and dogs and crustaceans (ghost crabs). Three nests in Yaniklar were found dug up (YS13, YS 16, YS 35) by unspecified predators with claws. There are no hatching data for nest YS 35 because it was discovered only because predators dug it up.

Invertebrates were reported in nests on 59 occasions. (49 in Yaniklar and 10 in Akgöl); 8 discoloured eggs (possible fungal infestations) were reported. The majority found were insect larvae. Tenebrionidae (black beetle) larvae were the most common with 16 reports. Myrmeleontidae was found on only one occasion (Tab. 1).

Tab. 1: Invertebrates and number of reports in total, Yaniklar and Akgöl.
Tab. 1: Evertebraten und die Anzahl der Funde insgesamt, in Yaniklar und Akgöl.

Invertebrates	Total number of reports	Number of reports in Yaniklar	Number of reports in Akgöl
Diptera larvae	15	13	2
Tenebrionidae larvae	16	14	2
Tenebrionidae adult	2	1	1
Fungal infestation	8	5	3
Acari	2	2	0
Annelidae	5	5	0
Myrmeleontidae	1	0	1
Unspecified larvae	10	9	1
Total	**59**	**49**	**10**

The average distance to the sea was 19.5 m. The range was from 9.5 m (AS14) to 42.3 m (Y3). In general, nests in Yaniklar were closer to the vegetation and in Akgöl closer to the sea. Egg chamber measurements were taken, yielding the following averages: diameter of nest chamber was 0.25 m, depth to top eggs was 0.30 m and depth to bottom eggs was 0.44 m.

Incubation time – defined as the period between laying the eggs until the first hatch – was calculated from nests of known nest date. These nests were detected during observation of egg-laying adults so that the exact nest date could be recorded. This was the case in 18 of 76 nests. Secret nests were not included because they were laid unobserved until 30 June and so it was not possible to calculate incubation time. This year (2012) the average incubation time was 48.2 days (SD ± 5.3); the minimum time was 37 days and maximum time was 59 days. However, there were substantial differences among the beaches: in Akgöl 45.8 days (SD ±2.3) and Yaniklar 50.6 days (SD ±6.4)

DISCUSSION

Every 2-3 years, fluctuations in nesting efforts occur (Fig. 5). Margaritoulis (2005) states that this is not uncommon, resulting from the specific reproductive characteristics of sea turtles, where females do not nest every season but do nest several times within a nesting period.

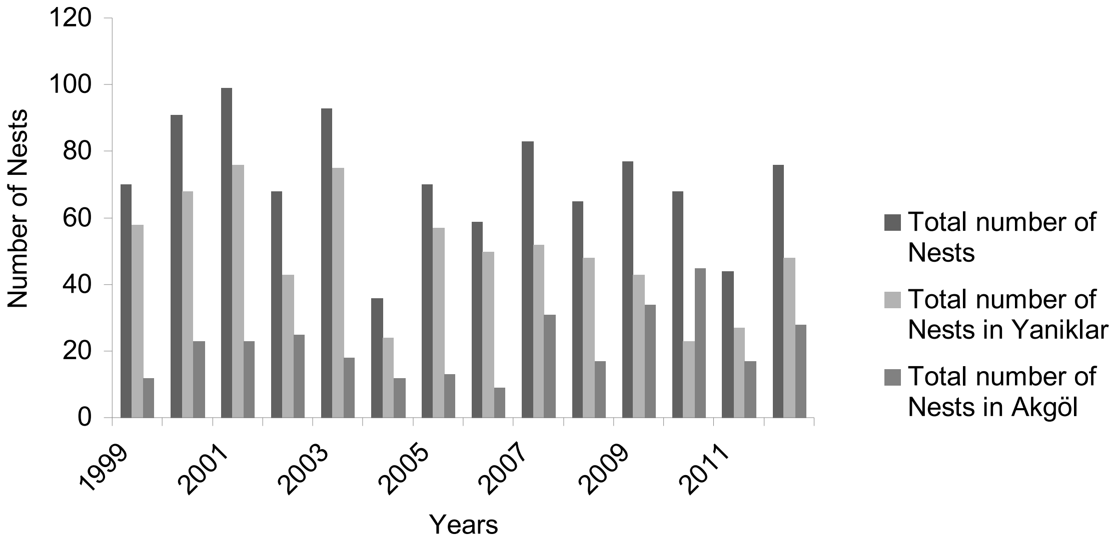

Fig. 5: Number of Nests, in total, Yaniklar and Akgöl, in the years 1999 to 2012
Abb. 5: Anzahl der Nester, insgesamt, in Yaniklar und Akgöl, in den Jahren 1999 bis 2012

There is a long-term decrease in the total number of nests, but this year there was a considerable increase compared to the year 2011. The peak season was in 2001 with 99 nests. The lowest number was detected in 2004 with only 36 nests. This continuous overall decrease may be a result of the declining sea turtle population and an increase of anthropological disturbances, as for example impacted nesting sites (sand compression, removal of sand), litter, campfires, etc.

On the whole, more nests were laid in Yaniklar than in Akgöl, a trend that has been constant throughout the years. This is most likely a result of Yaniklar being the longer beach, and thus giving the sea turtles more ground to lay their eggs.

Since 2001 a gradual decline in the nesting success can be noted (Fig. 5). This decline can have environmental or anthropogenic origins. Studies in Laganas (Greece) attribute fluctuations in nesting success to the moisture level of the sand (Margaritoulis, 2005). Turtles can only excavate egg chambers at a suitable moisture level. Other studies have suggested that the best hatching success was at a 25% moisture saturation of the sand (McGhee, 1990). Human-induced influences may include fishing and littering, which result in a decline in the turtle population. A decrease in the sea turtle population may result in fewer nests being laid.

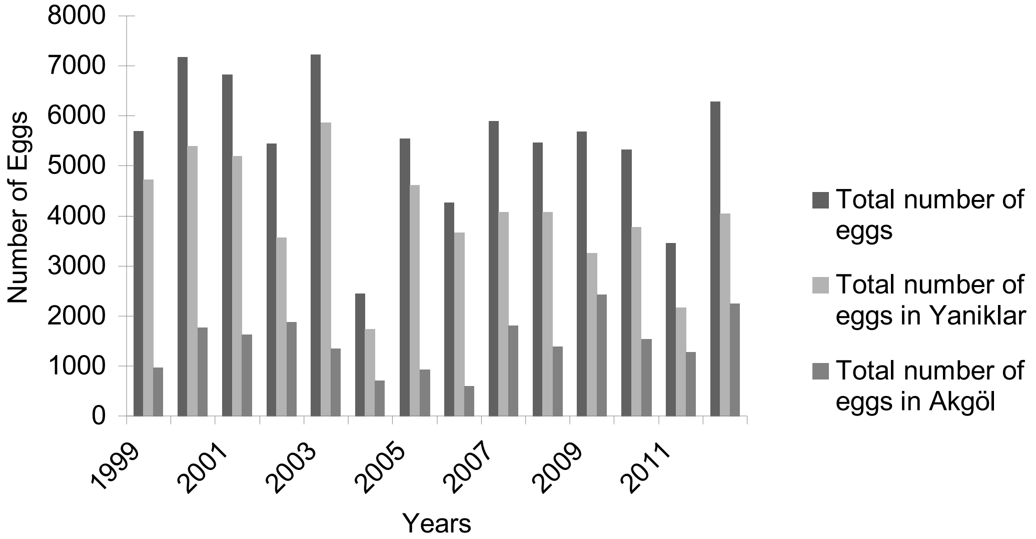

Fig. 6: Number of laid eggs, in total, Yaniklar and Akgöl, in the years 1999 to 2012
Abb. 6: Anzahl der gelegten Eier, insgesamt, in Yaniklar und Akgöl, in den Jahren 1999 bis 2012

Comparing Figures 6 and 7 a resemblance in pattern between the number of eggs and the number of hatchlings emerging can be noted. Margaritoulis (2005) stated that variations in the number of laid eggs do not necessarily coincide with the number of emerged hatchlings.

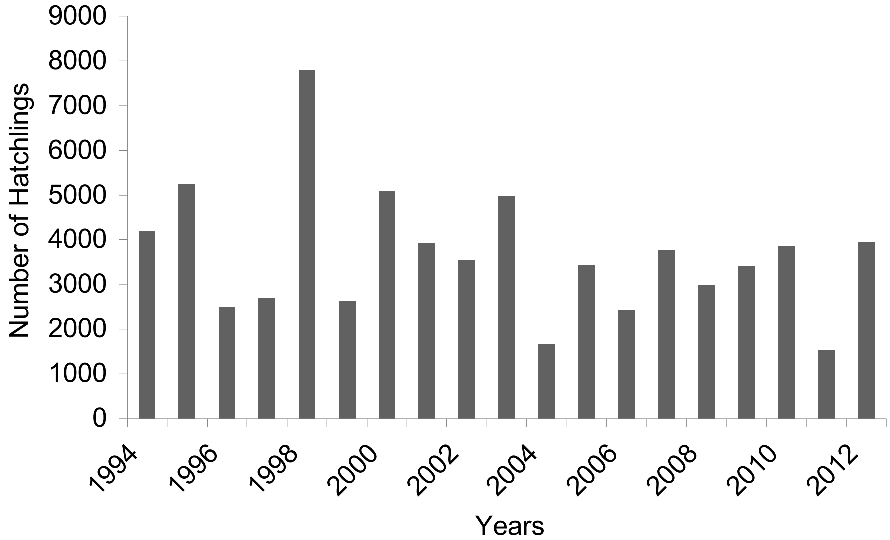

Fig. 7: Maximum number of hatchlings reaching the sea in the years 1994 to 2012
Abb. 7: Gesamtanzahl der Hatchlinge welche das Meer erreicht haben, in den Jahren 1994 bis 2012

The rate of hatchlings reaching the sea has been relatively consistent over the years being 89.8% on average, which is close to the value of 2012 (85.4%). Exceptions were 2011, when the value dropped to 54%, and 2000, when the value reached 98.4%.

Nest AS14 had a short distance to the sea of 9.5 m. During the excavation, 87 eggs were found: only one was unfertilized and the rest were empty shells (no dead hatchlings). This yields a hatching success of 100%. Due to the close distance to the sea, we can assume that the nest has been flooded, thus most probably influencing the nests temperature, gas exchange and possibly causing sand compression. This good hatching rate of a 100% may be an exception, since in 2009 three nests close to the shoreline had a low hatching rate. One nest, for example, had 84 eggs of which only 32 hatched. An interesting point is that the nests (in 2009 and 2012) close to the shore line were all located in Akgöl. (see Gimpl, this volume).

This study showed a hatching success of 73.3% and an egg fertility rate of 90.4% (hatched plus fertilized but unhatched eggs). Furthermore there was a mortality of 15.1%, which consist of hatchlings dead in nest, predated and desiccated.

Peters et al. (1994) mentioned that egg failure in their study (Turkey) was caused by inundation, infertility, and embryonic mortality due to microbial infection, developmental arrest, and developmental abnormalities. These are possible explanations for the mortality in our nests as well, with potential additional factors being insufficient gas exchange, insect larvae, as well as objects such as stones or roots blocking the path of hatchlings (Peters et al. 1994; Margaritoulis 2005).

A study in Minabe, Japan, on *Caretta caretta* suggested that high nest temperature might evoke the death of embryos and pre-emergent hatchlings. Note, however, that both those studies did not further investigate the reasons of egg failure (Matsuzawa et al. 2002). This study suggests another possible cause for mortality inside nests (see Gimpl, this volume).

If the sand is too moist, it may be a good breeding ground for fungal growth, which may be lethal for eggs (McGhee 1990). This may have been the case on eight occasions in which the eggs displayed pink colouring (Fig. 12).

A high number of invertebrates were found in nests. These may also cause embryonic mortality. This year the reported occasions of invertebrates in nests were considerably higher than in the previous year (59 versus 21). Overall, 49 reports were made in Yaniklar, whereas only 10 reports were made in Akgöl, showing a higher tendency of invertebrate infestation in Yaniklar (Tab. 1). A possible explanation for this occurrence could be that most nests infested were close to the vegetation. Nests were located closer to the vegetation in Yaniklar than at the other beach. The shorter distance may have allowed invertebrates to reach the nests more easily.

Caldwell reported abnormal, small, yolkless eggs with a diameter of 28-30 mm as one type of several unusual egg sizes that are occasionally found in *Caretta caretta* nests at Cape Romain, South Carolina, USA (Caldwell 1959). Small eggs were also discovered on 3 occasions in the years 1969 and 1970 on Sanibel-Captiva Islands, Florida, USA (Le Buff et al. 1971). In these and our cases the unusual eggs were considerably smaller than the measurements given by

Caldwell. Our eggs varied in size between 10-20mm. We assume that they act as place fillers or they could be a type of mutation. Further research is needed to make a definitive statement. Note that the average incubation time of 48 days in 2010 and 2012 has shortened by 4.9 days compared to 52.9 (SD ± 6.2) days in 2009 (range: 43-66 days). 2011 had an average incubation time of 49 days (range: 43-52 days). Here the incubation time has shortened by 3.9 days in comparison to 2009.

One interpretation is that incubation time is getting shorter. A 19-year long study in Zakynthos, Greece, and another study at Patara beach, Turkey, has reported a mean incubation time of 55 days (Margaritoulis, 2005; Öz et al., 2004). On average the incubation period in Yaniklar and Akgöl was 7 days shorter.

The most likely influence resulting in shorter incubation periods in Yaniklar and Akgöl is the temperature. One hypothesis states that shorter incubation periods produce predominantly females and longer incubation periods producedpredominantly male hatchlings (Margaritoulis, 2005). Accordingly, one can assume that the beaches Akgöl and Yaniklar produced more females because of shorter incubation times.

Another influencing factor could be the moisture level. In an experiment by McGhee (1990), incubation time was longer for eggs of *Caretta caretta* in wet sand. The short incubation times in Fethiye could mean that these beaches were drier, but a definite statement cannot be made because the sand moisture level has not been measured.

Mrosovsky and Yntema (1980) stated that incubation time is greatly influence by temperature and oxygen levels. Nests close to the sea are more likely to be inundated, which could cause changes in the above factors. Weather conditions such as excessive rainfall can also indirectly effect the ambient sand temperature, thereby increasing the incubation period (Burger 1976; Harrison 1952; Hendrickson 1958; Moorhouse 1933; Kraemer 1980).

It would be interesting to conduct further studies to determine whether the incubation time varies during the breeding season depending which month the eggs are laid as well as the nest depth and distance to the sea.

Our average distance to the sea was 19.6m (SD ± 6.8), being similar in both Akgöl and Yaniklar. Wood and Bjorndal (2000) showed a mean distance to the sea of 21.4 m. SD ± 5.5. The mean nest depth of our field course was 0.44 m, which was very similar to a study by Kraemer and Bell (1980), who reported a mean depth of 0.43 m SD ± 10.7 (Kraemer & Bell 1980). These values are very similar and seem, to be in the norm.

In Akgöl most nests found were on the sandy part of the beach, which only consists of a small area. A sandy environment makes it easy for hatchlings to reach the sea. In other parts of the

beaches hatchlings have to overcome many more obstacles, by crawling over cobbles and debris, putting them at a higher risk of getting stuck. This can increase the predatory risk and risk of desiccation, since hatchlings may take longer to reach the sea than on sandy beaches.
Egg development is prone to be influenced by various factors such as Temperature, gas exchange and sand humidity. Sandy beaches, as can be found in Akgöl are very popular with visitors, making the beach subject to anthropogenic influences such as litter and compression of sand by cars. These can effect the egg chambers environment and thus effect the development of eggs, possibly resulting in a decrease in the hatching rate.
Raising public awareness with concepts such as 'Responsible Tourism' and 'Corporate Responsibility' may help in reducing influences negative on the development of sea turtle nests (www.seaturtle.org).

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APPENDIX

Fig. 8: Hatchling caught in fishing net on shore.(Photo: S. Prader)
Abb. 8: Hatchling gefangen in ein Fischnetz, an Land.

Fig. 9: Excavation; note distinct egg chamber.(Photo: S. Prader)
Abb. 9: Exkavation; siehe deutliche Eigrube.

Fig. 10: Small eggs found in nest AS2 (Photo: O. Macek) Abb. 10: Kleine Eier in Nest AS2 gefunden

Fig. 11: Small egg connected to normal sized egg (Photo: E. Schweiger)
Abb. 11: Kleines Ei, verbunden mit einem normalen Ei

Fig. 12: Discolored eggs; potential fungal infestation of an egg. (Photo: O. Macek)
Abb. 12: Verfärbte Eier; möglicher Pilz Befall von einem Ei.

Fig. 13: Late stage embryo. (Photo: I. Rabl)
Abb. 13: Embryo in spätem Stadion.

Fig. 14: Middle stage embryo; note black eye. (Photo: I. Rabl)
Abb. 14: Embryo in mittlerem Stadion; siehe schwarzes Auge.