# Nature conservation field course: Protection of sea turtles (*Caretta caretta*) in Turkey 2011

## Projektpraktikum: Schutz von Meeresschildkröten (*Caretta caretta*) in der Türkei 2011

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## XI. Bachelor Thesis

# Kurzfassung

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Fethiye, eine Bucht an der Mittelmeerküste Türkeis, ist ein Nistgebiet der Unechten Karettschildkröte (*Caretta caretta*). Seit 1994 findet dort jährlich ein Schutz- und Forschungsprojekt der Universität Wien in Zusammenarbeit mit einer türkischen Universität (dieses Jahr Pamukkale Universität, Denizli) statt. Es ist eine Langzeitstudie, die an den Niststränden Yaniklar, Akgöl und Çaliş durchgeführt wird. Diese Niststrände gehören zu den SEPAs( Special Environmental Protection Areas), sind aber durch anthropogene Einflüsse (z.B Tourismus, Verschmutzung jeglicher Art) stark geprägt.

*Caretta caretta* steht auf der Roten Liste von IUCN und gilt als stark gefährdete Spezies. Sie nistet an Stränden in der Türkei, Griechenland, Zypern und Lybien. Neben *Caretta caretta* kommt auch *Chelonia mydas* (Grüne Meeresschildkröte) als nistende Meeresschildkröte im Mittelmeer vor.

Mit einer Gesamtzahl von 62 Nestern ist dies der niedrigste Wert seit 1994 in Fethiye.

Im Zeitraum vom 02.07 und 17.09 2011 wurden in Morgen- und Nachtschichten durch türkische und österreichische Studenten Daten über die adulten Tiere, Nistaktivität, den Hatchlingserfolg, Temperatur und Veränderungen am Strand aufzeichnet.

Die Nistaktivität zeigt leider an allen Stränden einen negativen Trend. Vor allem in Çaliş gibt es nach Einbruch der Dunkelheit eine starke touristische Nutzung der Promenade mit seinen Bars und Restaurants. Dort konnten 18 Schildkrötennester, davon 16 secret Nester, gefunden werden. Secret Nester sind jene Nester, die erste Tage nach dem tatsächlichen Legedatum oder durch den Schlupf von jungen Schildkröten gefunden werden. Somit kann man bei so genannten secret Nestern auch keine genaue Inkubationszeit angeben. Vier Spuren von adulten Schildkrötenweibchen wurden am Strandabschnitt von Çaliş gefunden, die längste Spur war 250m, die kürzeste 5.4m. Die durchschnittliche Distanz zum Meer bei Nestern entlang der Promenade betrug 16.4m. Diese Nester lagen 38% näher zum Meer als jene, die am nördlichen Abschnitt des Strandes ohne Promenade lagen. Dort lag die durchschnittliche Distanz zum Meer bei 25.1m.

Am Strand von Yaniklar und Akgöl wurden insgesamt 44 Nester gefunden. Das ist die zweitniedrigste Anzahl an Nestern, die seit 1994 gezählt wurden( 2004 wurden 37 Nester gezählt). In Yaniklar wurden 27 Nester, davon 25 secret Nester und in Akgöl 17, davon 12

secret Nester lokalisiert. Die durchschnittliche Distanz zum Meer betrug in Akgöl 19.9m und in Yaniklar 17.3m. Zwischen 3. und 24. Juli wurden 34 Spuren von adulten Weibchen an beiden Strandabschnitten gefunden (27 in Akgöl und 7 in Yaniklar). In Akgöl waren die Spuren länger (durchschnittlich 49.6m) und variierten in der Länge mehr als in Yaniklar, wo die durchschnittliche Spurenlänge 29.2m betrug. Obwohl Akgöl ein kleinerer Strandabschnitt als Yaniklar ist, wurden 79.4% aller adulten Spuren dort gesichtet.

Um Rückschlüsse auf die Eianzahl und den Hatchlingserfolg ziehen zu können, wurden 5 Tage nach dem letzten Schlupf bei jedem Nest eine Excavation durchgeführt. Am Strand von Çaliş wurden 1537 Eier gelegt, von denen 1199 Hatchlinge geschlüpft sind. Das Maximum an Hatchlingen (Schlüpflinge), die erfolgreich das Meer erreicht haben liegt bei 67.5% (1039 Hatchlinge). In 4 von 18 Nestern wurden Larven von Diptera und Coleoptera gefunden. In Yaniklar und Akgöl wurden 3464 Eier gelegt, davon waren 60% entwickelte Jungtiere (1551 in Yaniklar und 520 in Akgöl), die das Meer erfolgreich erreicht haben. Insgesamt 864 Eier (25%) wurden verschlossen in den Nestern gefunden. Tot im Nest oder den vielen Fressfeinden zum Opfer gefallen waren 529 Hatchlinge. Die Eikammern hatten eine durchschnittliche Tiefe von 0.45m und eine durchschnittliche Breite von 0.26m. Hauptschlüpfzeit war im August mit 24 Nestern. Weiters wurden in 11 Nestern Larven von Diptera und Coleoptera gefunden.

In Çaliş wurde ein Anstieg an Sonnenliegen (1624) von 26.1% und Sonnenschirmen (711) von 10.4% zum Vorjahr erhoben. Besonders hoch ist auch die Zunahme von Barrieren in Form von Strandmöbeln. Im Vergleich zum Vorjahr beträgt der Unterschied zwischen 225% (Sitzsäcke) und 375% (Tische). Auch wurzelnde Bäume oder Kunststoffmatten reduzieren die geeigneten Nistplätze von *Caretta caretta* oder hindern die Tiere daran ins Meer zu kommen. Tiefe Gräben wurden entlang der Zum Strand angrenzenden Straße gegraben um Fahrzeuge am Befahren des Strandes zu hindern. Zu den positiven Veränderungen zählt das Aufstellen von drei Informationsschildern entlang des Strandes oder auch neue Abfallbehälter entlang der Promenade. Abfallbehälter entlang der Promenade.

In Yaniklar dominieren vor allem 2 Hotelanlagen. Das Majesty Club Tuana verringerte die Anzahl der Liegen von 233 auf 201 und das Lykia Botanika von 157 auf 120. Die Sonnenschirme (2009 = 33 „Tuana“; 34 „Botanika“) am Strand wurden 2010 bei beiden Hotelanlagen durch 2 Reihen Sonnendächer ausgetauscht und die Holzstege am Strand wurden 2011 entfernt. Ab Mitternacht werden die Beleuchtungen beider hoteleigener Bootsstege abgedreht. Auch hier wurden Informationsschilder an beiden Endes von Yaniklar

und Akgöl aufgestellt, sowie ein Informationsschild am Strand vor dem Hotel Lykia Botanika. In Akgöl wurden Holzpfeiler entlang der Zufahrtsstrasse zum Strand aufgestellt, die Fahrzeuge den Weg auf den Strand versperren sollen.

Während der Feldarbeit wurden drei toten Schildkröten an den Stränden von Çaliş und Yaniklar gefunden, davon zwei *Caretta caretta* und eine *Trionyx triunguis* (Nilweichschildkröte). In den Jahren von 2000 bis 2011 konnten insgesamt 23 tote Schildkröten gefunden werden. Davon wiesen knapp die Hälfte der Tiere Verletzungen anthropogenen Ursprungs auf, wobei dies aber nicht gleichzeitig die Todesursache sein muss. Da es sich hier nur um Beobachtungen während der Sommermonate handelt, muss eine höhere Anzahl an verstorbenen Tieren pro Jahr angenommen werden. Der Jahresreport 2010 des Rescue Centers für Meeresschildkröten in Dalyan zeigt ebenso den hohen negativen Einfluß bei verletzten Tieren von Menschen insbesondere durch die Fischerei.

Drei Meeresschildkröten wurden 2011 mit einem Metalltag markiert mit den Nummern TR 0206, TR0208 und TR48. Ein *Caretta caretta* Weibchen (TR 48) wurde am 10 Juli am Strand von Akgöl gefunden und wurde in Çaliş mit einem Satellitensender ausgestattet. Dies ist die erste Unechte Karettschildkröte, die in Fethiye mit einem Satellitensender ausgestattet wurde. Im Oktober wurden noch zwei in der Bucht von Fethiye lebende Männchen mit einem Sender ausgestattet. Der Transmitter erlaubt neue Erkenntnisse über das Leben der Unechten Karettschildkröte

Weiters wurden 8 Bachelorarbeiten mit jeweils unterschiedlicher Thematik behandelt.

•Welche Auswirkungen die Nestpostition auf den Schlupferfolg hat, wurde in Yaniklar sowie Akgöl untersucht. Dazu wurde der Strand in 3 Abschnitte aufgeteilt: Nahe der Gezeitenzone (0 – 12.9m), Strandmitte (13.0m – 20.9m) und Nahe der Vegetation (> 21.0m). Den geringsten Schlupferfolg hatten demnach sowohl in Akgöl als auch in Yaniklar Nester nahe der Gezeitenzone, während Nester zwischen 13.0m-20.9m, also der Strandmitte die meisten Hatchlinge zu verzeichnen hatten.

•Strandmüll und die Auswirkungen auf einen Niststrand wurden in einer Bachelorarbeit untersucht. Müll sowohl in frei treibender Form im Meer als auch als Strandmüll kann zu Bestandseinbusen bei der Unechten Karettschildkröte führen. Um den Grad der Verschmutzung am Strand von Yaniklar feststellen zu können, wurden an 4 Strandabschnitten, die jeweils 200m² groß waren, Müll eingesammelt. Der Müll wurde nach Material und Größe bestimmt und auf die Dichteverteilung am Strand umgerechnet. Mehr als

die Hälfte des gesammelten Mülls war aus Plastik, dann folgt Schaumstoff und als dritte große Gruppe organischer Abfall. Die durchschnittliche Müllvereilung über den Strand betrug 11.1g/m² und 0.9 Gegenstände/m².

•In Yaniklar wurden die negativen Auswirkungen von Autos auf Niststränge gezeigt. Es wurden zwischen 169 Autos während dem Ramadan (Fastenmonat) und 196 Autos vor dem Ramadan am Strand gezählt. Autos werden nicht nur als Transportmittel sondern auch als Batteriequelle für Lichtanlagen und Musikanlagen verwendet. Es macht dabei den Anschein, dass adulte Tiere Strandabschnitte mit vielen Autos meiden. Zum Schutz der Jungtiere wurden Barrieren errichtet und auf ihre Wirksamkeit untersucht.

•Als zusätzliche anthropogene Störung und Problem für alle Meeresschildkröten, nicht nur für *Caretta caretta*, werden auch jegliche Arten von Wassersport gezählt. Durch Kollisionen kann es zu Verletzungen, ja sogar zum Tod kommen. Um die Gefahr des Wassersports zu verdeutlichen wurde ein Aktivitätsbudget der Wassersportfahrzeuge erstellt. Es zeigt zu welchen Uhrzeiten die meiste Gefahr für die Meeresschildkröten ausgeht. Dazu wurden zwei Zonen im Meer festgelegt, die „safe zone“ und die „permitted zone“. Die Ergebnisse zeigen, dass es vor allem in den Nachmittagsstunden zu einem erhöhten Vorkommen an Wasserfahrzeugen kommt. Einige dieser Fahrzeuge halte sich nicht an das Verbot in der „safe zone“ zu fahren und stellen somit auch eine Gefahr für Schimmer dar.

•In Agköl führte ebenfalls die Lichtquelle von einem Hotel zur Desorientiere der Jungtiere, während sm Strandabschnitt Yaniklar die meisten Hatchlingsspuren auf direktem Weg ins Meer führten, nur ein Nest zeigt eine große Ablenkung der Hatchlinge.

•Touristische Strandnutzung (Sonnenligen und Sonnenschirme) kann zu einer Veränderung der Nesttemperatur oder auch zu einer mechanischen Zerstörung der Schildkrötennester führen. Die Temperaturveränderung im Schildkrötennest wurde mit verschiedenen Beschattungsarten, darunter ein Handtuch, ein Sonnenschirm, Abfall und einer Sonnenliege durchgeführt. Die Sandtemperatur ist wichtig für die Geschlechterentwicklung der Hatchlinge. Der größte Temperaturunterschied wurde bei der Sonnenliege gemessen. Er betrug 1.3°C in 27 cm Tiefe und 0.8°C in 47 cm Tiefe.

•Auch der Grad der Lichtverschmutzung am Strand von Çaliş wurde erhoben. Çaliş ist im Vergleich zu Yaniklar durch die Strandpromenade touristisch mehr genutzt. Für die Untersuchung wurde die Promenade an Hand ihrer Geschäftslokale (Bars, Restaurants, Geschäfte und Reiseveranstalter) in 85 Sektionen unterteilt. Über Nacht wurden von nahezu

jeder Sektion Fotos erstellt um die unterschiedlichen Lichttypen festzustellen. Es konnten 1015 Lichter gezählt werden, über die Hälfte davon waren Glühbirnen. Von den 11 Nestern innerhalb des Promenadenabschnittes, befanden sich alle bis auf ein Nest im letzten Drittel der Promenade, wo die Lichtanzahl mit 28% am geringsten war.

•Zusätzlich wurden auch Touristenbefragungen durchgeführt um den Wissensstand der Urlauber zu erheben. Lediglich 62% der Touristen wissen, dass der Strand von Calis der Unechten Karettschildkröten als Nistplatz dient. Davon wurde fast ein Drittel vom Infostand, der jedes Jahr von der Universität Wien vor Ort ist, aufgeklärt. Häufig gestellte Fragen sind dabei über das Projekt, den Zweck der Schutzkäfige, die Nester, die Brutzeit, die Anzahl der Nester und über die Hatchlinge.

# Executive Summary

Christina Schraml

Fethiye is designated as a SEPA (Special Environment Protection Area) and one of the important nesting areas of the loggerhead turtle (*Caretta caretta)* in Turkey. Since 1994, a long-term study in the framework of a University of Vienna field course and various Turkish Universities (this year the Pamukkale University, Denizli) has been conducted every summer in Fethiye.

During this period, data on adult turtles, tracks, nests, hatchling success, temperature and anthropogenic disturbances were collected daily in morning and night shifts. In 2011, the data were collected by Austrian and Turkish students between 2 July and 17 September on three nesting beaches: Yaniklar, Akgöl and Çaliş. There is a strong influence of tourism (especially light pollution and leisure activities of tourists) on all three beaches.

*Caretta caretta* is classified as endangered and is listed in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species. In the Mediterranean, two species are known to nest, *Caretta caretta* (loggerhead turtle) and *Chelonia mydas* (green turtle). Other Mediterranean nesting beaches of *Caretta caretta* are in Greece, Cyprus, and Libya.

A total number of 62 nests at Fethiye nesting area, making it the year of the lowest number of nests since 1994. The number of nests decreased compared to the previous years and confirms the long-term declining trend.

The negative effects of light pollution and tourism are reflected in the decreasing number of *Caretta caretta* nests over the last 18 years. In Çaliş the influence of the promenade is very strong as there are many bars and restaurants for tourists. This year, 18 nests were found, 16 of which were so-called secret nests, i.e. they were only discovered due to the tracks of emerging young sea turtles. Four tracks were found, the longest was over 250 m and the shortest was only 5.4 m. The average distance of the nests to the sea along the promenade was 16.4 m. These nests were 38% closer to the sea than the nests north the promenade, whose average distance was 25.1 m.

At Yaniklar and Akgöl beach a total number of 44 nests were discovered – which is the second lowest number of nests since 1994 (in 2004, 37 nests were recorded). At Yaniklar beach there were 27 nests, of which 25 were secret nests. The beach of Akgöl had 17 nests

(12 secret nests). The average distance of the nests to the sea in Akgöl was about 19.9 m and in Yaniklar 17.3 m. Between 3 July and 25 July, 34 tracks were discovered on both beaches combined, 27 of them on Akgöl and 7 on Yaniklar. In Akgöl the length of the tracks was usually longer (49.6 m) and varied considerably, while in Yaniklar tracks were a lot shorter (29.2 m). Most tracks were recorded on Akgöl (79.4%) although it is by far the smaller beach.

For collecting data on the hatchling success, every nest was excavated approximately 5 days after the last hatch. In Çaliş a total of 1537 eggs were laid, and 1199 turtles hatched. The maximum success rate of hatchlings reaching the sea was 67.5% (1039 hatchlings). In 4 of 18 nests, insect larvae of Coleoptera ad Diptera were found.

In Yaniklar, 3464 eggs were laid, 60 % (2071) of which developed successfully. Of those, 1551 hatchlings reached the sea in Yaniklar, 520 in Akgöl. 864 eggs (25%) were recorded as unhatched. 529 hatchlings were reported as dead in the nest or predated. Egg chamber measurements showed an average size of 0.45 m depth and 0.26 m width. The average depth from the surface to the top of the eggs was 0.28 m. Main hatching time was in August (24 nests). In 11 nests, Diptera and Coleoptera larvae were found.

At Çaliş beach the number of all sun beds and parasols were counted. Compared to the year 2010, the increase of sun beds was 26.1% (to 1624) and the parasols increased 10.4% (to 711). The strongest increase was in the number of other beach furniture such as beanbags, with a plus of 225 % (130 items), and 183 tables represent a plus of 357% compared to the year 2010. Ditches were dug at the landward end of some beach sections to prevent vehicles from entering the beach. Positive developments were recorded this year as well. This includes new information signs on the beach and trash cans at certain locations.

In Yaniklar two hotels dominate the beach, the Majesty Club Tuana and the Lykia Botanika hotel. Both hotels placed 2 rows of sun beds on the beach and they were displaced to the back of the beach, with no wooden footbridge in between, as had been the case in earlier years. The number of sun beds decreased, in the case of Tuana from 233 to 201 and Lykia Botanika from 157 to 120.The lights of the pier were switched off after midnight. In 2010, the parasols of both hotels Tuana and Botanika were replaced by sun pavilions. Three new signs were erected; one was set up at Lykia Botanika beach area. In Akgöl, ditches were dug and wooden stakes were hammered down into the ground to prevent people from driving on the beach.

During fieldwork, three dead turtles were found on Yaniklar and Çaliş beach. Two of these turtles were *Caretta caretta,* one in Yaniklar and one in Çaliş. The third turtle was a *Trionyx*

*triunguis*. Between the years 2000 and 2011, a total of 23 dead turtles were found washed on shore. This number represents a minimum estimate because the counting only comprised the dead turtles during the sea turtle course in the summer months. About one half (48 %) of the turtles listed in the earlier reports had clear signs of human impacts. The annual report 2010 of the rescue center in Dalyan clearly shows that humans and especially the fishing industry have a negative impact on sea turtles.

Three turtles were tagged (TR0206, TR0208, TR48). No tagged turtle from the years before was sighted. One *Caretta caretta* female (TR48) was captured near Akgöl and tagged with a transmitter (TR48) in cooperation with the Stazione Zoologica Anton Dohrn (Italy) and Pamukkale University (Turkey). On 1 October, two loggerhead turtle males, which are both residents of Fethiye harbour, also received a satellite tag.

Increasing anthropogenic activity (hotels, tourism, light pollution, trash) on the nesting beaches of *Caretta caretta* influence their behaviour and hatching success. Light and noise can disturb or prevent the egg disposition and hatchlings can be irritated. Touristic use (sun beds, parasols) can alter the sand temperature and physically damage nests. The following anthropogenic actives were examined this year: beach pollution, light pollution, cars on the beach, water sport effects and sand temperature.

Eight bachelor theses, each with a separate topic, were conducted in Fethiye in 2011.

• One bachelor thesis examined if the nest position has an effect on the success of the embryonic development and what factors prevent the successful development of the animals. For this purpose, the beach was divided in 3 sections: one near the intertidal zone (0 - 12.9 m), one in the center of the beach (13m - 20.9 m) and one near the vegetation (> 21 m). The data of 3 nests per section in Yaniklar as well as in Akgöl were collected and compared. The comparison of the number of hatched turtles in Yaniklar and Akgöl shows that the success of those nests in the intertidal section was the lowest.

• Trash continues to be a big problem, both as floating material in the sea and pollution on the beach. Such marine debris can reduce nesting activity and hatchling success. At Yaniklar, beach litter was collected at four different transects (each 20 m wide and 100 m long) and was classified into 9 material categories and 4 size classes. Altogether, 7654 items were found. More than the half (55.4%) was made of plastic, followed by foam (18.3%) and organic garbage (6.6%). The average debris density was 11.1 g/m ² or 0.9 items/m².

• In addition to pollution on the beach, there were many cars (and their owners) as well. Although parking areas are available nearby, many people park their cars directly on the beach. One reason is that the cars are used as energy sources for light and/or music. The threats of parking and driving cars on the beach include running over hatchlings, frightening off the adult females, aborting nesting attempts, disorientating hatchlings, and crushing nests or compacting the sand. The number of cars counted during one week ranged from 196 (before the Ramadan fasten month) to 169 cars (during Ramadan). For a better conservation of *Caretta caretta*, the students built barriers to prevent cars from driving on the beach.

• Another frequent source of mortality to sea turtles is vessel traffic, especially in coastal waters. To get more information about the risk of vessel traffic, a general activity budget was created. The observed water area was split into two zones: the so-called safe zone (swimming area between the two piers) and the permitted zone (outside swimming area). The results show an activity peak in the late afternoon and that many vessel operators drive through the prohibited safe zone, which poses a serious risk for swimmers too.

• One bachelor thesis analysed sea finding orientation of loggerhead hatchlings at Yaniklar and Akgöl beach. On Agköl beach, one hotel with strong lights caused disorientation of hatchlings. In Yaniklar, however, almost all hatchling tracks went directly to sea because there is nearly no light pollution. This underlines the importance of Yaniklar as a nesting site.

• One study quantified the change in sand temperature at various depths through shading, simulating a natural nest at Calis beach. The shade was produced in different ways: with a towel, a sunshade, litter and a sun bed. The influence of flooding (natural tides) was tested. Sand temperature helps determine the sex ratio of the hatchlings. The highest impact on sand temperature involved shade by a sun bed, with a temperature decline of 1.3°C in 27 cm and 0.8°C in 47 cm depth.

• Another problem of human activity is light pollution along the promenade in Çaliş. Many bars, restaurants, travel agencies and other shops are located there, many of which are very strongly illuminated in the evening and night time. To help quantify light pollution, the promenade was divided into 85 sections (each section representing one building). After taking photos of each of these sections at night, the light sources were classified into different types. Compared to 2010, the total number of lights increased to 1015. Altogether there were 11 nests. All nests except one were located in the last third of the beach. In this third the number of lights was the lowest (28%) in comparison to the other two thirds (34% and 38%).

• For a better understanding between tourists and *Caretta caretta*, interviews were conducted with holiday-makers on Çaliş beach. Only 62% of the tourists knew about the nesting activity of the Loggerhead turtle on this beach. One third of these persons got their information from the information booth on the promenade, which is an initiative of local and regional sea turtle conservation organizations and various universities and is open on Çaliş beach every summer Frequently asked questions concerned the project, the purpose of the (protective) cages, nests, nesting season, and the number of nests and hatchlings.

# The nesting season of adult loggerhead turtles (*Caretta caretta*) on Çaliş Beach (Fethiye, Turkey) in 2011

Nikolaus Filek

KURZFASSUNG

Zwischen 02 Juli und 17 September 2011 wurde das langjährige Projekt zum Schutz und zur Erforschung der gefährdeten Schildkrötenart *Caretta caretta* im Zuge eines Artenschutzprogamms am Strand von Çaliş (Fethiye, Türkei) durchgeführt.

21 österreichische StudentInnen der Universität Wien haben zusammen mit 8 türkischen StudentInnen der Universität Pamukkale 78 Tage in täglichen Morgen- und Abendschichten auf dem ca. 3 km langen Strand das Nistverhalten der Meeresschildkröte *Caretta caretta* beobachtet und untersucht. Das internationale Team ist im Rahmen des Projekts dafür verantwortlich, dass auf dem Strand, welcher „Special Environment Protected Area" (SEPA) ist, in den kommenden Jahren auch weiterhin Meeresschildkröten ihre Nester bauen können. Der Strand wird jedoch auch stark touristisch genutzt und es entstehen immer mehr Restaurants, Bars und Hotels auf Kosten naturbelassener Sumpfgebiete. Aus diesem Grund, und der damit einhergehenden starken Promenadenbeleuchtung, wird es immer schwieriger für die Meeresschildkröten ungestört zu nisten. Die negativen Effekte der Lichtverschmutzung und des Tourismus spiegeln sich in den abnehmenden Nestzahlen der letzten 18 Jahre wider. Verglichen mit dem ersten Projektjahr 1994, wo 36 Nester dokumentiert wurden, fand man dieses Jahr nur die Hälfte.

Insgesamt wurden Daten von 18 Nestern und 4 Spuren erhoben. Der durchschnittliche Abstand der Nester zum Meer war 16.4 m entlang der Promenade und 25.1 m im nordwestlichen Teil des Strandes. Die längste Spur war über 250 m und die kürzeste Spur nur 5 m lang. Es wurden zwei adulte Schildkröten bei einem Landgang von türkischen Kollegen beobachtet, vermessen und anschließend markiert.

Das Projekt ist Bestandteil eines sicheren Fortbestehens der Meeresschildkrötenpopulationen im Mittelmeergebiet und zeigt die Komplikationen mit zunehmendem Tourismus auf.

ABSTRACT

Between 2 June and 17 September 2011 at Çaliş Beach (Fethiye, Turkey), a long-term conservation and research field course on the loggerhead sea turtle (*Caretta caretta*) turtle was conducted.

Over 78 days, 21 students from the University of Vienna and 8 students of the University Pamukkale observed and documented the nesting behavior of the loggerhead sea turtles in daily morning- and night shifts at the 3-km-long beach. This international team is working to secure the future of the sea turtle population in the Mediterranean Sea, especially on Çaliş Beach, which is a Special Environment Protected Area (SEPA). The beach is also a hot spot of 'sea, sand and sun' tourism, and restaurants, bars and hotels have rapidly grown in this wetland area. Because of this and the strong promenade lighting, safe and undisturbed nesting is becoming increasingly difficult for the sea turtles. The negative effects of light pollution and tourism are reflected in the decreasing number of *Caretta caretta* nests over the last 18 years. Compared to the first field course 1994, when 36 nests were recorded, this year only half of this number of nests was found.

18 nests and 4 tracks were found this year: The average distance of the nests to the sea next to the promenade was 16.4 m; for the nests north the promenade, the average distance was 25.1 m.The longest track was over 250 m and the shortest was only 5.4 m. Two adult female turtles were observed by our Turkish colleagues, measured and tagged.

These efforts are necessary to preserve the population of sea turtles, despite all the negative human impacts.

INDRODUCTION

In the Mediterranean Sea, two species of marine turtles, *Chelonia mydas* (the Green Turtle) and

*Caretta caretta* (the Loggerhead Turtle) have been recorded as nesting. Both species are protected under the Convention on the Conservation of European Wildlife and Natural Habitats

(Bern Convention) and the Convention for the International Trade in Endangered Species

(CITES) and classified as 'endangered' and

Fig.1: Çaliş Beach next to Fethiye
Abb.1: Çaliş Beach nahe Fethiye
(Photo: M. Stachowitsch)

'vulnerable', respectively, by the IUCN
(International Union for the Conservation of Nature and Natural Resources; the World Conservation Union) (Broderick & Brendan, 1996).
New research has shown that, besides the Loggerhead turtle (*Caretta caretta*) and the green turtle (*Chelonia mydas)* a third species was recorded in the Mediterranean Sea, the leather-back turtle *(Dermochelys coriacea)* (Casale, 2010).
The status of marine turtle populations varies greatly on a global scale. Some populations are declining and in some cases near extinction, while others are stable or even increasing. There are five major threats that endanger marine turtles today, as well as other less significant hazards - all are the result of human activity. The five major hazards are: fisheries impacts, direct take, coastal development, pollution and pathogens, and global warming (IUCN).

The loggerhead turtle is characterized by a huge head and large crushing jaws (Spotila, 2004). The head and the carapace of the adult turtles are reddish brown, the ventral side of the carapace is brighter, with diffuse dark margins. Compared to other species this turtle has a larger head and beak, allowing them to feed on hard-shelled animals such as crustaceans and molluscs. Unlike other female turtles, they can also bite if disturbed while building a nest. These turtles lay one to four clutches in one summer. Accordingly, it would be theoretically possible that just 4 or 5 turtles came to Çaliş Beach this year to produce the 18 documented nests. Sea turtle nesting beaches are not necessarily close to their foraging grounds, which are widespread.
The loggerhead sea turtle (*Caretta caretta*) nests on sand beaches where they emerge at night and first swim parallel to the shoreline for some time in order to monitor the beach. When there is no source of disturbance the turtles come ashore searching the area for a suitable location for a nest, considering place and substrate. When a female turtle searches for a nesting site, she usually pauses at the site and then starts making a body pit. This involves turning the anterior edge of a flipper down in the sand and pushing the limb back so that sand is swept backward (Hailman & Elowson, 1992).
The next step after making a body pit is digging the egg chamber in which the turtle will release her eggs. There are unfertilized and fertilized eggs. The female will lay around 100 eggs in a probably 50 cm deep chamber.
The digging of the egg chamber is an energetically costly and complex phase of nesting. The female turtle remains stationary when laying eggs because the chamber is directly beneath the animal's extended cloacal tube (Hailman & Elowson, 1992).

The last step for a nesting turtle is to camouflage the nest with sand and other material on the beach. They do so by movements of the flippers and often the turtle throws the sand a few meters with all the energy it has left in order to cover up the nest. If there were no tracks to localize the nest, it would be nearly impossible for a human eye to find the nest after such a camouflage. Finished with the nesting, the turtle turns around and returns to the ocean.

The beach in Çaliş, next to Fethiye (Fig. 1), is a hot spot for tourism. But this coastal ecosystem also supports high levels of biodiversity. However, coastal areas also support the highest densities of the human population (Small & Nicholls 2003) and are popular tourist destinations. These two factors have been shown to negatively affect the environment (Miller & Auyong 1991). On Çaliş Beach (Fig 8)., for example, this is evident in the well-lit promenade or the picnic area, where at every sunset Turkish families gather together, sitting on carpets and making dinner, also with bright light sources. They also go swimming which is disturbing for female turtles and may prevent them from going on land. Another big problem is the lack of sea turtle-relevant information: tourists and locals are poorly informed. Without sufficiently informing holiday-makers or local residents in Çaliş in order to prevent the loss of the sea turtle population in the Mediterranean Sea, it is a possible scenario that by the year 2030 there will be no more nests on Çaliş Beach.

## MATERIAL AND METHODS

From 2nd July to 17th September 2011, students from the University of Vienna and University Pamukkale worked on a *Caretta caretta* species protection field course on Çaliş Beach in Fethiye, Turkey. This beach is a Special Environment Protected Area (SEPA), which means there are laws to prevent damage to nature and to protect the animals and flowers within the area. But only one sign is present on the 3.5km long beach to inform tourists and residents (Fig 9). Çaliş Beach is a hot spot of tourism, so it was the task of our team to support the turtles when they went on the land to lay a nest.

### Night shifts

Before the night shifts began, the plastic netting on the nest cages had to be pulled down in case of hatching. This was necessary to ensure that the hatchlings could not escape and could be collected when the students checked the nests during the night shift. While it may seem illogical to keep the young turtles briefly caged, this is in fact the only possibility to keep the hatchlings safe: they all would otherwise run in the wrong direction towards the promenade

because of the light pollution from the bars and restaurants. Most of them would die of exhaustion and predators such as dogs. We also noticed that the hatchlings run very long distances parallel to the sea shore, always toward the promenade lights, and only turn back to the sea in darker parts of the beach.

The night shift lasted at least 4 hours from 22:00 until 02:00 and the route along the beach was walked four times. Starting point was in front of Mutlu Hotel (Fig.7) and end point was near the Surf Café (Fig.6). In this shift the beach was monitored for adult turtles to secure their going on land and/or to record their tracks to look for already dug nests and compare the track lengths and widths.

In case an adult turtle emerged from the sea, the team members stayed absolutely quiet in order not to frighten the animal. The observers should sit or lie on the ground: any noise could cause the turtle to return to the sea without digging a nest. This meant no talking by the team members. During the egg-laying process the students could observe the ovipositor from behind, dropping one egg after another.

When the female is finished, she covers the egg chamber with sand in a process called camouflage. On its way back to the shore, the measurements began. The first student had to hold the turtle tightly from behind, because *Caretta caretta* has powerful jaws and a potentially painful bite. The second student was responsible for the measurement with a wooden calliper and a measurement tape. With the wooden calliper, the straight length (SCL) and width (SCW) of the carapace were measured, and with the tape the curved length (CCL) and width (CCL) was measured. The third student collected the data and wrote it in a field documentation booklet. Afterwards, this information was transferred to the data sheets.

During this process the turtle was checked for any tags on its flippers. If there was no tag, the Turkish colleagues tagged some turtles on the right flipper. This was not seen by any Austrian student this year. Other information such as on epibionts or injuries was gathered, and the turtle was then released to the sea.

One important task was to find the nests. The students tried to locate them by using a metal rod (’shish’), pushing it carefully in the sand. It is possible to find the nest because the sand on top of the egg chamber is much softer and looser, making it easier for the metal rod to penetrate the sand.

To find the nest again in the morning shift, a triangulation was made. For the triangulation, the students looked for three distinct points of reference near the nest, landmarks such as stairs in the promenade wall or a tree. It was very important that these landmarks be reliable throughout the summer. With a tape measure, one landmark on the left and one landmark on

the right were chosen and marked. A third was mostly chosen directly straight to the nest, typically from the promenade wall (Fig.2). Other measurements included the distance to the sea and the different zones of sand (dry, moist, wet).

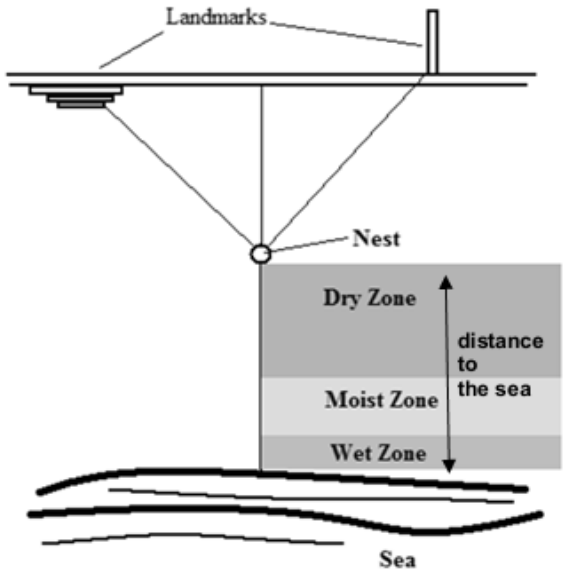



Fig. 2: Schematic illustration of a triangulation to secure the position of a nest
Abb. 2: Skizze einer Triangulation (Grätzl & Greistorfer, 2010)

After this step, metal cages were put over the nests in order to protect the hatchlings from predators and retain the turtles when they hatch and inform the tourists and residents that there is a *Caretta caretta* nest underneath the sand. They were equipped with loose plastic mesh nets.

On 1st August the night shift was changed, the breeding season was over and the students did not see any adult turtle during July. Therefore, monitoring involved a hatchling control.

Between 22:00 and 02:00, only the nests were controlled every hour.

**Morning shifts**

The morning shift started at 06:00 and typically lasted until 08:00. The purpose of this shift and the task for the students was to look for tracks of any sea turtles that had come out in the night after the last night shift ended. When a track was found the students measured the length and the width of the track. Additionally the number of body pits and incomplete egg chambers were noted. This procedure was done with every track, regardless of the nesting success.

In the morning shift, the triangulation was made for every nest. This also helped to determine whether the position of the cages had been changed: sometimes visitors removed the cage from its original spot.

The plastic net had to be pulled up every morning shift because if hatchlings emerge during the day their path to the sea is not blocked.

RESULTS

**Nests**

On Çaliş Beach there were 18 nests in the breeding season 2011. 16 of these nests were 'secret nests'. That means the adult turtle was not observed during egg deposition. When the Austrian students arrived, there were already 8 nest cages on the beach. Nests C1 & C2 were the only nests with a documented nesting date (Tab.1). CS1-CS6 had just an approximate estimate from our Turkish colleagues. CS7-CS16 were all found after the first hatch by observation of the hatchling tracks in the night- or morning shifts. 11 of the nests were laid in front of the promenade, 7 in the area north the Picnic zone (Fig. 5, Fig. 6 and Fig. 7). There were 3 nests less compared with the last year. The nesting time ended on 4$^{th}$July, which is shorter compared to the last two years (2009: August 6$^{th}$; 2010: July 10$^{th}$) (Federspieler & Sperandio, 2009; Grätzl & Greistorfer, 2010). This year there was one nest less than the average number of the last 18 years (19 nests), but the overall trend appears to be declining (Fig. 3).

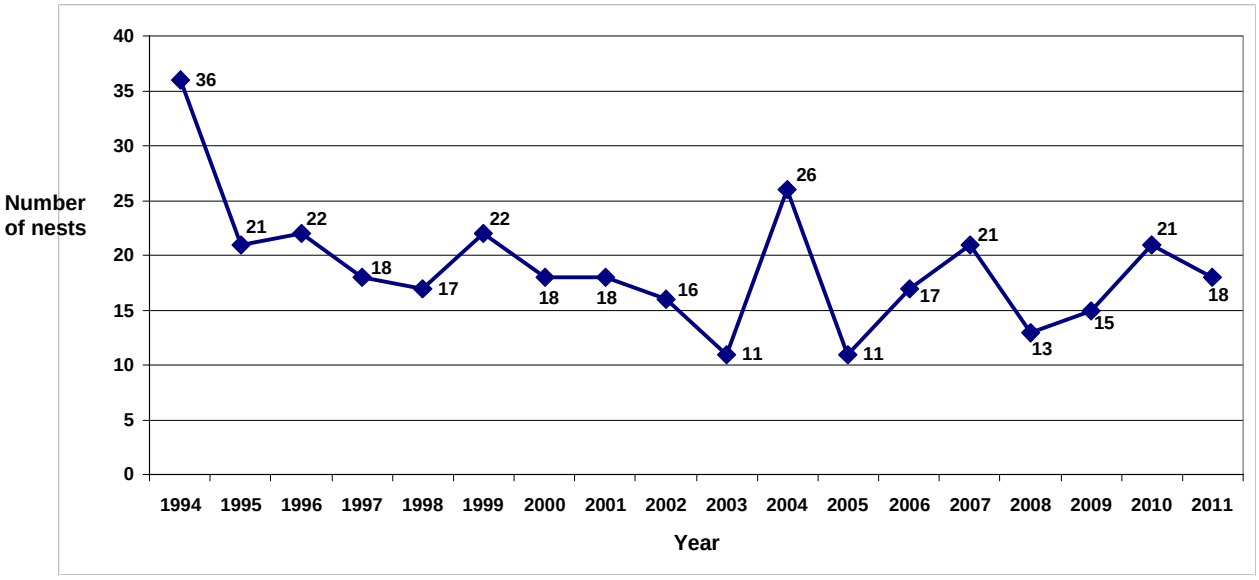



Fig. 3: Development of the number of nests in the years 1994 – 2011 on Çaliş Beach. The line shows fluctuations but what appears to be an overall decreasing trend.

Abb. 3: Entwicklung der Nestanzahl in den Jahren 1994 – 2011 am Strand von Çaliş. Ein genereller Rückgang ist zu beobachten.

The average distance of the nests to the sea next to the promenade was 16.4 m (Fig. 4, grey bars). Those nests along the promenade wall were 38% closer to the sea than the nests north the promenade, whose average distance was 25.1 m (Fig. 4, white bars).

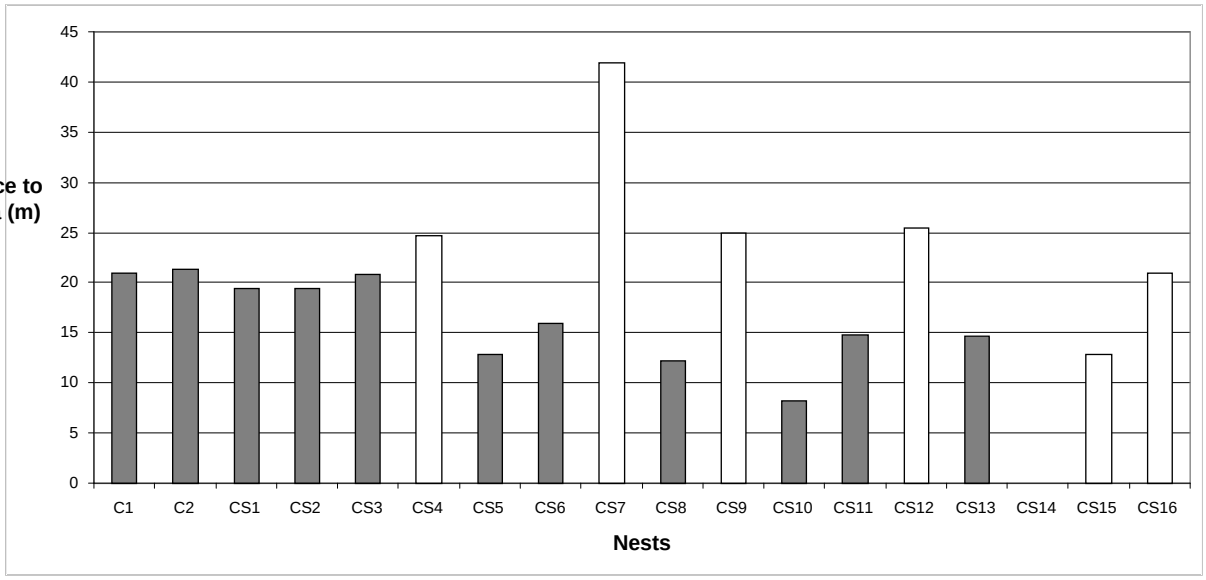



Fig. 4: Nest distance to the sea in meters. Gray bars: nests in front of promenade wall; white bars: nests positioned elsewhere.
Abb. 4: Abstand der Nester von der Wasserlinie in Meter. Die grauen Balken stellen die Nester bei der Promenadenmauer und die weißen Balken die Nester abseits der Promenadenmauer dar.

This season there were a few so-called ‘problem nests’, where different incidents occurred. CS3 & CS13 continuously hatched during the day: our team was often called by café owners or tourists to pick up the hatchlings before they were burnt by the sun. One dead hatchling was found deposited on the table in front of the info desk.

CS4 was located on bad substrate; there were many big stones in the sand. Although the students kept the stones away from the top of the egg chamber and protected the nest with a cage, dogs dug in the nest. One morning shift there were several eggs and half dead hatchlings on the surface.

CS7 was located near the new hotel complex ‘Sunset Apartments’ (Fig. 6). One week before hatching started, an excavator compressed the sand of the nest (Fig. 10). Furthermore strong light sources occure from the complex.. This led the hatchlings over the street, where after the first hatch 5 young turtles run over by cars (Fig.11). The hotel manager assured that he saved around 55 hatchlings, but after the excavation it was clear, based on the number of eggs, that he only could have saved around 28.

CS9 was found after the first hatch in the morning shift, where approximately 5 hatchlings emerged. Thereafter, the egg chamber partially collapsed and the other turtles got stuck in the nest. 29 hatchlings were saved and brought to sea, but it was not noticed that 25 were still trapped and these individuals were found dead when the nest was excavated.

CS16 was on the Surf Café grounds (Fig.6) and got wet everyday because they owners water their plants. In Çaliş Beach, no hatchery was made during the nesting season 2011.

Tab. 1: Overview of the nests at Çaliş Beach in 2011: distance to the sea and the beach zones (dry, moist, wet). (n.d.: no data, -: no date or track was observed)
Tab. 1: Überblick über die Nester am Strand von Çaliş im Jahr 2011, die Entfernung zum Meer und die Strandzonen (trocken, feucht, nass). (n.d.: keine Daten, -: weder Datum noch Spur vorhanden)

| NestNr. | Date | Distance to the sea(m) | Track Nr. | Dry zone (m) | Moist zone (m) | Wet Zone (m) |
|---|---|---|---|---|---|---|
| C1 | 20.06. | 20.9 | - | 12.3 | 7.1 | 1.5 |
| C2 | 04.07. | 21.3 | - | 13.8 | 3.5 | 4.0 |
| CS1 | - | 19.4 | - | 10.5 | 6.7 | 2.2 |
| CS2 | - | 19.4 | - | 11.1 | 6.7 | 1.6 |
| CS3 | - | 20.8 | - | 12.8 | 6.1 | 1.9 |
| CS4 | - | 24.7 | - | 16.7 | 4.0 | 4.0 |
| CS5 | - | 12.9 | - | 6.4 | 4.8 | 1.7 |
| CS6 | - | 16.0 | - | 8.5 | 5.9 | 1.6 |
| CS7 | - | 41.9 | - | 37.9 | 2.0 | 2.0 |
| CS8 | - | 12.3 | - | 7.4 | 3.5 | 1.4 |
| CS9 | - | 25.0 | - | 23.5 | 1.0 | 1.5 |
| CS10 | - | 8.3 | - | 2.6 | 2.1 | 3.6 |
| CS11 | - | 14.8 | - | 9.6 | 3.0 | 2.2 |
| CS12 | - | 25.4 | - | 20.0 | 4.6 | 0.8 |
| CS13 | - | 14.7 | - | 4.8 | 5.9 | 4.0 |
| CS14 | - | n.d. | - | n.d. | 3.5 | 2.5 |
| CS15 | - | 12.8 | - | n.d. | n.d. | n.d. |
| CS16 | - | 20.9 | - | n.d. | n.d. | n.d. |

**Tracks**

Only 4 tracks were found on Çaliş Beach, two (Track 1 & 3) in the north-west part of the beach north the Picnic area and the other two (Track 2 & 4) in front of the promenade. None of them were associated with successful nesting, but at least in two cases (Tr. 1 & 3) the turtle tried to dig a nest.

Track 1 was over 250 m long (Fig. 12) and located in the northern area of the beach. This is an indicator that the turtle had enough time without being disturbed, but in this area the sub-

strate conditions were not good (stones, pebbles). A body pit and an incompletely build egg chamber were found.

Track 3 was over 50m long and also in the northern area. Here, a body pit and an unfinished egg chamber were also found. Conditions of the substrate were not good (stones, pebbles).

Tracks 2 & 4 were very short tracks in front of the promenade (Tab.2). The light pollution and the disturbance level in this area are quite high. The shape of both tracks is a semicircle from the sea directly back into the sea. The shortest track was only 5.40m long.

Tab. 2: Overview of tracks at Çaliş Beach in 2011.
Tab. 2: Überblick über die Spuren am Strand von Çaliş im Jahr 2011.

| Track Nr. | Track Date (2011) | Furthest distance to the sea [m] | Total length of track (m) | Track width (cm) | Number of body pits | Number of unfinished egg chambers |
|---|---|---|---|---|---|---|
| 1 | 05.07. | 73.5 | 256.8 | 60.0 | 1 | 1 |
| 2 | 16.07. | - | 5.4 | 70.0 | 0 | 0 |
| 3 | 18.07 | 27.3 | 54.6 | 63.0 | 1 | 1 |
| 4 | 19.07 | 5.2 | 10.5 | 65.0 | 0 | 0 |

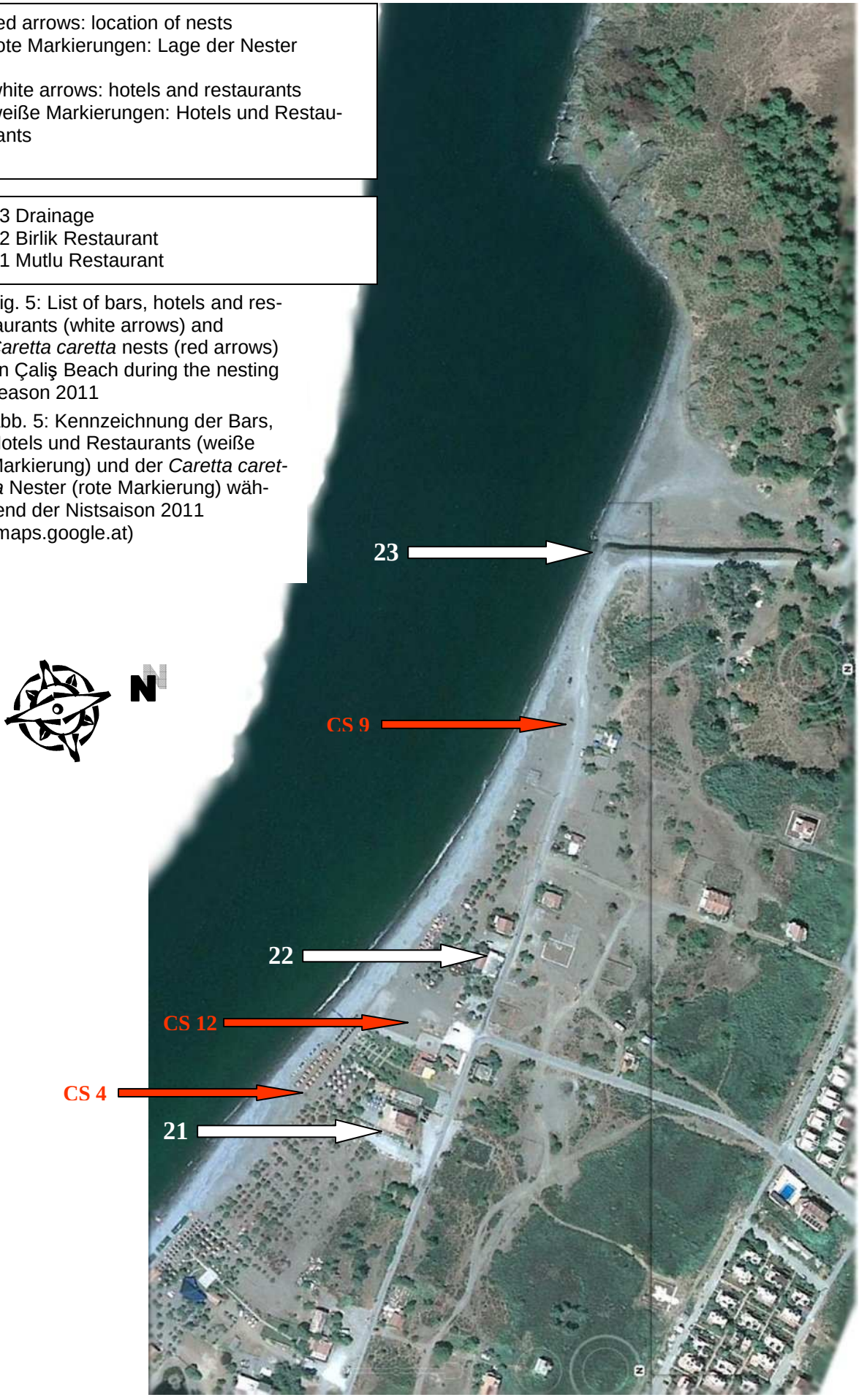
red arrows: location of nests
rote Markierungen: Lage der Nester

white arrows: hotels and restaurants
weiße Markierungen: Hotels und Restaurants

23 Drainage
22 Birlik Restaurant
21 Mutlu Restaurant

Fig. 5: List of bars, hotels and restaurants (white arrows) and *Caretta caretta* nests (red arrows) on Çaliş Beach during the nesting season 2011

Abb. 5: Kennzeichnung der Bars, Hotels und Restaurants (weiße Markierung) und der *Caretta caretta* Nester (rote Markierung) während der Nistsaison 2011 (maps.google.at)



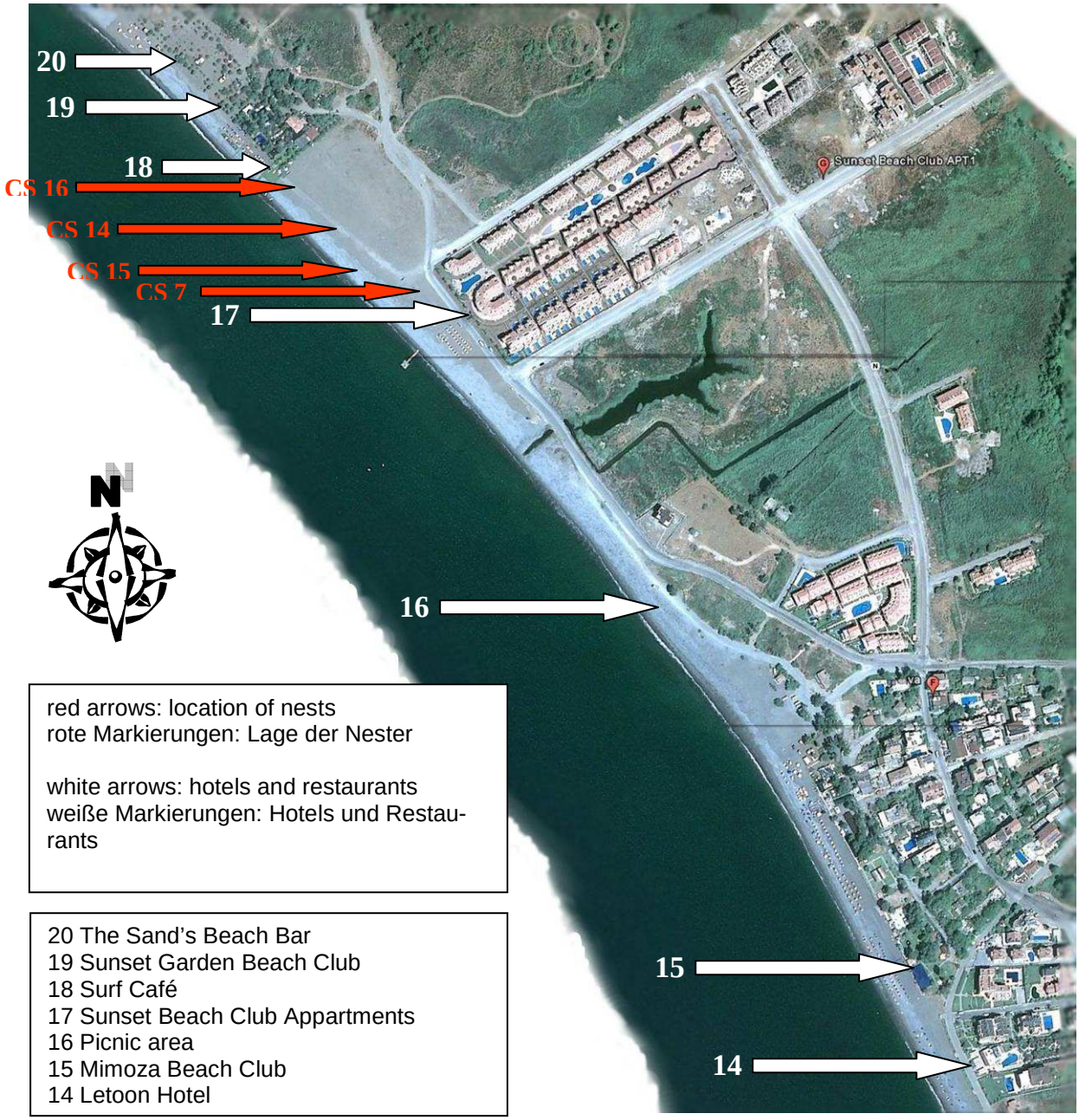



Fig. 6: List of bars, hotels and restaurants (white arrows) and *Caretta caretta* nests (red arrows) on Çaliş Beach during the nesting season 2011

Abb. 6: Kennzeichnung der Bars, Hotels und Restaurants (weiße Markierung) und der *Caretta caretta* Nester (rote Markierung) während der Nistsaison 2011 (maps.google.at)

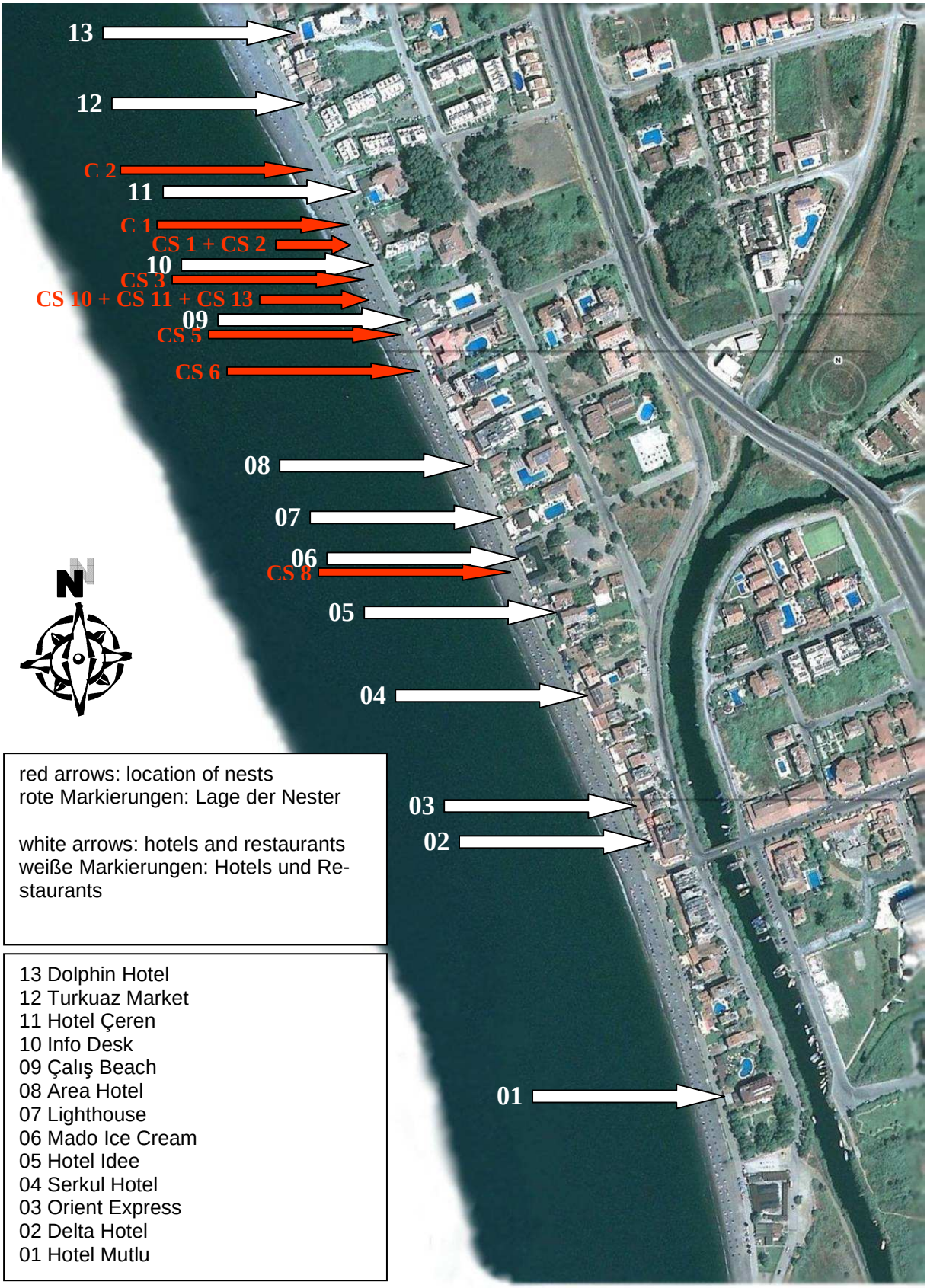



Fig. 7: List of bars, hotels and restaurants (white arrows) and *Caretta caretta* nests (red arrows) on Çaliş Beach during the nesting season 2011

Abb. 7: Kennzeichnung der Bars, Hotels und Restaurants (weiße Markierung) und der *Caretta caretta* Nester (rote Markierung) während der Nistsaison 2011 (maps.google.at)

**Adults**

During the 2011 nesting season, two adult turtles were observed and tagged by the colleagues of the Turkish University Pamukkale. The first *Caretta caretta* was observed on 20th June and the second on 4th July. After that date, no more living adult sea turtles were seen on Çaliş Beach by the Austrian or the Turkish observation team.

Both turtles were tagged on the right flipper and none of them had an epibiont (an organism living on the surface of another living organism, wikipedia.org), according to the data of the Turkish colleagues. They measured the carapace length and width of just one of those two individuals (Tab. 3).

Tab. 3: Size and Tag-number of the observed adult loggerhead turtles on Çaliş Beach in 2011 (CCL: curved carapace length, CCW: curved carapace width, SCL: straight carapace length, SCW: straight carapace width).
Tab. 3: Größe und Tag-Nummer der beobachteten adulten unechten Karettschilkröten am Strand von Çaliş im Jahr 2011 (CCL: gekurvte Carapaxlänge, CCW: gekurvte Carapaxbreite, SCL: gerade Carapaxlänge, SCW: gerade Carapaxbreite).

| Adult-number | Date (2010) | Tag-number | SCL (cm) | SCW (cm) | CCL (cm) | CCW(cm) | Epibionts |
|---|---|---|---|---|---|---|---|
| 1 | 20.06. | TR Y 0206 | 67 | 50 | 75 | 57 | 0 |
| 2 | 04.07 | TR Y 0208 | - | - | - | - | 0 |

DISCUSSION

**Nests**

During the 2011 field course, 16 out of 18 nests were secret nests, i.e.> 88%. That means that only for two nests there was a corresponding observation of an adult female sea turtle. These observations were documented by the Turkish colleagues, and although the night shifts of the Austrian students already begun on 3rd July, there was a *Caretta caretta* emergence on 4th July at 3:45 recorded by the Turkish team after the official night shift. This was the last adult turtle seen during this years nesting season. The Austrian students did not see any adult in Çaliş in 2011. Except one nest (C2, which was laid on 4th July) all others were laid in June or earlier. This situation was also shown in earlier field courses, and therefore it would be optimal to expand the project to the whole of June. Unfortunately, most Austrian students could not leave the University in Vienna at that time because of the exams at the end of a semester. Perhaps volunteers could gather this important data in June. The Turkish team was on Çaliş Beach earlier this year, and discovered the first 8 nests. The remaining 10 nests were all found by Austrian and Turkish students together, as they walked the shifts together. Communication problems led to coordination problems for the shift plan leading to exhausting shifts. An in-

crease of students at the very beginning of the project would be helpful to relieve such bottlenecks.

The first two weeks only 8 nests were known on the beach and it seemed to be a bad year for successful nesting. In the end however, 18 nests were documented, one less than the average of 19 from the data of the last 18 years. It is in some ways remarkable that, despite the tourists, strong light pollution on the promenade, the beach furniture and litter, *Caretta caretta* still emerges to dig their nests here.

Remarkably, 11 of 18 nests were built nearly in the same area in front of the promenade: 10 nests were located more or less in front of our info desk. One possible explanation is that the light pollution in this part of the beach is lower than in other parts, where every night of the week the bars and restaurants vie for attention of the tourists with light shows and very loud music, which is audible along the entire beach.

The average distance of the nests to the sea next to the promenade was 16.4 m. This is 38% closer to the sea than the nests to the north of the promenade, whose average distance was 25.1 m. One logical explanation is the delimitation of the beach by the promenade wall. After the promenade, there is more space for a sea turtle to crawl inland; there, the substrate is less ideal over the first 15 m, so most of the turtles dug their nests beyond this 15 m line.

Without the nest cages, many hatchlings would die. The cages are also indispensable in order to protect the nest and hatchlings against predators. They are also a very important 'eye catcher' on the beach. Although the cages were often used as a garbage bin or were moved or misused by tourists to hang their bathing suits, many people asked about their purpose on the beach. This means that information was provided based solely on the presence of the cages.

**Tracks**

This year, only 4 tracks were found on Çaliş Beach, which is a strong decrease compared with the last two years (2009:12; 2010:17). Two tracks were located in the north-west part of the beach above the Picnic area and the other two in front of the promenade. None of them were associated with successful nesting, but at least in two cases the turtle tried to dig a nest. These efforts were made north the picnic area, where as mentioned above, the light pollution and the disturbance level are not as high as in front of the promenade. This can be illustrated with one of those two tracks, which was over 250 m long. Moreover, nesting may have been unsuccessful due to bad substrate. Both tracks in front of the promenade were very short; the semicircle shape of the tracks indicates that the turtle was frightened and turned immediately back into the sea without any effort at making a nest.

Compared to the last two years (2009: August 6th; 2010: July 10th) (Federspieler & Sperandio, 2009; Grätzl & Greistorfer, 2010) the nesting season decreased (July 4). In light of global climate change, such developments might be important to study in future research.

**Adults**

No living adult was seen on Çaliş Beach by the Austrian students. The Turkish colleagues were able to observe two individuals. The first observation was made before the project started for the Austrians and the second was made shortly after arrival of the Austrian team during the time between night shift and morning shift. Although sea turtles can arrive after the night shift ended, it is important to start this shift at 22:00. At this time, many tourists would still be present, potentially filming it or taking photos. It is more necessary to protect the nesting procedure at this earlier time than during the night after 02:00, because only a few people are on the promenade then.

In general, a lot more information must be given to the tourist and residents. There was one old sign providing information about the Special Environment Protected Area, and during this year's field course three signs were additionally positioned. Hopefully, many people will see them. Otherwise, the only information about the turtles is given at our info desk during the project time and this is definitely not enough. There should be information for tourists and locals all year round, maybe in hotels, bars or restaurants. The people living in Çaliş should better know the ecological importance of their beach in order to preserve an endangered species. The people coming to Çaliş as tourists should be informed before they even arrive, e.g. by hotels on their internet pages. Brochures could be made available on planes headed towards sea turtle nesting areas, not only on the Turkish shores, but all sea turtle nesting beaches.

Our observation and research efforts to protect the sea turtle are merely a small effort to preserve the population. The current developments and tourism boom, along with new building sites and more and more waste on the beach will have negative impacts on this species, which has been there for 200 million years.

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http://iucn-mtsg.org/about-turtles/ (23.10.2011)

APPENDIX ( all photos taken by M. Lampropolous)

Fig. 8: Calis Beach: Promenade area, note beach visitors bring their own sunshades.
Abb. 8: Calis Beach: Strandabschnitt bei der Promenade; Strandbesucher bringen eigene Sonnenschirme mit.

Fig 10: Excavator next to nest CS 7.
Abb. 10: Bagger neben Nest CS 7.

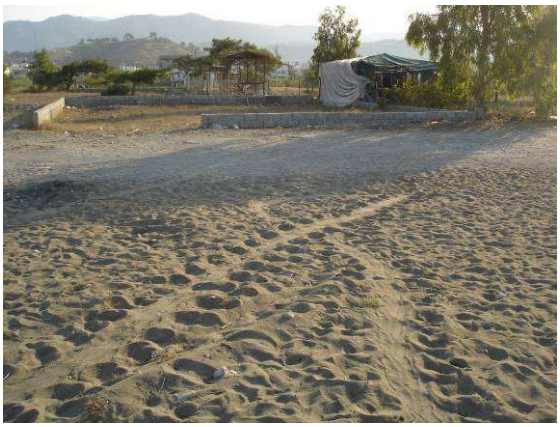

Fig. 12: Track 1: over 250 m long, passes a street and leads to a concrete wall.
Abb. 8: Track 1: 250 m lange Spur führt überdie Straße zu einer Betonmauer.

Fig. 9: Information sign on the beach at Picnic area in the middle of the beach.
Abb. 9: Hinweisschild in der Strandmitte nahe der „Picnic area“.

Fig. 11: Dead hatchling from nest CS 7 run over by vehicle in front of Sunset Appartments
Abb. 11: Überfahrener toter Hatchling von Nest CS7auf der Straße vor Sunset Appartments.

# Nesting Activity of the Loggerhead Sea Turtle, *Caretta caretta*, on the Beaches Yaniklar and Akgöl at the Turkish Mediterranean Coast, 2011

Nina Gallmetzer

KURZFASSUNG

Die beiden Strände Akgöl und Yaniklar in der Nähe von Fethiye stellen in der Türkei einen der wichtigsten Nistplätze für die Unechte Karettschildkröte dar. Daher werden im Zuge des Meeresschildkröten Projektpraktikums seit 17 Jahren Daten erhoben, um das Nistverhalten der Population in Fethiye zu untersuchen. Auch dieses Jahr arbeiteten vom 2. Juli bis zum 17. September Studenten der Universität Wien in Zusammenarbeit mit Studenten der türkischen Universität Pamukkale an diesem Projekt. Leider setzte sich dabei auch heuer der Trend der letzten Jahre fort und die Anzahl der Nester sank weiter. Heuer wurden insgesamt 44 Nester gefunden. Damit wurde das Jahr 2011 zum Jahr mit der zweitniedrigsten Nesteranzahl, die jemals erhoben wurde. Insgesamt wurden zudem 34 Spuren gezählt, die eine durchschnittliche Anzahl von 0,9 bodypits aufwiesen.

Ursachen für diesen Trend lassen sich vermutlich in erster Linie im steigenden Tourismus auf dem an sich unter Schutz stehenden Küstenabschnitt finden. Zwar wurde Fethiye 1988 als SPA (Special Protection Area) ausgewiesen, die Schutzmaßnahmen werden allerdings nur wenig umgesetzt.

ABSTRACT

The beaches of Fethiye represent one of the most important nesting sites for *Caretta caretta* in Turkey. For that reason the university's Sea Turtle Field Course started collecting data 17 years ago to monitor the nesting activity of the population nesting around Fethiye. In 2011, students of the Universities of Vienna and Pamukkale worked on that project together from 2 July to 17 September to collect data. 34 tracks of adult turtles were counted, showing an average value of 0.9 bodypits per track.

The trend for decreasing numbers of nests over the past years apparently continued this year. In 2011 a total number of 44 nests were recorded, making it the year with the second lowest number of nests since 1994.

The main reason for this development probably involves increasing tourism. Although Fethiye was designated an SPA (Special Protection Area) in 1988, only few specific measures have been implemented to protect the turtles in this area.

## INTRODUCTION

The “Sea Turtle Field Course” was first conducted in 1994 in Fethiye, Turkey, and aims to collect data and thereby provide an opportunity to monitor the development of a population of *Caretta caretta* sea turtles nesting in Fethiye. In 2011, the first group of Austrian students arrived on 2 July and the last left Turkey on 17 September.

The loggerhead turtle is the most common sea turtle species in the Mediterranean, laying an average of 5031 nests every year, most of them on nesting sites in Cyprus, Greece and Turkey. 27.2 % of those nests can be found on several nesting sites along the Turkish coast (Margaritoulis et al., 2003), Fethiye being one of the most important, according to nest number and density (Özdemir et al., 2008).

Although Fethiye was designated an SPA (Special Protection Area) in 1988 (Özdemir et al., 2008), large parts of Akgöl and Yaniklar are nowadays characterized by anthropogenic disturbance caused first and foremost by two big tourist resorts. As for turtle protection, two signs have been put up to inform tourists as well as local residents about Fethiye’s important role as nesting site for an endangered species, both placed at rather remote parts of the beach.

Due to a high degree of noise and light pollution, big tourist resorts (such as “Club Tuana” and “Lykia Botanica”) pose a problem for sea turtles. At night, hotel guests party on the beach and make bonfires. As females are highly sensitive to noise and light while approaching the beach to lay their eggs, they are easily distracted and scared away. Such activity is potentially dangerous for already laid nests. The data collected over the last 17 years show a gradually decreasing number of nests on both observed beaches and therefore raise a legitimate concern.

## MATERIAL AND METHODS

The coastline we monitored is divided in two sections. The section starting from Onur Camp going west is called Akgöl and is 1.0 km long. The other section, going east, is called Yaniklar and has an overall length of about 4.8 km. At both beaches, surveys and data collection were done by Austrian students (University of Vienna) and their supervisors in collaboration with Turkish students (Pamukkale University) from 3 July to 17 September.

### *Night Shifts*

Night shifts were done in teams of three students starting on 3 July and ending when first nest was found hatching during the morning shift of 14 July on Yaniklar. Afterwards, night shifts were stopped in order to avoid potentially stepping on hatchlings on the dark beach. The beaches of Akgöl and Yaniklar were surveyed alternately, changing almost every night. The

shifts started at 10 p.m. at Onur Camp and either went west to the end of Akgöl or east until a landmark called “Lonely Tree” halfway along Yaniklar Beach.

One night shift usually took two to four hours depending on the number of female turtles we encountered, as one female can require one to two hours to complete the nesting process (Hirth, 1980 in Miller et al., 2003). During the shifts we split up in a transverse line across the beach to cover a bigger surveillance area. One person walked slightly above the waterline, another close to the vegetation line and a third between them. In this manner we scanned the beach one length, waited for 20 to 30 minutes, returned, and repeated the whole procedure a second time.

When we encountered a turtle, we waited several meters away so as not to disturb her attempt to lay a nest. We waited either until she finished or approached the sea without nesting. With a tape measure we then measured the curved length and width of her carapace as well as the straight length and width using a caliper. After measuring the turtle, we checked for injuries and epibionts such as barnacles and finally looked for tags (but never tagged any ourselves).

*Morning Shift*

Beyond night shifts, morning shifts were done the whole time of the project, first starting on 4 July until 17 September. Also, as opposed to the night shifts, in the morning both beaches were surveyed every day, each by a team of two to three persons.

The shifts started at 6 a.m. and took two to four hours depending on whether we found tracks of hatchlings or adult turtles along the beach. The “long way” took distinctively longer, sometimes up to five hours to get back to the camp. Like at night, we formed a transverse line or just split up – one looking near the sea, the other near the vegetation.

For the first weeks we walked to the end of the respective beach looking for tracks of adults, which would lead us to their nests. Later in the season on we focused on tracks of recently emerged hatchlings.

*Measuring and Numbering Tracks*

Tracks were named after the beach we found them on and numbered successively according the date they were made. Tracks discovered on Akgöl were designated AT and tracks on Yaniklar were designated YT. We recorded the tracks’ length, width the number of bodypits and the farthest distance to sea, we also sketched its shape on a datasheet.

*Measuring, Marking and Numbering Nests*

To locate a nest we used a metal rod (Turkish: Şiş). We carefully pushed the rod through the sand along the track where we suspected the nest. If the rod penetrated the sand easily at the depth of an egg chamber, we had found the nest.

To avoid losing nests, we built a semicircle of larger cobbles and wrote the nest number on some of them. Further, we measured the nest's distance to the sea and to at least 2 different, easily recognizable landmarks such as prominent trees, bushes, stones etc.

The numbering of nests was done similar to that of tracks. Nests on Akgöl started with the letter A (e.g. A1), nests on Yaniklar with the letter Y (e.g. Y1). In addition to these nests, there were also nests that had either been found by our Turkish colleagues prior to our arrival or were found later due to hatching. Those nests were called secret nests, had put an "S" after their initial letter (e.g. AS1, YS1) and had a separate numbering system.

RESULTS

The raw data of all nests as well as tracks on the beaches of Akgöl and Yaniklar are included in Appendix 1.

*Nests*

In 2011, 44 nests were recorded at the beaches of Akgöl and Yaniklar. Compared to the last eighteen years, it therefore ranks among the worst years since the beginning of this project in 1994 (**Fig. 1**, **Table 1**).

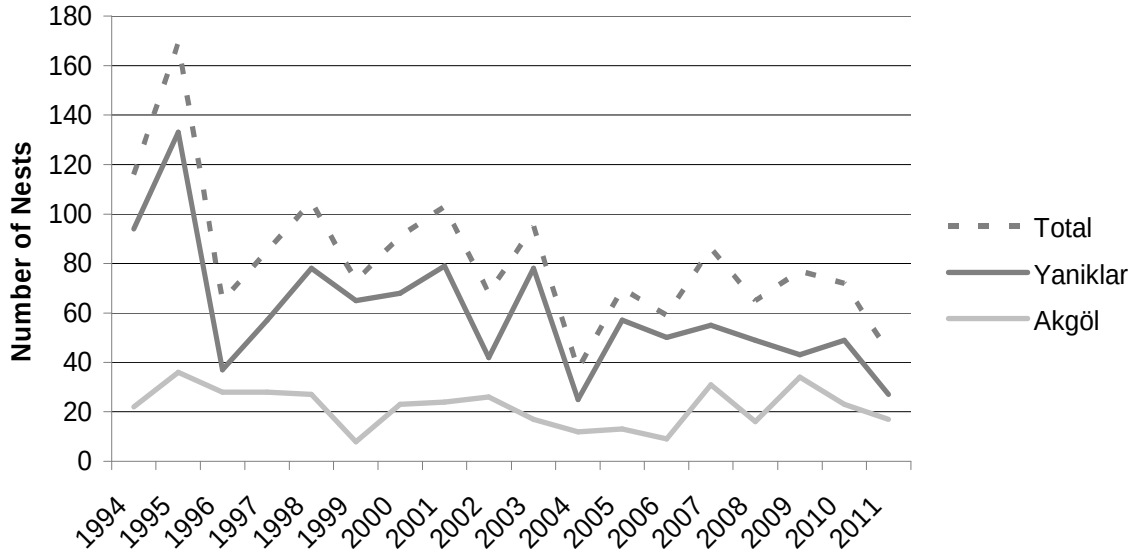


Fig. 1: Annual number of nests on Akgöl and Yaniklar Beach (1994-2011).
Abb. 1: Jährliche Anzahl der Nester auf den Stränden Akgöl und Yaniklar (1994-2011).

17 of those nests were located in Akgöl, the other 27 in Yaniklar (**Fig. 2**). Only 18.9% of all nests were "dated nests" having a known nesting date (A1-A5, Y1-Y2). The other 37 nests were either found by our Turkish colleagues prior to our arrival (2 July) or were found later on due to hatching (i.e. "secret nests").

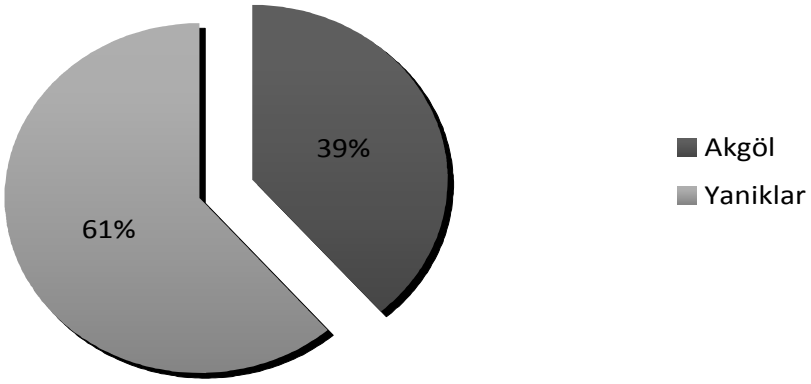


Fig. 2: Distribution of the nests on Akgöl and Yaniklar Beach. Total number of nests: 44.
Abb. 2: Verteilung der Nester auf den Stränden Akgöl und Yaniklar. Gesamtzahl der Nester: 44.

The average distance of the nests to the sea in Akgöl was about 19.9m, but showed a very high variance of 13.4. In Yaniklar both the average distance was less (17.3m) as well as the standard deviation 4.2 (**Fig. 3**).

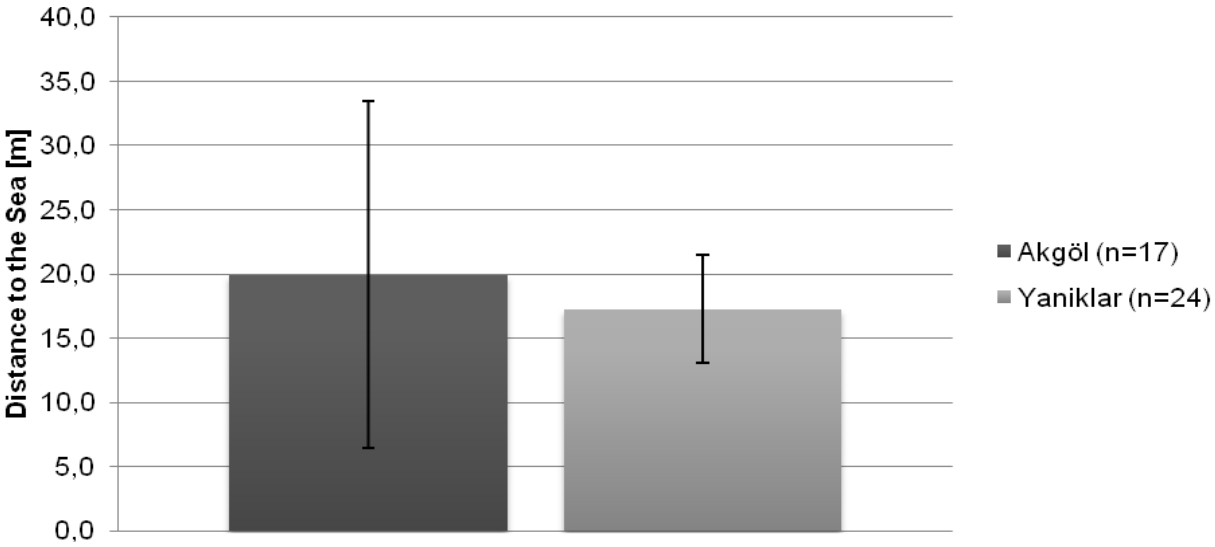


Fig. 3: Average distance to the sea including standard deviation.
Abb. 3: Mittlere Entfernung vom Meer inklusive Standardabweichung.

**Fig. 4** and **Fig. 5** show the distance to the sea of each nest we measured the beach zones of. The figures show that some nests (e.g. A5) were made very close to the waterline, situated almost in the moist zone, whereas others were dug far from the water (e.g. AS1, AS3).

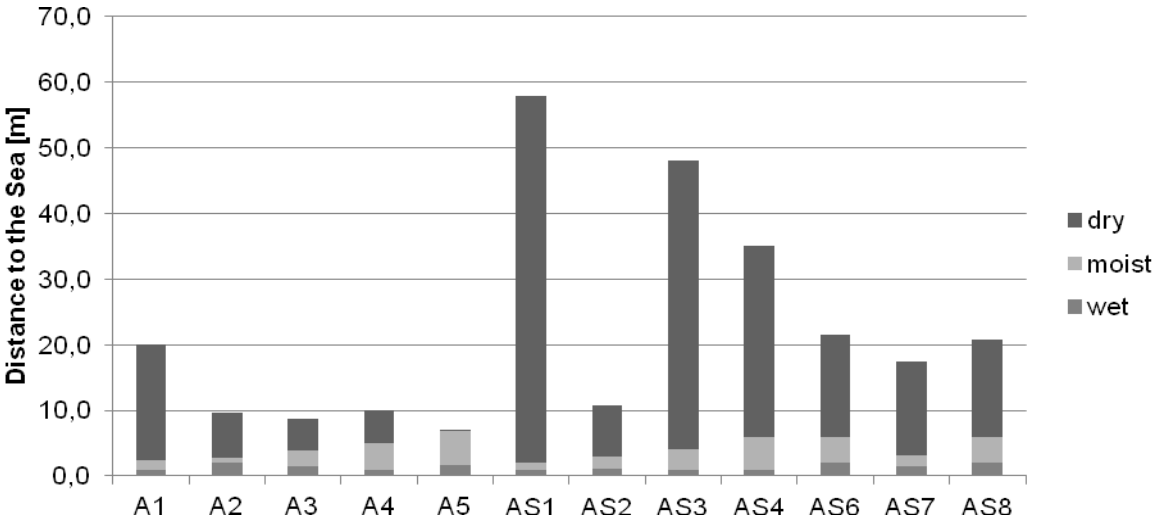


Fig. 4: Distance to the sea of the nests in Akgöl and relative proportions of the stretches that were wet, moist and dry.
Abb. 4: Entfernung der Nester zum Meer in Akgöl und relative Proportionen der nassen, feuchten und trockenen Abschnitte.

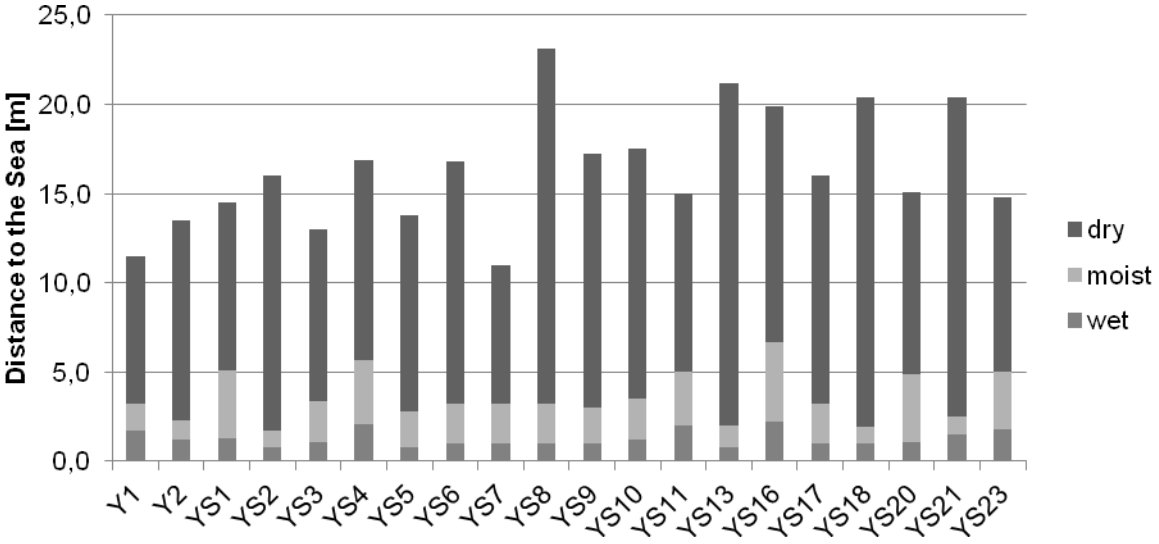


Fig. 5: Distance to the sea of the nests in Yaniklar and relative proportions of the stretches that were wet, moist and dry.
Abb. 5: Entfernung der Nester zum Meer in Yaniklar und relative Proportionen der nassen, feuchten und trockenen Abschnitte.

*Adults*

This year we encountered *Caretta caretta* nine times during our night shifts. Due to the lack of tags, however, we can't be sure how many different females we actually saw. Based on epibionts, we were able to identify at least three encounters to be with the same turtle (turtle 2, 3 & 6). Thus, we encountered at most seven different individuals, all of them on Akgöl beach.

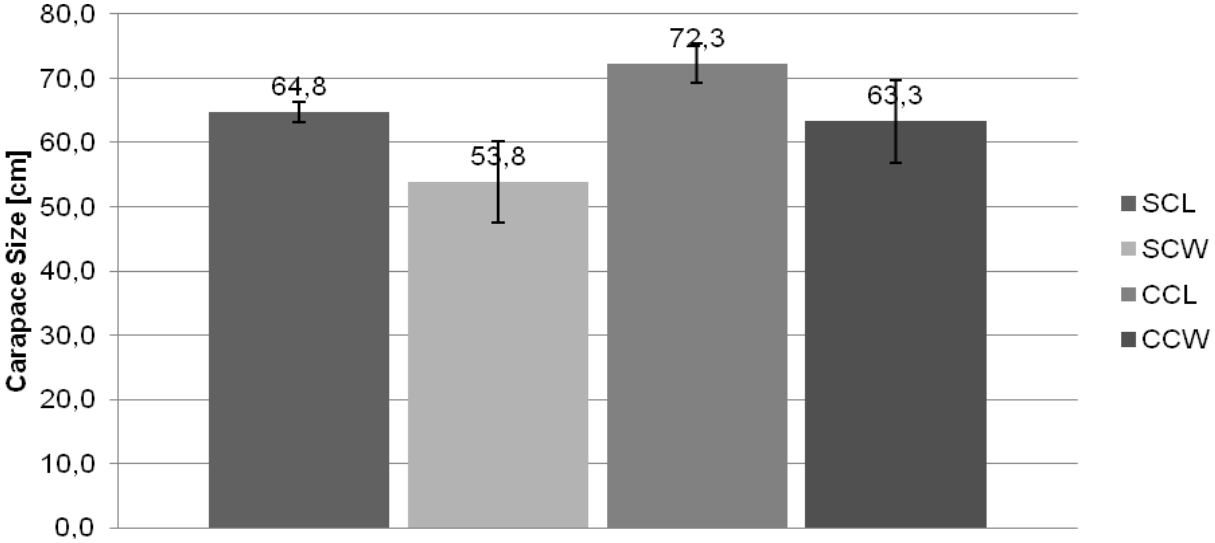

Fig. 6: Carapace measurements of adult females (in cm) including standard deviation. SCL straight carapace length, SCW straight carapace width, CCL curved carapace length, CCW curved carapace width. N=9.
Abb. 6: Panzerabmessungen der adulten Weibchen (in cm) inklusive Standardabweichung. SCL gerade Panzerlänge, SCW gerade Panzerbreite, CCL gekrümmte Panzerlänge, CCW gekrümmte Panzerbreite. N=9.

The average size of the carapace was 64.8cm in length (SCL) and 53.8cm in width (SCW) if measured with the caliper. The corresponding values were 72.3cm in length (CCL) and 63.3cm in width (CCW) measured with the tape (**Fig. 6**).

*Tracks*

Most tracks recorded this year were found on Akgöl (79.4%) although it is by far the smaller beach. Between 3 July and 25 July 34 tracks were discovered on both beaches combined, 27 of them on Akgöl and 7 on Yaniklar. In Akgöl the length of the tracks was usually longer (49.6m) and varied considerably (**Fig. 7**) while in Yaniklar tracks were a lot shorter (29.2m) and varied considerably shorter in their length (**Fig. 8**).

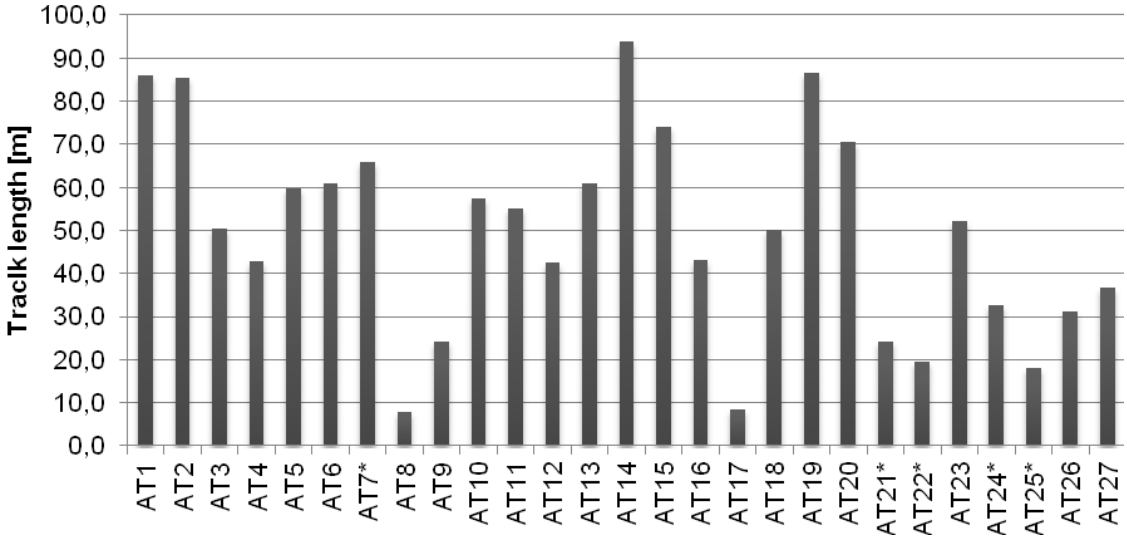

Fig. 7: Length of tracks on Akgöl. * = successful nesting attempt, i.e. nest.

Abb. 7: Länge der Spuren auf dem Strand von Akgöl. * = erfolgreicher Nistversuch, d.h. Nest.

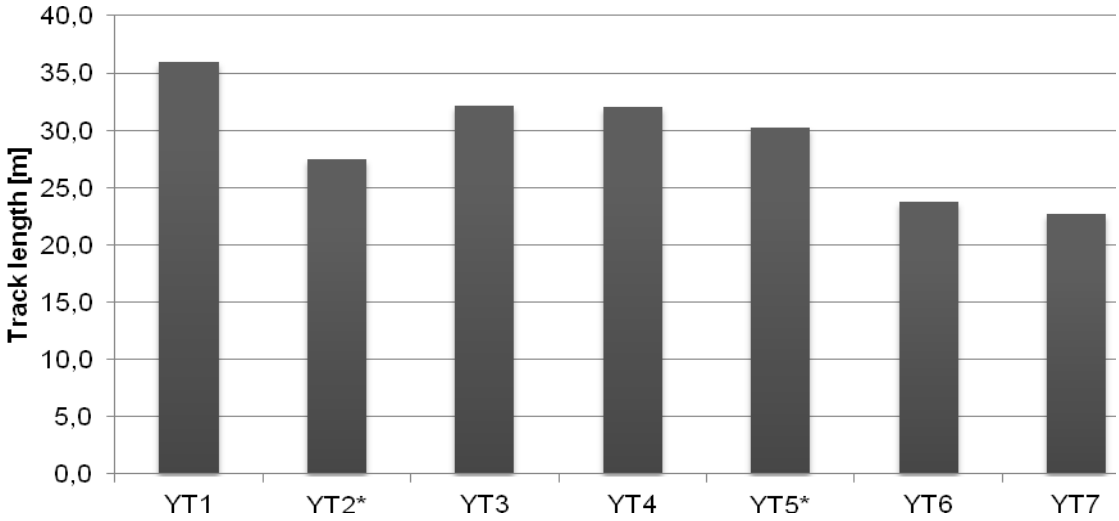


Fig. 8: Length of tracks on Yaniklar. * = successful nesting attempt, i.e. nest.
Abb. 8: Länge der Spuren auf dem Strand von Yaniklar. * = erfolgreicher Nistversuch, d.h. Nest.

Of those 34 attempts to build a nest, only 7 succeeded, yielding a success rate of 22.5%. In Yaniklar, 28.6% were successful, in Akgöl the number was lower (18.5%).

Track width ranged from 51cm to 81cm, with an average of 68. Additionally, one track measured 130cm in width and therefore being a statistical outliner. We also recorded the number of bodypits for each track we found and counted a total number of 29 This is an average of 0.9 bodypits per track.

## DISCUSSION

The data on *Caretta caretta*'s nesting activity in Turkey collected over the last 17 years show a gradually decreasing number of nests on the observed beaches of Akgöl and Yaniklar. This year only 44 nests were found (decrease of 39% in relation to 2010), making 2011 the year with the second smallest number of nests since 1994 when data were collected for the first time. Only in 2004 were even fewer nests found (37).

Even though the nesting activity of *Caretta caretta* shows strong fluctuation at times, probably reflecting natural fluctuations (Margaritoulis, 2005), a long-term downward trend is clearly evident. For the first ten years, drops in nest numbers occurred every three years.

Since 2002 these drops have been observed every second year. In 2011, for the first time since the beginning of record-keeping, the number of nests dropped twice in a row.

Potential reasons for the decreasing numbers of nests as well as adult turtles are most likely marine pollution, industrial fishing and tourism. As part of the marine pollution, plastic bags pose a big problem, since *Caretta caretta* can confuse them with jellyfish, a major food item. The main problem is commercial fishing, killing adult turtles and reducing the odds of survival for juvenile ones as well. Through by-catch in the Mediterranean, probably over 44 000 sea turtles are killed each year (Casale, 2011).

As for the observed beaches, modern tourism poses another major problem. Big tourist resorts such as “Lykia Botanica” and “Tuana” on the beaches cause noise and light pollution that disturbs sea turtles while they are looking for suitable nesting spots. If disturbed during this sensitive stage, the turtle may flee and, after trying several times, may discharge her eggs in the sea.

Additionally, for nesting, sea turtles need a low-salinity, well-ventilated substrate, high humidity and no chance for the tide to flood the nest (Bolten, 2003). Such places may have become rare over the past years. Due to the removal of sand all over the beaches, for example, the quality of the substrate has changed from sand to more coarse gravel or even cobbles, making it hard for *Caretta caretta* to find suitable spots to dig nests.

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RAW DATA

Table 1: Annual number of nests in Akgöl and Yaniklar from 1994-2011.
Tab. 1: Jährliche Anzahl der Nester in Akgöl und Yaniklar von 1994 bis 2011.

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

Table 2: Nesting data Akgöl. A = nest Akgöl, AS = secret nest Akgöl, AT = track Akgöl, n.a. = no data available, * = track including nest.
Tab. 2: Nestdaten von Akgöl. A = Nest Akgöl, AS = secret nest Akgöl, AT = Spur Akgöl, n.a. keine Daten vorhanden, * = Spur beinhaltet Nest.

| Nr. | Nest Nr. | Track Nr. | Date | Distance to the sea (in m) | | | |
|---|---|---|---|---|---|---|---|
| | | | | dry | moist | wet | total |
| 1 | A1 | AT7* | 12.07.2011 | 17,6 | 1,5 | 0,9 | 20,0 |
| 2 | A2 | AT21* | 15.07.2011 | 6,8 | 0,8 | 2,0 | 9,6 |
| 3 | A3 | AT22* | 15.07.2011 | 5,0 | 2,3 | 1,5 | 8,8 |
| 4 | A4 | AT24* | 16.07.2011 | 5,1 | 4,0 | 1,0 | 10,1 |
| 5 | A5 | AT25* | 17.07.2011 | 0,2 | 5,2 | 1,6 | 7,0 |
| 6 | AS1 | n.a. | n.a. | 55,9 | 1,0 | 1,0 | 57,9 |
| 7 | AS2 | n.a. | n.a. | 7,8 | 1,9 | 1,1 | 9,8 |
| 8 | AS3 | n.a. | n.a. | 44,0 | 3,0 | 1,0 | 44,0 |
| 9 | AS4 | n.a. | n.a. | 29,0 | 5,0 | 1,0 | 35,5 |

| | | | | Distance to the sea (in m) | | | |
|---|---|---|---|---|---|---|---|
| 10 | AS5 | --- | no nest | --- | --- | --- | --- |
| 11 | AS6 | n.a. | n.a. | 15,5 | 4,0 | 2,0 | 21,5 |
| 12 | AS7 | n.a. | n.a. | 14,3 | 1,7 | 1,5 | 17,0 |
| 13 | AS8 | n.a. | n.a. | 14,8 | 4,0 | 2,0 | 20,8 |
| 14 | AS9 | n.a. | n.a. | n.a. | n.a. | n.a. | 7,1 |
| 15 | AS10 | n.a. | n.a. | n.a. | n.a. | n.a. | 11,3 |
| 16 | AS11 | n.a. | n.a. | n.a. | n.a. | n.a. | 20,2 |
| 17 | AS12 | n.a. | n.a. | n.a. | n.a. | n.a. | 20,0 |
| 18 | AS13 | n.a. | n.a. | n.a. | n.a. | n.a. | 18,5 |

Table 3: Nesting data Yaniklar. Y = nest Yaniklar, YS = secret nest Yaniklar, YT = track Yaniklar, n.a. = no data available, * = track including nest.
Tab. 3: Nestdaten von Yaniklar. Y = Nest Yaniklar, YS = secret nest Yaniklar, YT = Spur Yaniklar, n.a. keine Daten vorhanden, * = Spur beinhaltet Nest.

| Nr. | Nest Nr. | Track Nr. | Date | Distance to the sea (in m) | | | |
|---|---|---|---|---|---|---|---|
| | | | | dry | moist | wet | total |
| 1 | Y1 | YT2* | 07.07.2011 | 8,3 | 1,5 | 1,7 | 11,5 |
| 2 | Y2 | YT5* | 10.07.2011 | 11,2 | 1,1 | 1,2 | 13,5 |
| 3 | YS1 | n.a. | n.a. | 9,4 | 3,8 | 1,3 | 14,5 |
| 4 | YS2 | n.a. | n.a. | 14,3 | 0,9 | 0,8 | 16,0 |
| 5 | YS3 | n.a. | n.a. | 9,6 | 2,3 | 1,1 | 13,0 |
| 6 | YS4 | n.a. | n.a. | 11,2 | 3,6 | 2,1 | 16,9 |
| 7 | YS5 | n.a. | n.a. | 11,0 | 2,0 | 0,8 | 13,8 |
| 8 | YS6 | n.a. | n.a. | 13,6 | 2,2 | 1,0 | 16,8 |
| 9 | YS7 | n.a. | n.a. | 7,8 | 2,2 | 1,0 | 11,0 |
| 10 | YS8 | n.a. | n.a. | 19,9 | 2,2 | 1,0 | 23,1 |
| 11 | YS9 | n.a. | n.a. | 14,2 | 2,0 | 1,0 | 17,2 |
| 12 | YS10 | n.a. | n.a. | 14,0 | 2,3 | 1,2 | 17,5 |
| 13 | YS11 | n.a. | n.a. | 10,0 | 3,0 | 2,0 | 15,0 |
| 14 | YS12 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| 15 | YS13 | n.a. | n.a. | 19,2 | 1,2 | 0,8 | 21,2 |
| 16 | YS14 | --- | no nest | --- | --- | --- | --- |
| 17 | YS15 | --- | no nest | --- | --- | --- | --- |
| 18 | YS16 | n.a. | n.a. | 13,2 | 4,5 | 2,2 | 20,5 |
| 19 | YS17 | n.a. | n.a. | 12,8 | 2,2 | 1,0 | 16,0 |
| 20 | YS18 | n.a. | n.a. | 18,5 | 0,9 | 1,0 | 20,5 |
| 21 | YS19 | --- | no nest | --- | --- | --- | --- |
| 22 | YS20 | n.a. | n.a. | 10,2 | 3,8 | 1,1 | 15,1 |
| 23 | YS21 | n.a. | n.a. | 17,9 | 1,0 | 1,5 | 20,6 |
| 24 | YS22 | n.a. | n.a. | n.a. | n.a. | n.a. | 16,9 |
| 25 | YS23 | n.a. | n.a. | 9,8 | 3,2 | 1,8 | 14,8 |
| 26 | YS24 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| 27 | YS25 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| 28 | YS26 | n.a. | n.a. | n.a. | n.a. | n.a. | 14,8 |
| 29 | YS27 | n.a. | n.a. | n.a. | n.a. | n.a. | 26,0 |
| 30 | YS28 | n.a. | n.a. | n.a. | n.a. | n.a. | 28,0 |

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

| Date | Turtle Nr. | Track Nr. | Nest Nr. | SCL | SCW | CCL | CCW |
|---|---|---|---|---|---|---|---|
| 12.07.2011 | 1 | AT7 | A1 | 62 | 52 | 72 | 65 |
| 14.07.2011 | 2 | AT11 | no nest | 66 | 45 | 72 | 48 |
| 14.07.2011 | 3 | AT12 | no nest | 66 | 45 | 72 | 48 |
| 14.07.2011 | 4 | AT13 | no nest | n.a. | n.a. | 78 | 69 |
| 14.07.2011 | 5 | AT14 | no nest | n.a. | n.a. | 69 | 64 |
| 14.07.2011 | 6 | AT15 | no nest | 66 | 45 | 75 | 48 |
| 15.07.2011 | 7 | AT21 | A2 | 65 | 57 | 68 | 65 |
| 16.07.2011 | 8 | AT24 | A4 | n.a. | 51 | 74 | 66 |
| 17.07.2011 | 9 | AT25 | A5 | 66 | 64 | 73 | 66 |

Table 5: Emergences in Akgöl (in m). AT = track Akgöl, * = track including nest, n.a. = no data available.
Tab. 5: Landgänge in Akgöl (in m). AT = Spur Akgöl, * = Spur beinhaltet Nest, n.a. = keine Daten vorhanden.

| Track Nr. | Date | Distance to the sea | Track length | Track width | Nr. of bodypits |
|---|---|---|---|---|---|
| AT1 | 03.07.2011 | 35,6 | 85,9 | n.a. | 3 |
| AT2 | 11.07.2011 | 38,8 | 85,3 | 1,30 | 0 |
| AT3 | 11.07.2011 | 24,5 | 50,5 | 0,60 | 1 |
| AT4 | 11.07.2011 | 21,6 | 42,8 | 0,68 | 1 |
| AT5 | 11.07.2011 | 16,8 | 59,7 | n.a. | 0 |
| AT6 | 11.07.2011 | 25,6 | 60,8 | 0,62 | 1 |
| AT7* | 12.07.2011 | 20,0 | 65,9 | 0,70 | 1 |
| AT8 | 13.07.2011 | 2,9 | 7,8 | 0,60 | 0 |
| AT9 | 13.07.2011 | 11,2 | 24,2 | 0,58 | 0 |
| AT10 | 13.07.2011 | 27,1 | 57,5 | 0,63 | 1 |
| AT11 | 14.07.2011 | 18,1 | 55,0 | 0,63 | 0 |
| AT12 | 14.07.2011 | 21,1 | 42,6 | 0,75 | 1 |
| AT13 | 14.07.2011 | 25,0 | 61,0 | 0,81 | 3 |
| AT14 | 14.07.2011 | 39,3 | 93,8 | 0,73 | 2 |
| AT15 | 14.07.2011 | 34,6 | 74,0 | 0,75 | 0 |
| AT16 | 14.07.2011 | 20,8 | 43,0 | 0,75 | 0 |
| AT17 | 14.07.2011 | 4,3 | 8,4 | 0,69 | 0 |
| AT18 | 15.07.2011 | 23,6 | 50,2 | 0,73 | 0 |
| AT19 | 15.07.2011 | 30,8 | 86,6 | 0,81 | 2 |
| AT20 | 15.07.2011 | 30,8 | 70,5 | 0,81 | 2 |
| AT21* | 15.07.2011 | 9,6 | 24,3 | 0,60 | 0 |
| AT22* | 15.07.2011 | 8,8 | 19,4 | 0,60 | 0 |
| AT23 | 16.07.2011 | 21,9 | 52,2 | 0,62 | 1 |
| AT24* | 16.07.2011 | 10,1 | 32,6 | 0,62 | 2 |
| AT25* | 17.07.2011 | 7,0 | 18,1 | 0,60 | 0 |
| AT26 | 23.07.2011 | 14,7 | 31,2 | 0,64 | 1 |
| AT27 | 25.07.2011 | n.a. | 36,8 | 0,51 | 1 |

Table 6: Emergences in Yaniklar. YT = track Yaniklar, * = track including a nest, n.a. = no data available.
Tab. 6: Landgänge in Yaniklar. YT = Spur Yaniklar, * = Spur beinhaltet Nest, n.a. = keine Daten vorhanden.

| Track Nr. | Date | Distance to the sea | Track length | Track width | Nr. of bodypits |
|---|---|---|---|---|---|
| YT1 | 07.07.2011 | 17,0 | 36,0 | 0,70 | 1 |
| YT2* | 07.07.2011 | 11,5 | 27,5 | 0,67 | 1 |
| YT3 | 10.07.2011 | 15,5 | 32,1 | 0,61 | 1 |
| YT4 | 10.07.2011 | 16,4 | 32,0 | 0,61 | 1 |
| YT5* | 10.07.2011 | 13,5 | 30,2 | 0,60 | 1 |
| YT6 | 13.07.2011 | 11,6 | 23,8 | 0,60 | 1 |
| YT7 | 15.07.2011 | 9,4 | 22,7 | 0,57 | 0 |

# *Caretta caretta* hatchlings in Caliş 2011

Bettina Glasl, Michaela Morhart

KURZFASSUNG

Dieser Bericht entstand im Rahmen eines Projektpraktikums der Universität Wien zum Schutz und Erforschung der Unechten Karettschildkröte (*Caretta caretta*) in Fethiye (Türkei). Seit mehr als 18 Jahren arbeiten jedes Jahr türkische Studenten und Studierende der Universität Wien in diesem Projekt zusammen. 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. Insgesamt 11 Wochen wurden die Strände Calış und Yaniklar in Fethiye intensiv vom Projekteam, bestehend aus 21 Studenten der Universität Wien, betreut und die Ereignisse dokumentiert. Durch die langjährige Datensammlung lassen sich die Ergebnisse der einzelnen Jahre sehr gut miteinander Vergleichen und mögliche Veränderungen und Trends auswerten.

Im Untersuchungsjahr 2011 konnten insgesamt 18 Nester der Unechten Karettschildkröte in Calış gefunden und betreut werden. 16 der insgesamt 18 Nester waren sogenannte “secret nests“. Secret Nester werden erst durch Laufspuren-, oder das Auffinden der jungen Schildkröten (Hatchlinge) selbst, entdeckt. Insgesamt wurden dieses Jahr 1542 Eier gezählt, aus denen 1200 Hatchlinge schlüpften. Mindestens 824 Hatchlinge erreichten diese Saison das Meer, belegt durch das Freilassen durch die Studenten. In diesem Sommer betrug die maximale Erfolgsrate in Calış 67.5 % (1039 Hatchlinge), welche sich aus der maximalen Anzahl der leeren Eischalen minus der gefundenen toten Hatchlinge ergibt.

ABSTRACT

This report is part of the conservation and research field course of the University of Vienna on *Caretta caretta* in Fethiye in Turkey. For more than 18 years, Turkish and Austrian students have been working together in this effort every year. Three of 14 nesting beaches of *Caretta caretta* in the eastern Mediterranean Sea are declared as “Specially Enviroment Protected Areas“(SEPAs), including the beaches of Fethiye. The project team of 21 Austrian students monitored the beaches in Calış and Yaniklar for 11 weeks and documented their findings during that time. Because of an existing long-time data collection it is possible to compare the results of the single years and to draw some general conclusions.

In the year 2011, 18 nests of *Caretta caretta* were found and monitored in Calış. Most of the nests (16 out of the 18) were so-called “secret nests”. Secret nests were found by following tracks of young turtles or by detecting young turtles (hatchlings) on their way to the sea. This year, one nest was found between two rows of sunbeds at the Surf Café even though the sand was artificially raised on this place. In addition, although cars on the beach are forbidden, one nest with car tracks was observed. Furthermore, in four of eighteen nests, insect larvae of Coleoptera and Diptera were found. These nests contained a high number of unfertilized eggs and dead embryos.

In total, 1542 eggs were laid, of which 1200 turtles hatched. A minimum of 824 hatchlings visibly reached the sea in this season. This minimum number was determined by counting the individuals that were released to the sea by the students. The maximum success rate in Calış was 67.5 % (1039 hatchlings), estimated based on the maximum number of empty egg shells minus the number of hatchlings that were found dead.

## INTRODUCTION

The loggerhead sea turtle (*Caretta caretta*) approximately 5000 individuals (Demetropoulus & Hadjichristophorou, 1995) counts the most common turtle species in the Mediterranean Sea. Although its habitat covers the whole Mediterranean Sea, *Caretta caretta* only nests on the eastern beaches of the Mediterranean, e.g. the coasts of Turkey, Greece or Cyprus (Stachowitsch and Fellhofer, 2011).

An adult female turtle returns to the beach to nest only every two to four years, at exactly the same beach where it hatched (natal homing) (Bowen et al., 2004). Within a period of two weeks, they can lay up to four nests. The number of eggs varies, in Calış (Turkey) it ranges from 23-134 eggs (Stachowitsch and Fellhofer, 2011). The incubation time ranges from 44-64 days, depending on environmental conditions such as the consistence of the sand, temperature, humidity, depth of the nests and location of the nest (Stachowitsch and Fellhofer, 2011). The sex of the juvenile turtles is determined through the nest temperature (Maxwell et al., 1988). Usually the juvenile sea turtles hatch at night (Salmon and Wyneken, 1987) over a period of 1-5 days. After emerging from their nest, the sea turtles orientate toward the brightest point, which is normally the horizon over the sea. If such an orientation is not possible because of lights from bars & restaurants, lanterns or lights on the beach promenade,

young turtles cannot find their own way to the sea and die either due to exhaustion or predation while running in the wrong direction.

## MATERIAL AND METHODS

The beach in Calış was monitored from 2 July to 17 September by altogether 11 students from the University of Vienna. The monitoring was arranged in two shifts, during which the 3-km-long beach was controlled in small groups of up to three Turkish and Austrian students. The morning shift started at 6 a.m. at the Türkü cadiri bar and ended about 8 a.m. at the northern end of the beach. During the night shift the beach was patrolled four times from 10 p.m. to 2 a.m. but only as far as the Surf Café. Nesting time of adult loggerhead turtles end at the beginning of August. In the nightshifts of late August, only nests were controlled.

While we patrolled the beach, we searched for adult turtles laying their nests, for adult and juvenile tracks or new hatched turtles. Encountering an adult sea turtle, the task of the students was to measure and tag the sea turtles and determine the location of the new nest with GPS. In Calış beach the nests were marked with a big yellow triangular metal cage and a green plastic net or wire wrapped around (Fig.7 A), for protecting the turtles nests. On the top of the cages we fixed a sign in three languages (English, Turkish and German) so that people would recognize it as a sea turtle nest. The net around the cages could be lifted up or down. In the morning shift the nets were pulled up about 10 cm (starting about 40 days after the nest was laid) to prevent turtles that hatched during the day from dying in the hot sand of the cages. If juvenile turtle were found in the cages during the morning shift, they were either released to the sea (if the rising sun was not too high and the sand temperature still low) or took them to our sea turtle camp in a plastic bucket filled with some moist sand and covered with a towel. In the following night shift, the young turtles were removed from the camp bucket and released in groups of 4 turtles on the beach.

Before the night shift and sunset, all nets of the cages were pulled down again. This procedure was necessary to prevent the new hatched turtles running into the wrong direction because of the bright lights of the promenade. If hatchlings were found during the night shift, they were collected and put into a plastic bucket with wet sand and covered with a towel. Afterwards we went to a darker part of the beach, released them a few meters away from the sea and waited until they reached the ocean.

In both shifts we searched for new hatchling tracks (in the night we used a weak red light) to discover potential secret nests. If new tracks were found, they were counted and recorded. Also, the direction of the tracks (to the sea or landward) and the presence of predators such as dogs, cats or birds was noted.

About 5 days after the last hatchling emerged, the nest was excavated. Afterwards, the empty eggshells, fertilized and unfertilized eggs (Fig.8 A), dead and living turtles were counted. The fertilized eggs were divided into three main stages according to their appearance and the embryo development (Fig.8 B-D): the early embryonic stage (< 1cm), middle embryonic stage (1-2 cm) and late stage (> 2cm) or when the embryo is already pigmented. During an excavation the nest was also measured again, including the depth from the beach surface to the top of the eggs, the depth and diameter of the egg chamber and the distance to the sea.

The minimal number of successful hatchlings was the number of hatchlings which were released by all students and the visible hatchling tracks leading to the sea. The maximum success was number of empty eggshells minus dead hatchlings. The rates (%) were calculated in relation to the total number of eggs.

## RESULTS

In 2011, eighteen nests of *Caretta caretta* were found in Calış sixteen of these were secret nests. This explains why there were no specific nesting time-related data for 16 nests. Only for two nests could the exact nest date and the incubation time be determined. The average incubation time of these two nests was 45.5 days.

In total, 1542 eggs were laid and the maximal number of hatchlings reaching the sea was 1039, the minimum was 823. The difference reflects the unknown fate of 216 hatchlings (i.e. where empty shells were present but the tracks not clearly discernible). Furthermore, 232 eggs were unfertilized, 103 died during an embryonic stage and 161 hatchlings died because of predation, sun or were stuck in the egg (Table 1).

Table 1: Overview of all nests, Calış 2011
Tab. 1: Übersicht aller Nester und deren Daten, Calış 2011

| Nest n° | Neste date | Incubation time (days) | Hatchlings reaching the sea | | Still living inside | Empty eggshells | Unfertilized eggs | Dead embryos | Dead hatchlings | Predated eggs | Total n° of eggs |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | MAX | | | | | | | |
| C1 | 20.06.2011 | 45 | 70 | 71 | 6 | 71 | 4 | - | - | - | 75 |
| C2 | 04.07.2011 | 46 | 25 | 41 | - | 44 | 22 | 16 | 3 | - | 82 |
| CS1 | secret | - | 35 | 38 | - | 55 | 23 | 14 | 17 | - | 92 |
| CS2 | secret | - | 68 | 71 | - | 75 | 8 | 7 | 4 | - | 90 |
| CS3 | secret | - | 54 | 82 | 6 | 103 | 7 | 2 | 21 | - | 112 |
| CS4 | secret | - | 31 | 40 | 2 | 53 | 5 | 7 | 13 | 7 | 72 |
| CS5 | secret | - | 41 | 74 | 4 | 75 | 4 | 7 | 1 | - | 86 |
| CS6 | secret | - | 62 | 63 | 3 | 63 | 1 | 3 | - | - | 67 |
| CS7 | secret | - | 29 | 57 | - | 62 | 32 | 2 | 5 | - | 96 |
| CS8 | secret | - | 89 | 94 | 2 | 98 | 10 | - | 4 | - | 108 |
| CS9 | secret | - | 29 | 29 | - | 54 | 13 | 7 | 25 | - | 74 |
| CS10 | secret | - | 13 | 19 | - | 19 | 56 | 2 | - | - | 77 |
| CS11 | secret | - | 65 | 73 | 4 | 73 | 3 | 3 | - | - | 79 |
| CS12 | secret | - | 62 | 62 | 16 | 81 | 4 | 1 | 19 | - | 86 |
| CS13 | secret | - | 27 | 71 | 11 | 76 | 3 | 11 | 5 | - | 90 |
| CS14 | secret | - | 61 | 61 | 1 | 93 | 5 | 7 | 32 | - | 105 |
| CS15 | secret | - | 5 | 36 | 1 | 36 | 25 | 6 | - | - | 67 |
| CS16 | secret | - | 57 | 57 | - | 69 | 7 | 8 | 12 | - | 84 |
| Total | | 45,5 | 823 | 1039 | 56 | 1200 | 232 | 103 | 161 | 7 | 1542 |

Figure 1 shows the total number of eggs in each single nest (C1-CS16). There is quite a high variation in the number of eggs per nest: CS3 had the largest number of eggs (112), whereas CS6 and CS15 had the lowest number of eggs (67).

The average number of eggs per nest was 86 - this number lies in the normal range for Loggerhead turtles nesting in turkey.

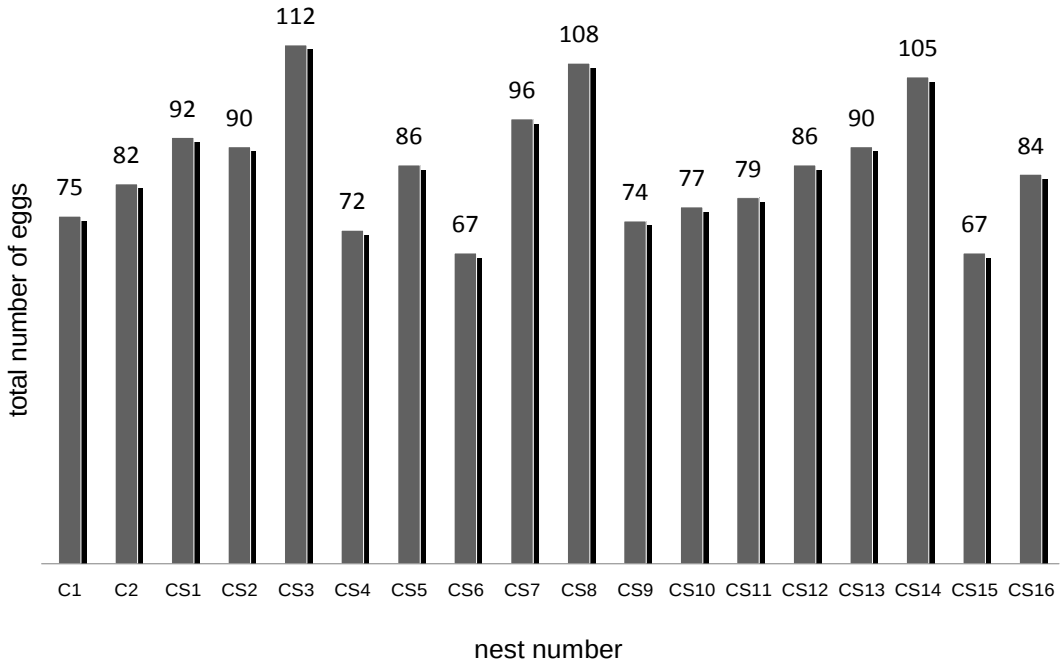


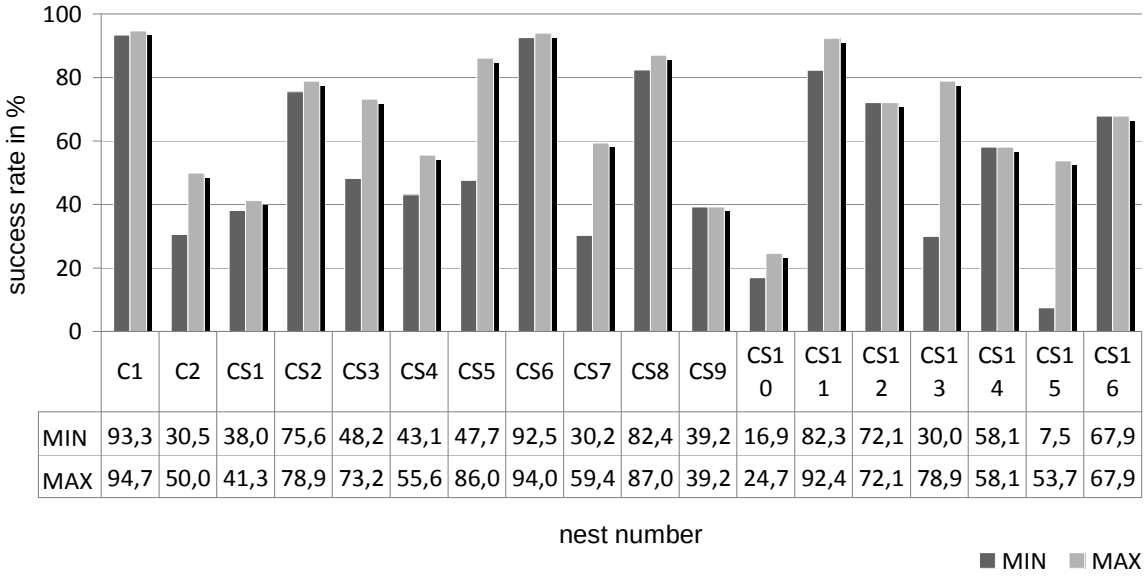

Fig.1: Total number of eggs per nest in Calış2011 (CS refers to secret nests)
Abb. 1: Gesamtzahl der Eier pro Nest in Calış2011 (CS verweist auf secret nests)

Figure 2 displays the minimal and maximal success rate in % for each single nest.

In more than half of the nests, the maximal and minimal success rates are similar. Only in some cases do the two values differ. For example CS15 had a minimal success rate of 7.5% but a maximum value of 53.7%.

This difference could be explained by the fact that the nest was not found on the first hatching date and most of the hatchlings had apparently crawled to the sea.

C1 was the nest with the highest success rate (93.3 %,) followed by CS6 with 92.5% (Fig. 2).




| | C1 | C2 | CS1 | CS2 | CS3 | CS4 | CS5 | CS6 | CS7 | CS8 | CS9 | CS10 | CS11 | CS12 | CS13 | CS14 | CS15 | CS16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MIN | 93,3 | 30,5 | 38,0 | 75,6 | 48,2 | 43,1 | 47,7 | 92,5 | 30,2 | 82,4 | 39,2 | 16,9 | 82,3 | 72,1 | 30,0 | 58,1 | 7,5 | 67,9 |
| MAX | 94,7 | 50,0 | 41,3 | 78,9 | 73,2 | 55,6 | 86,0 | 94,0 | 59,4 | 87,0 | 39,2 | 24,7 | 92,4 | 72,1 | 78,9 | 58,1 | 53,7 | 67,9 |

Fig.2: Minimal and maximal success rate (%) of each nest in Calış (2011)
Abb. 2: Minimum und maximale Erfolgsrate (%) der einzelnen Nester in Calış (2011)

The total maximum success rate was 67.5% in 2011. This is the sixth highest rate since the beginning of the sea turtle project in 1995. Since 1995, the average maximal success rate was 60.2% (Fig. 3).

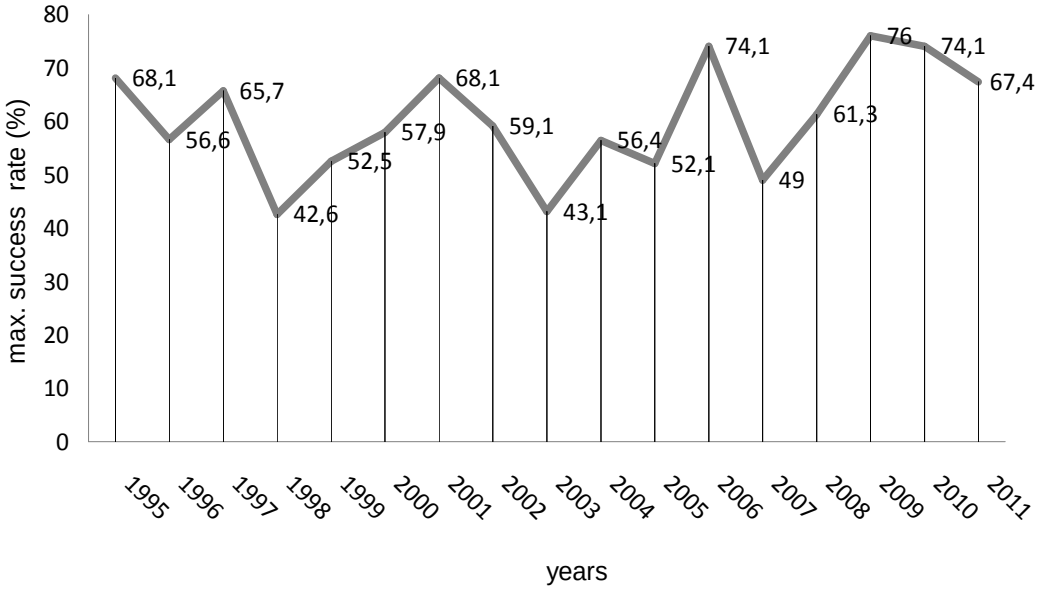



Fig.3: Maximal success rate (%) from 1995 to 2011
Abb. 3: Maximale Erfolgsrate (%) von 1995 bis 2011

During the excavations, all eggs were opened and analyzed, i.e. determined if they were unfertilized or fertilized. The fertilized eggs already contained a turtle embryo.
The exact stage of the dead embryos was observed, too. Generally there are three main stages determined: early, middle and late stage (Fig. 8 A-D).

Figure 4 presents the three different embryo stages of each single nest.
As already mentioned C1 was one of the most successful nests, there were no dead embryos at all. Furthermore, there were no dead embryos in CS8. The nest with the highest number of dead embryos was C2 followed by CS1. According to Figure 4, the most embryos died during the late and the early development stage.

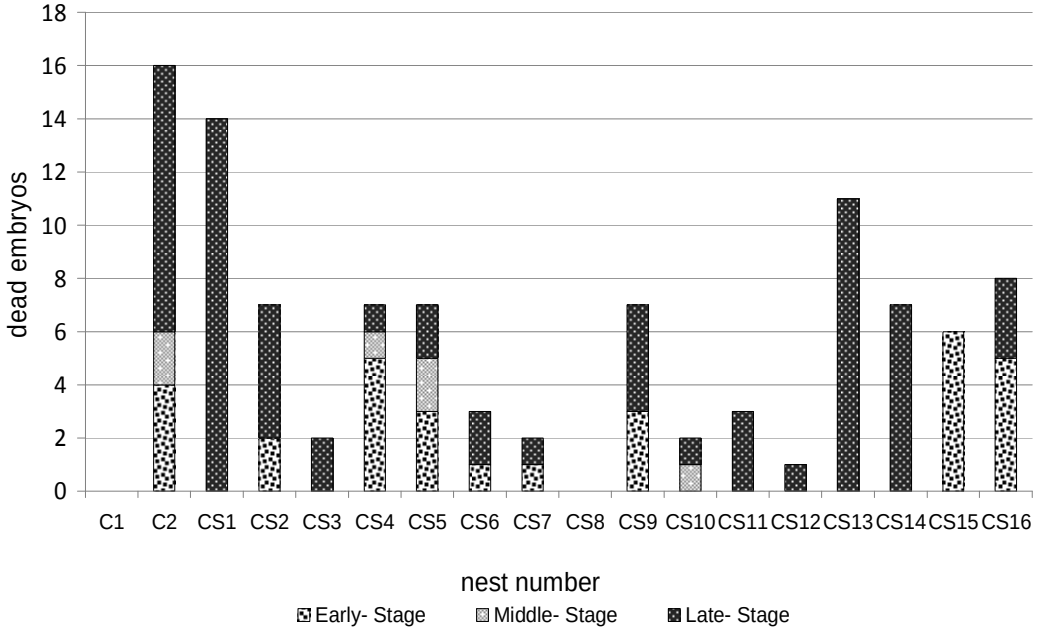



Fig.4: Development stages of dead embryo per nest
Abb. 4: Entwicklungsstadien der toten Embryonen pro Nest

Nest description

In Calış the first hatchling hatched on 14 July and the last on 21 August. During this time probably more than 823 hatchlings reached the sea.

Nest C1

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

| **Total nr. of eggs** | **75** |
|---|---|
| Nr. of empty egg shells | 71 |
| **Nr. of hatchlings r.t.s. (minimum)** | **70** |
| **Nr. of hatchlings r.t.s. (maximum)** | **71** |
| Nr. of unfertilized eggs | 4 |
| Nr. of dead embryos | 0 |
| Nr. of dead hatchlings | 0 |
| Nr. of predated eggs | 0 |

Nest C1was laid on 26 July. After 45 days the first hatchlings reached the sea. This nest was located in front of “Maya Bar”. The distance to the sea was 20.9m. During the excavation no dead embryos or insect larvae were found. This nest was the most successful nest in 2011.

Nest C2

Table 3: Nest data of C2 (r.t.s.: reaching the sea)
Tab. 3: Nestdaten von C2

| **Total nr. of eggs** | **82** |
|---|---|
| Nr. of empty egg shells | 44 |
| **Nr. of hatchlings r.t.s. (minimum)** | **25** |
| **Nr. of hatchlings r.t.s. (maximum)** | **41** |
| Nr. of unfertilized eggs | 22 |
| Nr. of dead embryos | 16 |
| Nr. of dead hatchlings | 3 |
| Nr. of predated eggs | 0 |

Nest C2 was laid on 4 July, close to the "Hotel Ceren". Three students watched the egg deposition of an adult *Caretta caretta*. 46 days later (19 August) the first hatchlings reached the sea. Eleven of those hatchlings escaped the nest cage and were found directly under a lamp on the promenade. The light of the lamp disoriented the hatchlings, so they were not able to find the right way to the sea. These hatchlings were collected by the project team and released on a darker part of the beach. The distance to the sea was 21.3m.

During the excavation, 22 unfertilized eggs and 16 dead embryos were counted. Furthermore, 10 of the hatchlings died during the late embryonic stage, two during the middle and four in the early embryonic stage. Finally, one egg was also infested with parasite larvae.

Nest CS1

Table 4: Nest data of CS1 (r.t.s.: reaching the sea)
Tab. 4: Nestdaten von CS1

| **Total nr. of eggs** | **92** |
|---|---|
| Nr. of empty egg shells | 55 |
| **Nr. of hatchlings r.t.s. (minimum)** | **35** |
| **Nr. of hatchlings r.t.s. (maximum)** | **38** |
| Nr. of unfertilized eggs | 23 |
| Nr. of dead embryos | 14 |
| Nr. of dead hatchlings | 17 |
| Nr. of predated eggs | 0 |

It was not possible to determine the exact nest date of CS1 (secret nest). The first hatchlings emerged on 28 July; during the next 4 days between 35 and 38 hatchlings reached the sea. CS1 was located directly in front of the "Keyif Café" and 19.4m from the waterline. Two of the 17 dead hatchlings died due sun and heat, 10 hatchlings were stuck in their eggs and five were found dead in the nest. 23 of the 92 eggs were unfertilized and 14 embryos died during the late stage.

Nest CS2

Table 5: Nest data of CS2 (r.t.s.: reaching the sea)
Tab. 5: Nestdaten von CS2

| **Total nr. of eggs** | **90** |
|---|---|
| Nr. of empty egg shells | 75 |
| **Nr. of hatchlings r.t.s. (minimum)** | **68** |
| **Nr. of hatchlings r.t.s. (maximum)** | **71** |
| Nr. of unfertilized eggs | 8 |
| Nr. of dead embryos | 7 |
| Nr. of dead hatchlings | 4 |
| Nr. of predated eggs | 0 |

This nest was located between the "*Caretta caretta* Infodesk" and the "Keyif Café" and the distance to the sea was 19.4m. The first hatchling reached the sea on 20 July. The last hatching event was four days later. During that period more than 68 hatchlings reached the sea. At the excavation, four dead hatchlings, eight unfertilized and seven dead embryos were counted. Of the seven embryos two died in the early and five in the late stage.

Nest CS3

Table 6: nest data of CS3 (r.t.s.: reaching the sea)
Tab. 6: Nestdaten von CS3

| **Total nr. of eggs** | **112** |
|---|---|
| Nr. of empty egg shells | 103 |
| **Nr. of hatchlings r.t.s. (minimum)** | **54** |
| **Nr. of hatchlings r.t.s. (maximum)** | **82** |
| Nr. of unfertilized eggs | 7 |
| Nr. of dead embryos | 2 |
| Nr. of dead hatchlings | 21 |
| Nr. of predated eggs | 0 |

CS3 was the nest with the highest number of eggs this year. It was laid next to the "*Caretta caretta* Infodesk" and 20.8m away from the sea. The hatching period was nine days and started on 27 July. Seven days after the last hatchling had emerged, the nest was excavated. Six hatchlings were still alive inside the nest and 20 dead hatchlings were stuck in the nest. Furthermore, two dead late embryo hatchlings and seven unfertilized eggs were counted in this nest.

Nest CS4

Table 7: Nest data of CS4 (r.t.s.: reaching the sea)
Tab. 7: Nestdaten von CS4

| | |
|---|---|
| **Total nr. of eggs** | **72** |
| Nr. of empty egg shells | 53 |
| **Nr. of hatchlings r.t.s. (minimum)** | **31** |
| **Nr. of hatchlings r.t.s. (maximum)** | **40** |
| Nr. of unfertilized eggs | 5 |
| Nr. of dead embryos | 7 |
| Nr. of dead hatchlings | 13 |
| Nr. of predated eggs | 7 |

This nest was next to the "Mutlu Hotel", 25,8m from the sea. The first hatchling emerged on 2 August. During the next 10 days, more than 30 hatchlings hatched. On 6 August a dog predated the nest and took two hatchlings and seven eggs. Just two days later a dog once again predated one hatchling. Furthermore, four hatchlings hatched during the day and dried out on their way to the sea.

During the excavation, five dead hatchlings were discovered, three of them stuck in their eggs; they were already infested by maggots.

Nest CS5

Table 8: Nest data of CS5 (r.t.s.: reaching the sea)
Tab. 8: Nestdaten von CS5

| | |
|---|---|
| **Total nr. of eggs** | **86** |
| Nr. of empty egg shells | 75 |
| **Nr. of hatchlings r.t.s. (minimum)** | **41** |
| **Nr. of hatchlings r.t.s. (maximum)** | **74** |
| Nr. of unfertilized eggs | 4 |
| Nr. of dead embryos | 7 |
| Nr. of dead hatchlings | 1 |
| Nr. of predated eggs | 0 |

CS5 was in front of the "Calış Beach Restaurant", just 12.9m from the waterline. The first hatchlings emerged on 15 August and the last observed hatching was one day later.

At the excavation, 75 empty shells and just one dead hatchling were recorded. Therefore, the expected number of hatchlings reaching the sea was higher than the observed number. One explanation is that some turtle tracks were missed because this was a highly frequented part of the beach (many footprints).

Nest CS6

Table 9: Nest data of CS6 (r.t.s.: reaching the sea)
Tab. 9: Nestdaten von CS6

| **Total nr. of eggs** | **67** |
|---|---|
| Nr. of empty egg shells | 63 |
| **Nr. of hatchlings r.t.s. (minimum)** | **62** |
| **Nr. of hatchlings r.t.s. (maximum)** | **63** |
| Nr. of unfertilized eggs | 1 |
| Nr. of dead embryos | 3 |
| Nr. of dead hatchlings | 0 |
| Nr. of predated eggs | 0 |

CS6 had the second highest maximum success rate in 2011. This nest was directly in front of the "Secil Market" and around 16.7m from the sea. During a period of three days, more than 62 hatchlings reached the sea. The first turtle hatched on 15 August. Four days after the last hatch, the excavation took place. One unfertilized egg and three dead embryos (1 early and 2 late) were found.

Nest CS7

Table 10: Nest data of CS7 (r.t.s.: reaching the sea)
Tab. 10: Nestdaten von CS7

| **Total nr. of eggs** | **96** |
|---|---|
| Nr. of empty egg shells | 62 |
| **Nr. of hatchlings r.t.s. (minimum)** | **29** |
| **Nr. of hatchlings r.t.s. (maximum)** | **57** |
| Nr. of unfertilized eggs | 32 |
| Nr. of dead embryos | 2 |
| Nr. of dead hatchlings | 5 |
| Nr. of predated eggs | 0 |

CS7 was located in front of the "Sunset Apartments", around 40m from the waterline. The first hatchlings emerged on 14 July. Over a period of six days, more than 29 hatchlings reached the sea. Even though vehicles are forbidden on the beach, a car crossed the nest and killed five hatchlings. Furthermore, three days later a tractor also crossed the nest. This compressed the sand and 12 hatchlings could not get out of this nest. These 12 hatchlings could were rescued and released to the sea. Four days after the last hatch the excavation took place. In this nest, 32 unfertilized eggs, two dead embryos (1 early and 1 late) and some larvae of Tenebrionidae were found.

Nest CS8

Table 11: Nest data of CS8 (r.t.s.: reaching the sea)
Tab. 11: Nestdaten von CS8

| **Total nr. of eggs** | **108** |
|---|---|
| Nr. of empty egg shells | 98 |
| **Nr. of hatchlings r.t.s. (minimum)** | **89** |
| **Nr. of hatchlings r.t.s. (maximum)** | **94** |
| Nr. of unfertilized eggs | 10 |
| Nr. of dead embryos | 0 |
| Nr. of dead hatchlings | 4 |
| Nr. of predated eggs | 0 |

This nest was found on 16 July in front of „Mado“, 16.25m from the sea. On the first day, 32 tracks were discovered; three of them did not reach the sea, possibly because of predation. 10 unfertilized eggs and two living hatchlings were observed during the excavation.

Nest CS9

Table 12: Nest data of CS9 (r.t.s.: reaching the sea)
Tab. 12: Nestdaten von CS9

| **Total nr. of eggs** | **74** |
|---|---|
| Nr. of empty egg shells | 54 |
| **Nr. of hatchlings r.t.s. (minimum)** | **29** |
| **Nr. of hatchlings r.t.s. (maximum)** | **29** |
| Nr. of unfertilized eggs | 13 |
| Nr. of dead embryos | 7 |
| Nr. of dead hatchlings | 25 |
| Nr. of predated eggs | 0 |

CS9 was also found on 16 July next to Calıştepe, around 25.6m from the waterline. The hatch of 29 sea turtles was observed and three dead hatchlings were found. During the next days no hatchlings emerged and on 19 July the excavation was carried out. The students found seven dead embryos, 13 unfertilized eggs and 22 dead hatchlings. Some of them were already infested by larvae of Coleoptera and Diptera.

Nest CS10

Table 13: Nest data of CS10 (r.t.s.: reaching the sea)
Tab. 13: Nestdaten von CS10

| | |
|---|---|
| **Total nr. of eggs** | **77** |
| Nr. of empty egg shells | 19 |
| **Nr. of hatchlings r.t.s. (minimum)** | **13** |
| **Nr. of hatchlings r.t.s. (maximum)** | **19** |
| Nr. of unfertilized eggs | 56 |
| Nr. of dead embryos | 2 |
| Nr. of dead hatchlings | 0 |
| Nr. of predated eggs | 0 |

On 25 July CS10 was discovered between the “Seketur Hotel” and the “Seketur Restaurant”, 14.1m from the waterline. The last hatchling hatched on 3 August. During the excavation, 56 unfertilized eggs were observed - a very high number of unfertilized eggs compared to the normal range.

Nest CS11

Table 14: Nest data of CS11 (r.t.s.: reaching the sea)
Tab. 14: Nestdaten von CS11

| | |
|---|---|
| **Total nr. of eggs** | **79** |
| Nr. of empty egg shells | 73 |
| **Nr. of hatchlings r.t.s. (minimum)** | **65** |
| **Nr. of hatchlings r.t.s. (maximum)** | **73** |
| Nr. of unfertilized eggs | 3 |
| Nr. of dead embryos | 3 |
| Nr. of dead hatchlings | 0 |
| Nr. of predated eggs | 0 |

CS11 was in front of the “Seketur Restaurant“ at a distance of 15.3m from the sea. The first turtle hatched on 29 July and the last on 2 August. Five days later the excavation was carried out. Three unfertilized eggs, three dead embryos and four hatchlings were observed. No dead embryos were found.

Nest CS12

Table 15: Nest data of CS12 (r.t.s.: reaching the sea)
Tab. 15: Nestdaten von CS12

| **Total nr. of eggs** | **86** |
|---|---|
| Nr. of empty egg shells | 81 |
| **Nr. of hatchlings r.t.s. (minimum)** | **62** |
| **Nr. of hatchlings r.t.s. (maximum)** | **62** |
| Nr. of unfertilized eggs | 4 |
| Nr. of dead embryos | 1 |
| Nr. of dead hatchlings | 19 |
| Nr. of predated eggs | 0 |

CS12 was close to the "Captain Café Bar" and 25.4m from the waterline. The first hatch was monitored on 30 July. Over a hatch period of five days, 46 hatchlings reached the sea. During the excavation, 16 hatchlings were found and released to the sea, just one dead embryo and four unfertilized eggs were counted.

Nest CS13

Table 16: Nest data of CS13 (r.t.s.: reaching the sea)
Tab. 16: Nestdaten von CS13

| **Total nr. of eggs** | **90** |
|---|---|
| Nr. of empty egg shells | 76 |
| **Nr. of hatchlings r.t.s. (minimum)** | **27** |
| **Nr. of hatchlings r.t.s. (maximum)** | **71** |
| Nr. of unfertilized eggs | 3 |
| Nr. of dead embryos | 11 |
| Nr. of dead hatchlings | 5 |
| Nr. of predated eggs | 0 |

On 3 August CS13 was located in front of the "Seketur Restaurant" (distance to the sea 14.65m). During the next four days probably more than 16 hatchlings emerged. On 10 August the excavation took place.

Nest CS14

Table 17: Nest data of CS14 (r.t.s.: reaching the sea)
Tab. 17: Nestdaten von CS14

| **Total nr. of eggs** | **105** |
|---|---|
| Nr. of empty egg shells | 93 |
| **Nr. of hatchlings r.t.s. (minimum)** | **61** |
| **Nr. of hatchlings r.t.s. (maximum)** | **61** |
| Nr. of unfertilized eggs | 5 |
| Nr. of dead embryos | 7 |
| Nr. of dead hatchlings | 32 |
| Nr. of predated eggs | 0 |

This nest was between the "Sunset Apartments" and the "Surf Café". The first hatchlings emerged on 4 August. During the next days, fewer hatchlings emerged. Sometimes hatchlings cannot reach the surface of the sand because cobbles or other barriers block the way out. Because this part of the beach is stony, several days later the nest was dug up by team members. 26 dead hatchlings were found inside the nest, but 30 hatchlings could be rescued. Some of the dead hatchlings were already infested by dipteran larvae.

Nest CS15

Table 18: Nest data of CS15 (r.t.s.: reaching the sea)
Tab. 18: Nestdaten von CS15

| **Total nr. of eggs** | **67** |
|---|---|
| Nr. of empty egg shells | 36 |
| **Nr. of hatchlings r.t.s. (minimum)** | **5** |
| **Nr. of hatchlings r.t.s. (maximum)** | **36** |
| Nr. of unfertilized eggs | 25 |
| Nr. of dead embryos | 6 |
| Nr. of dead hatchlings | 0 |
| Nr. of predated eggs | 0 |

On 15 August, CS15 was found next to the "Sunset Apartments" 12.8m from the sea. At the excavation on 18 August, 36 empty shells were found. Therefore, a lot of the hatchlings probably already left the nest before the first tracks were counted.

Nest CS16

Table 19: Nest data of CS16 (r.t.s.: reaching the sea)
Tab. 19: Nestdaten von CS16

| **Total nr. of eggs** | **84** |
|---|---|
| Nr. of empty egg shells | 69 |
| **Nr. of hatchlings r.t.s. (minimum)** | **57** |
| **Nr. of hatchlings r.t.s. (maximum)** | **57** |
| Nr. of unfertilized eggs | 7 |
| Nr. of dead embryos | 8 |
| Nr. of dead hatchlings | 12 |
| Nr. of predated eggs | 0 |

CS16 was located directly on the beach area which belongs to the "Surf Café" (20.9m distance from the sea). During the morning shift on 15 August, six tracks were observed. In this nest a lot of hatchlings were also found stuck in the nest but still alive. Large stones blocked the nest and the hatchlings would not have been able to emerge from the nest. At the excavation, 69 empty shells, 12 dead hatchlings, seven unfertilized and eight dead embryos were counted.

## DISCUSSION

Overall, eighteen nests were recorded in Calış this year. With an overall success rate of 67.5%, this year was a quite positive regarding the protection of *Caretta caretta* in Calış.

Students have been collected the data since the sea turtle project started in 1994. Because of this longtime dataset, it is possible to compare the different years. Figure 5 shows that the highest number of eggs was found in 1996 (1769). In contrast to 1996, in the year 2005 only 689 eggs were counted. On average, 1292 eggs were laid per year. Accordingly, the total number of eggs in 2011 was 19% higher than the average over the last 17 years. The trend of the diagram shows that, after peek years like 1996, 1998, 2004, 2006 and 2010, the total number of eggs decreases for several years. Therefore the expectation was that the number of eggs in 2011 would decrease in comparison to 2010.

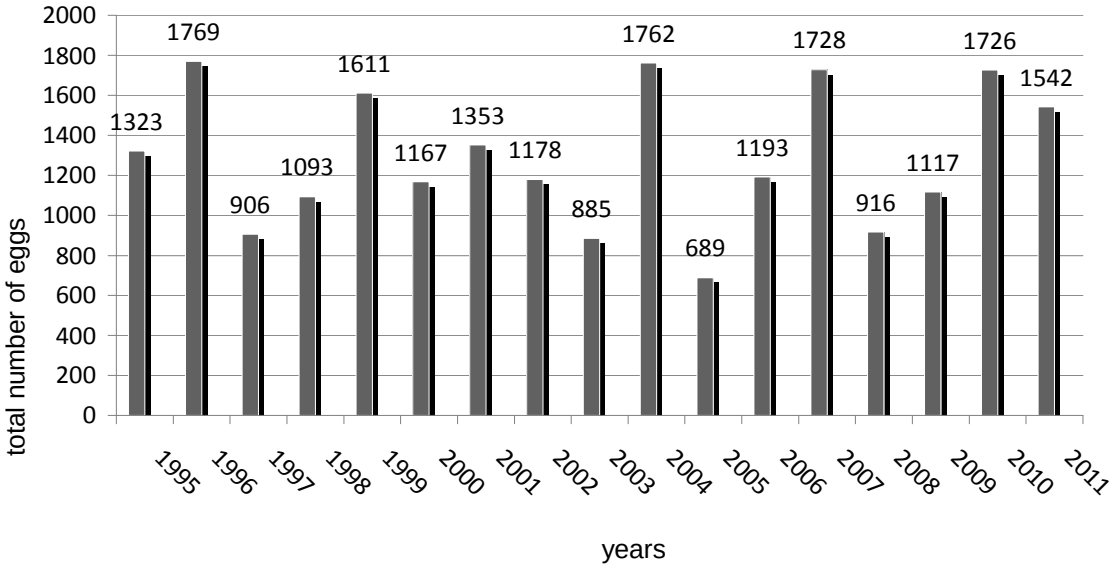



Fig.5: Total number of eggs from 1995 to 2011
Abb. 5: Gesamtzahl der Eier von 1995 bis 2011

A comparison between the years (Fig. 3) shows that the number of nests and the success rate underlies normal fluctuations about the years. Successful years (e.g.1994, 2004 and 2010) are often followed by years with a relatively low number of hatchlings and nests. The project year 2010 was a successful year with a high nest number of 21 (Fig. 6) nests and a maximum success rate of 74.1%. As expected, the success rate in the following year (2011) was lower. Nevertheless the number of nests decrease, see Fig.6.

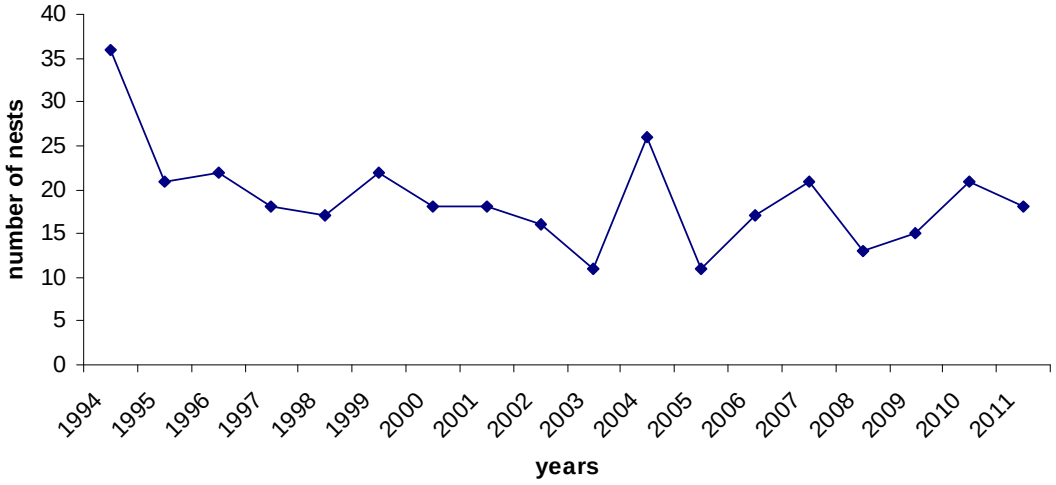



Fig.6: Total number of nests from 1994 until 2011

Fig.6: Anzahl der Nester von 1994 bis 2011

The nesting season 2011 started in early June and ended in early July. Sixteen of the eighteen nests were secret nests, probably all being laid in June before the Austrian students arrived in Calış. Only for two nests could the exact date regarding egg-laying be determined. According to other studies in Fethiye (Baran and Türkozan 1996), June was the month with the greatest nesting activity in Calış. This is a strong argument for beginning the field course earlier.

This year, on average 86 eggs per nest were observed, a normal number for *Caretta caretta* in Turkey (Stachowitsch and Fellhofer, 2011). Note, however that the average number of eggs per nest in Zakynthos over 120, significantly higher than in Calış (Skoufas 2005).

According to Stachowitsch and Fellhofer (2011), the average incubation time of 45.5 days (calculated for the two nests for which the exact egg-laying date was known) is in the range of what could be expected. An explanation for the difference of the incubation times in nests could be environmental conditions like consistence of the sand, temperature, humidity, depth of the nest and location of the nest (Stachowitsch and Fellhofer, 2011). This year, it was possible to estimate the incubation time for only two nests; a higher sample size could help to evaluate more accurately which factor is most important regarding incubation time.

In four nests (C2, CS7, CS9, CS14) insect larvae of Coleoptera and Diptera were found. The reason why parasitic larvae affect a nest remains unclear. The affected nests often showed a high number of unfertilized eggs or a high number of dead hatchlings inside the nest. The eggs and the dead turtles are a food source for the larvae. More data about turtle nests could help to clarify, whether the larvae were inside the nest first and caused the death of the hatchlings/embryos or whether the dead hatchlings attracted the larvae.

Compared to the last two years, a high number of 15% unfertilized eggs inside of all nests were counted in 2011. In the year 2010 the average number of unfertilized eggs of all nests was 10%, in 2009 only 4%. Furthermore, in 2009 the highest number of unfertilized eggs of a nest was 18 % and in 2010 66 %. In 2011 in Cs10 a high number of 73 % unfertilized eggs were counted. There are several possible reasons for such high numbers of unfertilized eggs. A possible explanation is marine pollution e.g. with heavy metals, crude oil or halogenated hydrocarbons can also have negative consequences on marine animals by distorting the pheromone system or leading to infertility. Maybe the extreme high number of unfertilized eggs in 2011 is a consequence of increasing marine pollution; however, more research would be needed to determine the exact causes (Power, 2011)

During the nesting season of *Caretta caretta* in Calış, the beach is also used as a tourist beach. Over the years, Austrian and Turkish students have tried to protect the sea turtles despite the increasing tourism. Tourism on sea turtle nesting beaches creates numerous problems. For example, the yellow protective cages above the turtle nests on the beach (Fig.7A) were often and probably unintentionally used as garbage cans (Fig.7B). Rubbish (glass bottles, stones) on top of a nest reduce the hatchlings chance to successfully emerge from their nests. Over the years, different kinds of cages were tested to prevent people from mistaking the cages with garbage cans. Furthermore, some of the cages were stolen or damaged by young people (Fig.7C). To avoid such damaging the education of local residents and tourists has to be improved so that people are aware that by damaging the cages they also damage or kill sea turtles. The increasing number of sunbeds (see Changes on Calis beach in this report) on the beach is also an increasing problem for sea turtles: they can be a barrier for the turtles. This year at the Surf Café, one nest was found between two rows of sunbeds even though the sand is artificial raised on this place (Fig.7D). Adult sea turtles can get stuck in such beach furniture, the chairs makes it difficult for a female to find a place where she can lay her eggs. In such a case, she will return to the sea and the whole clutch can be lost. For the future, the project team has to continue to talk to the restaurant & bar owners to advise them of *Caretta caretta* and the connected problems e.g. with sunbeds. Overall, many hatchlings were found and dead stuck inside the nest. In nature, this happens from time to time if for example big stones slide in to the nest and obstruct the opening. But humans can also increase the mortalities regarding stuck hatchlings. Although cars on the beach are forbidden, one nest with car tracks was observed (CS7) this year. Driving over a sea turtles nest with a car composes the sand and the hatchlings have no chance to emerge and reach the surface. Another problem is the daily washing of the sunbeds with water on the beaches. A lot of water is used and the sand around the chairs gets wet. This also compresses the sand which can kill hatchlings.

In the next years, the tourism in Calış will no doubt increase. Accordingly the conflicts between the tourism and sea turtle conservation efforts will increase. For this reason, this *Caretta caretta* project in Calış become more and more important over the years. Without the help of volunteers, the sea turtles have a reduced chance to survive, breed and adapt to a changing environment in Calış.

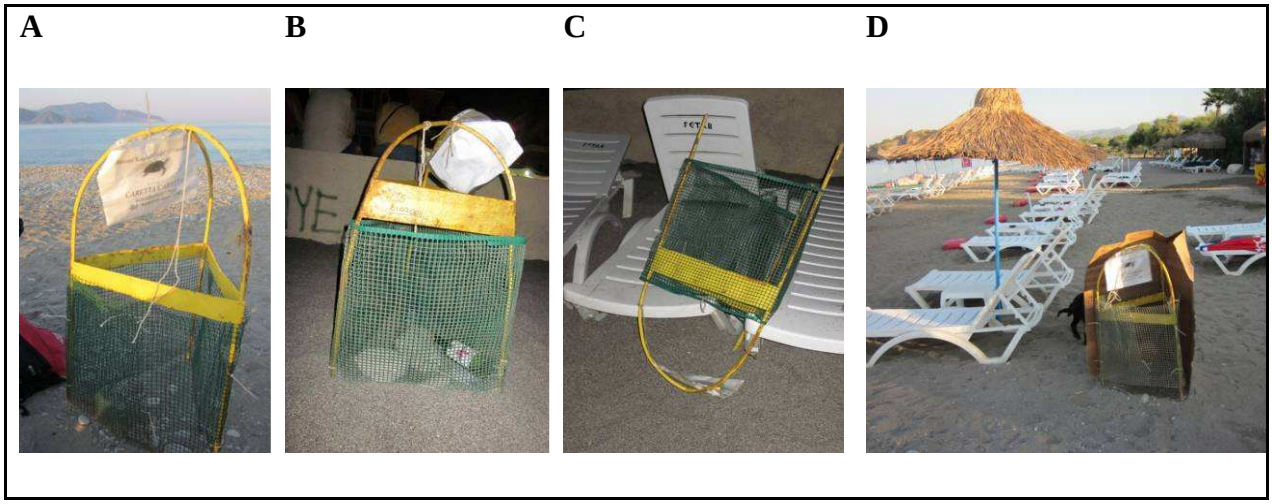



Fig.7: A) Yellow cage located above a *Caretta caretta* nest in Calış for protection, B) Sea turtle nest cage used as a rubbish bin, C) Cage removed and damaged by teenagers on the beach, D) Secret Nest between two rows of sunbeds near the Surf Café

Abb.7: A) Schützender, gelber Käfig über einem *Caretta caretta* Nest in Calış, B) Meeresschildkrötennestkäfig zweckentfremdet als Mülleimer, C) Von randalierenden Jugendlichen verschleppter Käfig, D) Secret Nest zwischen Liegestuhlreihen des Surfs Cafes

Photo: M. Morhart

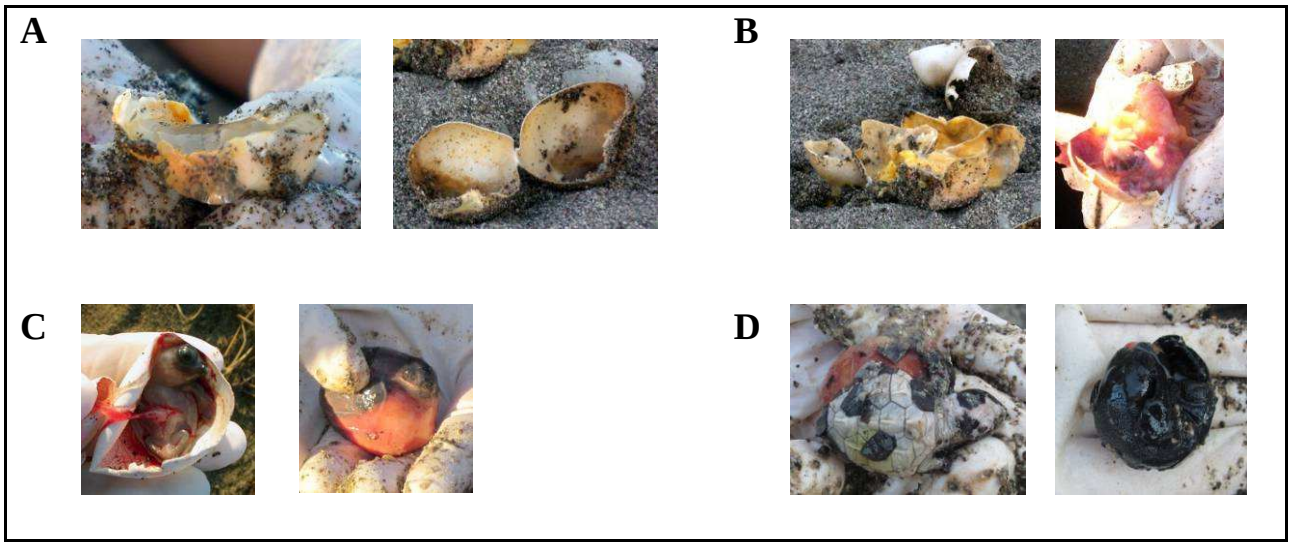



Fig.8: A) Unfertilized Eggs, B) Early Stage of embryos C) Middle Stage of embryos D) Late stage of embryos

Abb.8: A) Unbefruchtete Eier, B) Frühes Embryostadium, C) Mittleres Embryostadium, D) Spätes Embryostadium

Photo: A,B,C) M. Gross, D) M. Morhart

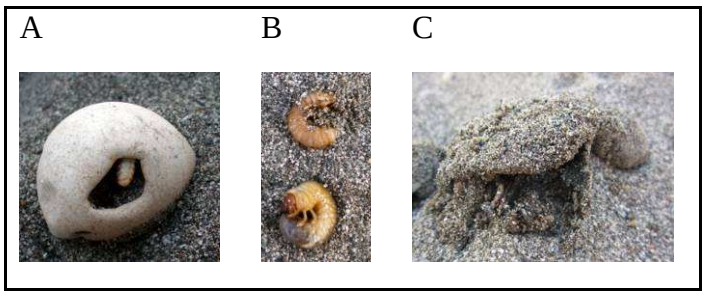



Fig.9: A) Parasitized egg, B) Parasite larvae of coleopterans and dipterans, C) Parasitized hatchling

Abb.9: A) Parasitiertes Ei, B) Parasitenlarve von Coleptorea und Diptera, C) Parasitierter Hatchling

Photo: A,B) M. Gross, C) M. Morhart

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# Hatchling data on *Caretta caretta* in Yaniklar 2011

Annika Buck, Paul Steiner

KURZFASSUNG

Im Projektpraktikum zum Schutz von Meeresschildkröten in der Türkei wurden die Nester der unechten Karettschildkröte (*Caretta caretta*) an Stränden von Fethiye beobachtet und geschützt. Dieses Projekt wird seit mehr als 18 Jahren in Zusammenarbeit mit den türkischen und österreichischen Studenten zur Aufrechterhaltung der SEPA (Special Enviroment Protected Area), unter Naturschutz stehenden Nistplätze, betrieben. In diesem Teil des Berichtes geht es um den Strand in Yaniklar der unterteilt ist in einen sogenannten long way (Yaniklar) und einen short way (Akgöl). Die Nester wurden von Juni bis September observiert. Insgesamt wurden 44 Nester gefunden, 27 in Yaniklar ( 25 secret Nester) und 17 in Akgöl (12 secret Nester). Ein secret Nest ist ein Nest das nur anhand von Jungtier Spuren entdeckt worden ist. Insgesamt wurden 3464 Eier (max.) gelegt von denen 60%, 2071 entwickelte Jungtiere, 1551 davon in Yaniklar (“long way”) und 520 in Akgöl (“short way”) erfolgreich das Meer erreicht haben. 864 Eier (25%) waren nicht geschlüpft. 529 Hatchlinge wurden tot im Nest bzw. getötet durch Fressfeinde, gezählt. Die Eikammmern hatten eine durchschnittliche Tiefe von 0.45m und eine Breite von 0.26 m. Die ersten Eier wurden in einer Tiefe von 0.28m gefunden. Die Hauptschlüpfzeit war im August mit 24 Nestern. In 11 Nestern wurden larven von Diptera und Coleoptera gefunden.

ABSTRACT

At the field course for the protection of sea turtles in Turkey, the nests of loggerhead turtles (*Caretta caretta*) were observed and protected on beaches of Fethiye. This project exists for more than 18 years in collaboration with Turkish and Austrian students in an official SEPA (Special Enviroment Protected Area). This part of the report deals with the beach at Yaniklar, which is divided into a so-called long way (Yaniklar) and a short way (Akgöl). The nests are under observation from June to September. A total of 44 nests were found, 27 in Yaniklar (of which 25 were secret nests) and 17 in Akgöl (of which 12 nests were secret nests). A secret nest is a nest that was discovered only due to the tracks of young sea turtles (hatchlings) in the sand. Altogether 3464 eggs (max.) were laid, of which 60 % (2071) developed successfully. Thereof 1551 hatchlings in Yaniklar (“long way”) and 520 in Akgöl (“short way”) successfully reached the sea. 864 eggs (25%) were recorded as unhatched. 529 hatchlings

were reported as dead in the nest or predated. Egg chamber measurements an average size of 0.45m depth and 0.26m width. The average depth from the surface to the top of the eggs was 0.28m. Main hatching time was in August (24 nests). In 11 nests Diptera and Coleoptera larvae were found.

## INTRODUCTION

Every two to four years, the adult female *Caretta caretta* beginning at an age from 12 to 15 years return to the beach of birth and make two to four nests within about two weeks (Spotila 2004). On Turkey´s beaches, *Caretta caretta* lays 23 to 198 eggs in one nest. The developing of young turtles takes 44 to 64 days (Miller et al. 2000). After the hatchlings emerge from the egg they stay in the sand for a while. The carapace is slightly folded and round when the turtle is still in the egg. For better floatability in the sea, the carapace must become flatter and harden. Hatchlings can live in the sand by breathing the air in the pores of the sand, if the sand is too dense this is not possible. After emerging from the sand at night, the hatchlings orient themselves by following the light of the moon and a wide free horizon of the ocean (Fish and Wildlife Research Institute, 2009). Strong shining lamps behind the nests can irritate the young sea turtles and they will run in the direction of such light. If they successfully go to the ocean and experience the first wave, they run faster and start swimming strongly.. In the water they orient themselves towards the wave direction. At first they make breathing pauses in short distances, but soon they learn to stay under water for up to 4 hours (Ernst, 2009). It takes the hatchlings 1-2 days to swim to the open ocean. The juvenile sea turtles eat plankton and hide in seaweed and other hiding places (Ernst, 2009). Perhaps one of 1000 hatchlings achieves the adult stage. This makes it important to take care of the nests.

## MATERIALS AND METHODS

### Study site

The sea turtle field course of the University of Vienna in 2011 was associated with the University of Pamukkale. As every year, it took place at two beaches (Yaniklar and Çalis) near Fethiye at the Turkish Mediterranean coast. These beaches are declared as Special Enviromental Protected Areas (SEPAs) by the Barcelona Convention. The present contribution analyzes Yaniklar beach. The beach of Yaniklar is split in two stretches, Akgöl beach (“short way”) in the west and Yaniklar beach (“long way”) in the east. The areas were

monitored from the 2 July until 17 September. Early in this period adult *Caretta caretta* still nested and later young sea turtles hatched.

**Night shifts (adults)**

The nesting season of *Caretta caretta* peaks in June and July (Miller et al. 2000). Adult females usually nest at night, hence night shifts were conducted from 23:00 to 02:00. We looked for fresh adult tracks and adults on the beach, without making noise or using torches. When an adult *Caretta caretta* was spotted, straight and curved carapace length and width were measured with a measuring tape and a caliper after nesting. After determination, measuring and a brief description of the turtle's appearance, it was released to the sea. Thereafter the nest was triangulated using a measuring tape. Two fixed points at the left and right side of the nest were defined and marked. The distance between nest and these fixed points and the distance to the sea was noted. The nest was then numbered and marked with sticks or stones in a way that did not hinder the young sea turtles from hatching and successfully reaching the sea. A sketch of the nest, the location, all measurements, the tracks and triangulation were noted on data sheets. Additionally the date and nesting time were noted and an approximate hatching date was calculated by adding 45 days to the nesting date.

**Day shift (hatchlings)**

Day shifts were performed between 05:00 and 06:00. The furthest end of the beach in Yaniklar (long way, small beach) was reached at around 09:00, depending on the activity at the nests. As in the night shift, we searched for adult tracks but also for hatchling tracks (Fig. 14.). The beaches were walked in parallel by at least two persons in order to spot every possible track. All the nests were controlled for hatchling tracks every day, especially when the approximate hatching date was close. When tracks were observed, they were counted and followed. All the tracks reaching into the sea, cases of predation (by hedgehogs, crabs, crows, foxes...), as well as tracks that went in the wrong direction and got lost in the vegetation were noted. Hatching nests were treated with special care and the uppermost centimeters of sand were checked for young *Caretta caretta* and for the presence of stones. In such cases the hatchlings were collected and brought to the camp in a bucket filled with moist sand covered with a cloth and kept in a cool place in the shade to prevent them from drying out. The hatchlings then were released the following night. Apart from that, no interferences with the natural hatching process took place.

**Secret nests**

This refers to nests that were made before the beaches were monitored (before 2 July) and therefore were not yet recorded. Secret nests were noticed by the appearance of hatchling tracks on the beach. In this case the tracks were counted and followed to their beginning. Then the nest was triangulated and numbered. All data and a sketch of the nest were noted on a data sheet.

**Excavations**

Five days after the last hatch, nests were excavated during morning shifts. Nests were carefully dug up and after determining that the hatch was complete, all laid eggs were counted and the depth of the nest, the depth of the moist zone and the width of the nest were measured. All empty eggshells were counted. Closed eggs were opened to classify the egg as unfertilized or as being of early-, mid- and late-embryonic stage (based on the presence of blood, body and pigmented body, respectively). Hatched but dead *Caretta caretta* in the nest were counted and the possible cause of death (stones, roots or hardened sand) was recorded. Fly larvae were noted.

**Problematic nests**

Nests that were made in problematic surroundings (near hotels, camps...) or at unsuitable ground condition (too many stones, roots, litter) were also treated with special care. In case of light pollution near the nest, a barrier was set up at night surrounding the nest to prevent hatchlings from following artificial lights and thereby running in the wrong direction. The barrier was checked for hatched sea turtles every three hours. In case of unsuitable beach conditions, stones, roots or litter were removed from the nest and, if necessary, sand was added

RESULTS

## Yaniklar and Akgöl

*Nests*

In total, 44 successful nests were made by *Caretta caretta* in Yaniklar and Akgöl in the nesting season 2011, of which 37 nests were secret nests. Thus, only 7 nests were made in the time period during the sea turtle field course between 2 July and the 17 September 2011. The remaining 37 secret nests were made prior the 2 July. One of these 44 nests did not complete in hatching until the 17 September. In Yaniklar 27 nests were made, of which 25 were secret nests and 17 in Akgöl, of which 12 were secret nests (Fig. 1.).

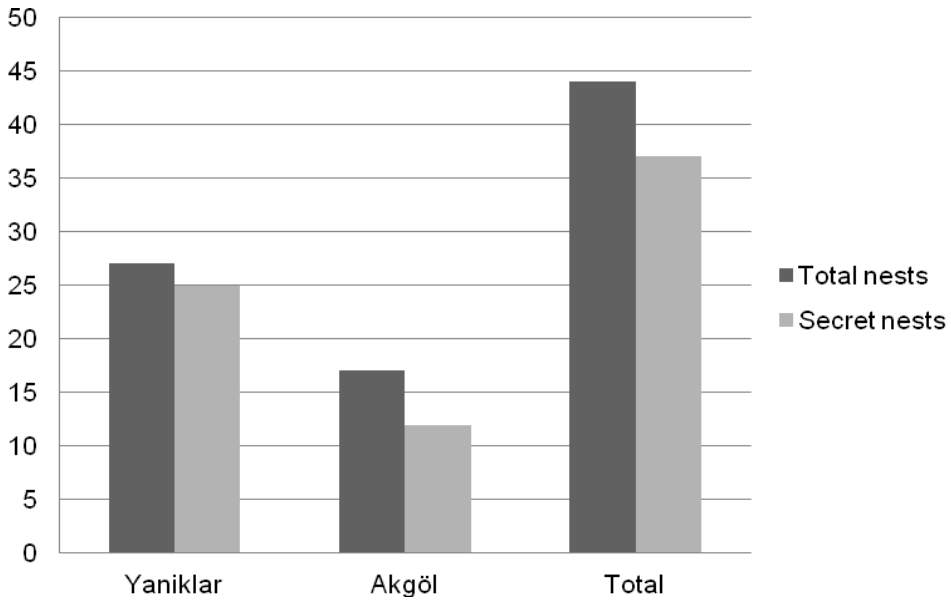


Fig. 1. Number of nests and secret nests in Yaniklar, Akgöl and in Total.
Abb. 1. Anzahl der Nester und secret Nester in Yaniklar, Akgöl und Gesamtzahl.

*Eggs*

In the 2011 nesting season, a total of 3464 eggs were laid. In Yaniklar, 2178 eggs were laid, and in Akgöl 1284. From the total 3462 eggs, 2071 hatchlings developed and were documented as ‘having reached the sea’ (Fig. 2.).

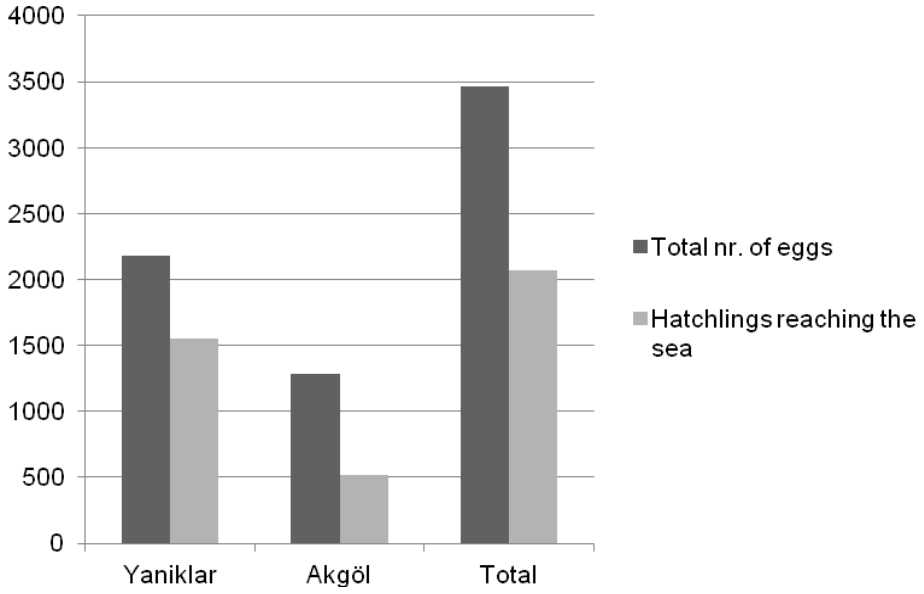


Fig.2. Total number of eggs and hatchlings reaching the sea in Yaniklar, Akgöl in total

Abb. 2. Gesamtanzahl der Eier und Jungtieren die das Meer erreichten in Yaniklar, Akgöl und total

*Hatchlings*

60% of all laid eggs developed and the hatchlings successfully reached the sea. 864 eggs (25% of all laid eggs) were documented as not fully developed (early-, mid- or late-embryonic stage) or unfertilized. The remaining 529 eggs hatched, but the hatchlings were reported as dead. Of these, 243 hatchlings were found dead inside of nests (7%) and the remaining 286 (8%) died outside of nests, (predation, heat) or were documented as dead because the tracks did not lead to the sea (these are referred to as 'lost hatchlings' in fig. 3.) (Fig. 3.).

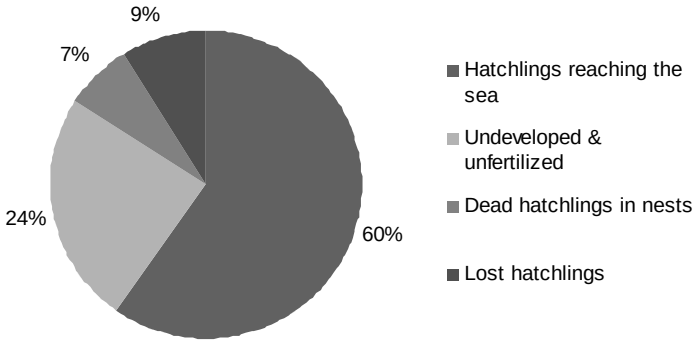


Fig.3. Precentages of total hatchlings reaching the sea, undeveloped hatchlings, unfertilized eggs, dead hatchlings found in nests and lost hatchlings.

Abb. 3. Prozentsätze aller Jungtiere, die das Meer erreicht haben, unentwickelte und unbefruchtete, tote Jungtiere die im Nest gefunden wurden und verlorene Jungtiere.

**Yaniklar**

In Yaniklar beach *Caretta caretta* females laid 2178 eggs and built 27 nests. Of these, 1795 eggs (82%) were fertilized, 383 (18%) unfertilized (Fig. 4.). Of all the fertilized eggs, 1696 eggs (94.5%) were noted as empty egg shells, which includes all hatchlings reaching the sea and all hatchlings that were found dead. Fertilized but unhatched eggs included: 43 eggs in early-embryonic stage (2.4%), 6 eggs in mid-embryonic stage (0.3%) and 50 eggs with embryos in late-embryonic stage (2.8%) (Fig. 5.). 1551 hatchlings were reported as 'having reached the sea'.

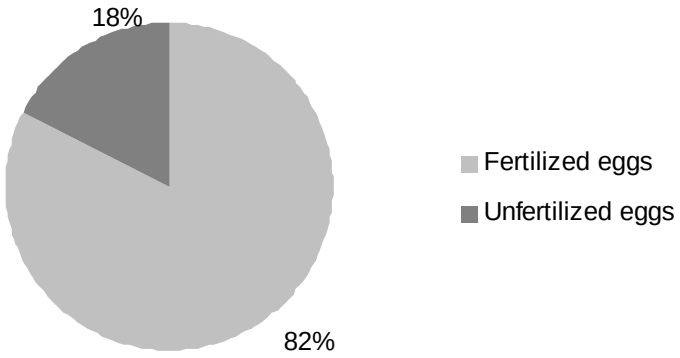


Fig. 4. Percentage of unfertilized and fertilized eggs in Yaniklar.
Abb. 4.Prozentsatz von unbefruchteten und befruchteten Eiern in Yaniklar.

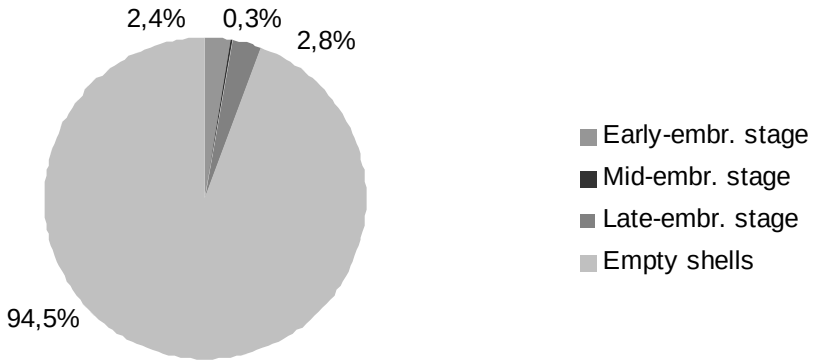


Fig. 5. Percentage of empty shells and not fully developed hatchlings in eggs, determined as early-, mid- and late- embryonic stage in Yaniklar
Abb. 5. Prozentsatz der in Yaniklar gezählten Eischalen und unentwickelten Eier die in ein frühes-, mittleres-, und spätes Entwicklungsstadium eingeteilt worden sind.

## Akgöl

At Akgöl beach, *Caretta caretta* females laid 1284 eggs and built 17 nests. Fertilized eggs amounted to 1117 (87%) and unfertilized eggs to 167 (13%) (Fig. 6.). Fertilized eggs here include 902 empty egg shells (81%), the remaining 19% were undeveloped embryos, recorded as 77 early-embryonic stage (7%), 15 mid-embryonic stage (1%) and 123 late-embryonic stage (11%) (Graph 7). 520 hatchlings were noted as having reached the sea.

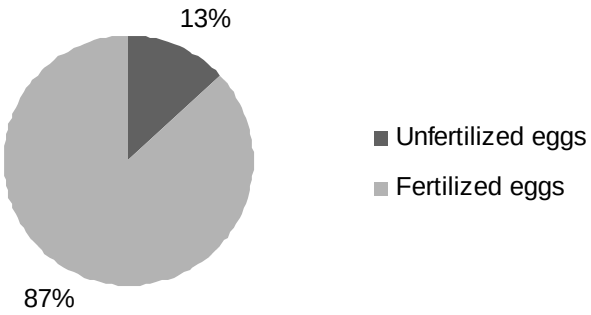


Fig. 6. Percentage of unfertilized and fertilized eggs in Akgöl.
Abb. 6. Prozentsatz der unbefruchteten und befruchteten Eier in Akgöl.

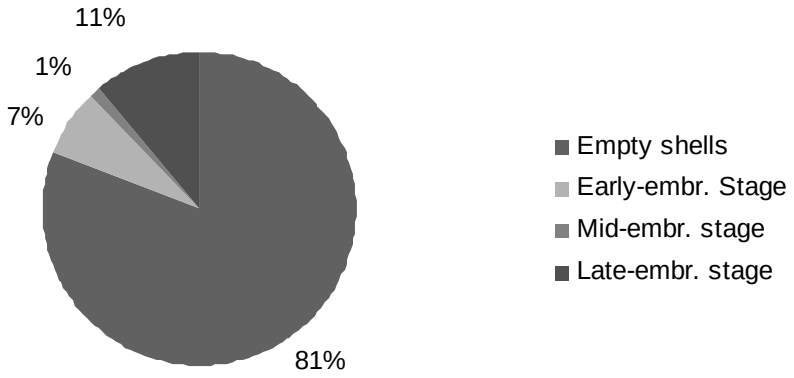


Fig. 7. Percentage of empty shells and not fully developed hatchlings in eggs, determined as early-, mid- and late-embryonic stage in Akgöl.
Abb. 7. Prozentsatz der in Akgöl gezählten Eischalen und unentwickelten Eier die in ein frühes-, mittleres-, und spätes Entwicklungsstadium eingeteilt worden sind.

*Nest measurements*

The average distance of a nest to the sea of both beaches was 17.84m. Egg chamber measurements an average size of 0.45m depth and 0.26m width. The average depth from the surface to the top of the eggs was 0.28m (Table 1.).

Most of the *Caretta caretta* nests hatched in August (24) while 16 nests hatched in July and one in September (Table 2.).

Table 2. Months when nests hatched and amount of nests
Tabelle 2. Monate an denen Nester schlüpften und die Anzahl der Nester

| **Month** | **Hatching nests** |
|---|---|
| July | 16 |
| August | 24 |
| September | 1 |

Table 1. Collected data on nests. Nests code: Y = Yaniklar, A = Akgöl, YS = Yaniklar secret nest, AS = Akgöl secret nest.H.d=Hatch date, D.s= distance to sea, E.d=Excavation date, E.s.= empty shells,H.n.= Hatchling living inside the nest, D.n.=Dead hatchlings in nest,U.e.=Unfertilized eggs, F.e=Fertilized eggs, E.e.=Early embryo, M.e.=mid embryo, L.e.=late embryo, T.e.= Total Number of eggs, T.s.=Total Nr. of empty shells, T.h.=Total Nr. Hatchlings reaching the sea, D.t.e.= Depth too of eggs, B.c.= Bottom of chamber, Di.= diameter

Tabelle 1. Gesammelte Daten der Nester. Nestschlüssel: Y = Yaniklar, A = Akgöl, YS = Yaniklar secret nest, AS = Akgöl secret nest

| Nest Nr. | H.d | D. s(m) | E. d | E. s. | H. n. | D. n. | U. e. | F. e. | E. e. | M. e | L.e. | T. e. | T.s. | T.h. | D.t.e (m) | B.c.(m) | D. (m) | Predation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YS1 | 14.07. | 13,7 | 27.07. | 106 | 3 | - | 21 | 106 | - | - | - | 127 | 106 | 106 | 0,20 | 0,42 | 0,26 | Diptera,2xNematoda digochaeta |
| YS2 | 20.07. | 15,5 | 27.07. | 39 | 1 | - | 45 | 42 | 2 | - | 1 | 87 | 39 | 39 | 0,12 | 0,36 | 0,34 | |
| YS3 | 09.08. | 12,6 | 21.08. | 113 | 7 | - | 5 | 114 | - | - | 1 | 119 | 113 | 111 | 0,22 | 0,49 | 0,29 | Diptera larvae, Fox |
| YS4 | 01.08. | 16,24 | 16.08 | 63 | - | - | 23 | 64 | - | - | 1 | 87 | 63 | 62 | 0,23 | 0,45 | 0,31 | Diptera larvae, Oligochaete 7 eggs with parasites |
| YS5 | 28.07. | 14,9 | 04.08. | 86 | - | - | 4 | 68 | - | - | - | 72 | 68 | 62 | 0,32 | 0,42 | 0,23 | birds |
| YS6 | 28.07. | 16,6 | 05.08. | 28 | - | - | 22 | 41 | 3 | - | 10 | 63 | 28 | 25 | 0,35 | 0,38 | 0,19 | |
| YS7 | 11.08. | 10,75 | 21.08. | 4 | - | - | 84 | 7 | 3 | - | - | 91 | 4 | 3 | 0,12 | 0,37 | 0,41 | nematode |
| YS8 | 27.07. | 22,5 | 06.08. | 65 | - | - | 4 | 68 | 2 | - | 1 | 72 | 65 | 63 | 0,34 | 0,46 | 0,19 | Pimeha sp. |
| YS9 | 02.08. | 17,35 | 16.08. | 72 | - | - | - | 72 | - | - | - | 72 | 72 | 72 | 0,10 | 0,39 | 0,27 | |
| YS10 | 09.08. | 17,5 | 21.08. | 71 | 4 | - | 1 | 72 | - | - | 1 | 73 | 71 | 71 | | | | many diptera, late empryo |
| YS11 | 27.07. | 12,1 | 09.08. | 94 | - | 1 | 2 | 101 | 1 | 2 | 3 | 103 | 94 | 45 | 0,31 | 0,45 | 0,26 | Diptera cocoon in unfert. eggs |
| YS12 | 11.08. | 16,79 | 24.08. | 102 | - | - | 2 | 104 | 1 | - | 1 | 106 | 102 | 99 | 0,43 | 0,49 | 0,23 | small worms in earl-embr |
| YS13 | 10.08. | 21,41 | 19.08. | 68 | 2 | 1 | 1 | 68 | - | - | - | 69 | 68 | 68 | 0,18 | 0,52 | 0,24 | 1 unf. egg diptera larvae |
| YS16 | 15.08. | 20,16 | 23.08. | 85 | 1 | - | - | 87 | - | - | 2 | 87 | 85 | 93 | 0,12 | 0,37 | 0,28 | |
| YS17 | 17.08. | 16,85 | 31.08 | 86 | 1 | 1 | 3 | 88 | - | - | 2 | 91 | 86 | 85 | 0,35 | 0,5 | 0,24 | 1 late+1 unf. Coleoptera larve |
| YS18 | 23.08. | 20,58 | 01.09. | 66 | - | - | 1 | 66 | - | - | - | 67 | 66 | 65 | 0,41 | 0,47 | 0,29 | |
| YS20 | 18.08. | 14,25 | 23.08. | 14 | 1 | - | 51 | 27 | 12 | - | 1 | 78 | 14 | 14 | 0,27 | 0,41 | 0,23 | |
| YS21 | 24.08. | 21,03 | 01.09. | 24 | - | - | 24 | 30 | 5 | 1 | - | 54 | 24 | 17 | 0,30 | 0,44 | 0,21 | early with Diptera larven |
| YS22 | 23.07 | 16,9 | 30.07. | 43 | - | 2 | 27 | 48 | 1 | 1 | 1 | 75 | 43 | 15 | 0,17 | 0,4 | 0,32 | Hedgehog |
| YS23 | 24.07. | 15,03 | 03.08 | 66 | 2 | 8 | 3 | 78 | - | - | 12 | 81 | 66 | 49 | 0,26 | 0,43 | 0,27 | |
| YS24 | 05.08. | 13,8 | 14.08. | 65 | - | 1 | 22 | 67 | - | - | 1 | 89 | 65 | 64 | 0,21 | 0,31 | 0,33 | |

Table 1. Collected data on nests. Nests code: Y = Yaniklar, A = Akgöl, YS = Yaniklar secret nest, AS = Akgöl secret nest
Tabelle 1. Gesammelte daten der Nester. Nestschlüssel: Y = Yaniklar, A = Akgöl, YS = Yaniklar secret nest, AS = Akgöl secret nest

| Nest Nr. | Hatchdate | Dist. to sea (m) | Excavation | Empty shells | Hatchling still living inside nest | Dead hatchlings in nest | Unfertilized eggs | Fertilized eggs | Early - embryo | Mid - stage | Late - stage | Total Nr. of eggs | Total Nr. of empty shells | Total Nr. hatchlings reaching the sea | Depth : top eggs (m) | Bottom of chamber (m) | Diameter (m) | Predation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YS25 | 06.08.2011 | 16,2 | 16.08.2011 | 72 | - | - | 3 | 74 | - | - | 2 | 77 | 72 | 71 | 0,41 | 0,5 | 0,36 | |
| YS26 | 25.08.2011 | 15,45 | 29.08.2011 | 82 | - | 1 | 2 | 85 | - | - | 2 | 87 | 82 | 82 | 0,40 | 0,54 | 0,24 | diptera larvae |
| YS27 | 28.08.2011 | 25,75 | 05.09.2011 | 83 | - | 3 | 5 | 87 | - | 1 | 3 | 92 | 83 | 80 | 0,37 | 0,52 | 0,22 | Nematoda late embr, scarabaeiden larve |
| Y1 | 02.09.2011 | 11,5 | 10.09.2011 | 69 | 1 | 3 | 6 | 78 | 7 | - | 2 | 84 | 69 | 56 | 0,39 | 0,52 | 0,24 | Nematoda |
| Y2 | 25.08.2011 | 12,9 | 31.08.2011 | 48 | 1 | - | 22 | 58 | 6 | 1 | 3 | 80 | 48 | 34 | 0,25 | 0,39 | 0,25 | |
| A1 | 26.08.2011 | 20,05 | 04.09.2011 | 37 | 5 | - | 3 | 41 | 1 | - | 4 | 44 | 37 | 14 | 0,29 | 0,48 | 0,25 | |
| A2 | 15.07.2011 | 9,3 | 03.09.2011 | - | - | - | 57 | 33 | 24 | 3 | 6 | 90 | - | - | 0,35 | 0,51 | 0,25 | |
| A3 | 15.07.2011 | 8,1 | 06.09.2011 | 24 | 2 | 1 | - | 41 | 5 | 2 | 10 | 41 | 24 | 16 | 0,52 | 0,61 | 0,15 | |
| A4 | 16.07.2011 | 10,1 | 05.09.2011 | 61 | 5 | 8 | 1 | 64 | 3 | - | - | 70 | 61 | 51 | 0,32 | 0,44 | 0,21 | Dog |
| A5 | not found | 7 | | | | | | | | | | | | | | | | |
| AS1 | 19.07.2011 | 66,45 | 24.07.2011 | 50 | 9 | 11 | 21 | 71 | 14 | 2 | 3 | 92 | 50 | 18 | 0,23 | 0,41 | 0,23 | Tenebrionidae, 2xMuscidae, 30xDiptera larvae |
| AS2 | 20.07.2011 | 8,8 | 28.07.2011 | 81 | - | 2 | 18 | 96 | 10 | 1 | 4 | 114 | 81 | 32 | - | 0,45 | 0,28 | |
| AS3 | 22.07.2011 | 43,73 | 26.07.2011 | 28 | 2 | 10 | 35 | 79 | 11 | 2 | 38 | 114 | 28 | 18 | 0,26 | 0,5 | 0,25 | Tenebrionidae, 10xDiptera larvae |
| AS4 | 22.07.2011 | 34,79 | 27.07.2011 | 56 | 6 | 3 | 4 | 88 | 3 | - | 20 | 79 | 56 | 22 | 0,28 | 0,4 | 0,34 | Diptera larvae |
| AS6 | | 20,85 | 09.08.2011 | 63 | 23 | 40 | 10 | 74 | - | 1 | 10 | 84 | 63 | 14 | 0,25 | 0,5 | 0,45 | |
| AS7 | 02.08.2011 | 15,85 | 08.08.2011 | 47 | 13 | 64 | 2 | 95 | - | 2 | 4 | 97 | 47 | 24 | 0,10 | 0,45 | 0,27 | |
| AS8 | 15.08.2011 | 19,85 | 22.08.2011 | 51 | 3 | 2 | 4 | 57 | 3 | 1 | 2 | 61 | 51 | 49 | 0,13 | 0,6 | 0,28 | |
| AS9 | 30.07.2011 | 7,1 | 31.07.2011 | 96 | 13 | 81 | 5 | 102 | - | - | 6 | 107 | 96 | 15 | 0,36 | 0,42 | 0,30 | |
| AS10 | 07.08.2011 | 10,71 | 13.08.2011 | 79 | - | - | 4 | 94 | 2 | - | 13 | 98 | 79 | 64 | 0,29 | 0,46 | 0,26 | 2 eggs with unknown insects |
| AS11 | 14.08.2011 | 18,5 | 22.08.2011 | 78 | - | - | 2 | 81 | 1 | 1 | 1 | 83 | 78 | 78 | 0,32 | 0,42 | 0,23 | |
| AS12 | 19.08.2011 | 19,2 | 24.08.2011 | 40 | - | - | 1 | 42 | - | - | 2 | 43 | 40 | 41 | 0,33 | 0,4 | 0,25 | |
| AS13 | 21.01.1904 | 18,4 | 24.08.2011 | 64 | - | - | - | 64 | - | - | - | 64 | 64 | 64 | 0,33 | 0,42 | 0,17 | |
| **total:** | | | | | | **243** | **550** | | **120** | **21** | **173** | | | | | | | |

## Predation

Diptera larvae were observed in 11 nests during the summer. Coleoptera larvae were also noted as frequent predators. Other predators that were predating hatchlings or that had left marks of predation were: dogs, birds and hedgehogs (Table 3.). Interestingly, predation by hedgehogs was recorded for the first time in this season. Hatchlings that were predated by hedgehogs were found without heads or wounds on the head (Fig. 10.). The wounds of the bite were ascribed to hedgehog jaws. Only one nest (YS22) was predated by hedgehogs, but several hatchlings were found dead and wounded.

Table 3. Reported predators and number of reports
Tabelle 3. Fressfeinde und Anzahl der Sichtungen

| Predator | Reports |
|---|---|
| Diptera larvae | 11 |
| Nematoda | 6 |
| Coleoptera larvae | 3 |
| Dog | 1 |
| Birds | 1 |
| Hedgehog | 1 |
| Unknown | 1 |

## Reports of problematic nests

There were a few reports on problems concerning the nest's state. Most of them involved stones in the nest. Other frequent problems were wet sand or obstacles in the egg chamber, and hardened sand or gravel above the eggs, roots in the nest and in eggs (Fig. 11. and Table 4.).

Table 4. Reported nests with problems and description of the problem.
Tabelle 4. Berichtete Problemnester mit Beschreibung des Problems

| Nest | Problem |
|---|---|
| YS2 | Stone in nest |
| YS3 | Hard sand |
| YS10 | Hard sand, big stones and a root |
| YS27 | Stone in nest |
| Y1 | Stones in nest |
| A2 | Wet/moist sand deep in nest |
| AS3 | Wet piece of wood in chamber, 30 eggs rotten |
| AS4 | 14 of 20 late-embryonic-stage-eggs rotten |
| AS7 | 42 hatchlings stuck in their shells |
| AS8 | Gravel beach |
| AS9 | Wet sand |

DISCUSSION

The Special Enviromental Protected Areas Yaniklar and Akgöl beach in Turkey are key nesting areas of *Caretta caretta* at the Mediterranien coast. In the nesting season 2011, 44 nests were made. This number is relatively low, when compared to the data collected in nesting seasons from 1999 onwards (Fig.8). The number of nests made ranges from 36 (2004) up to 99 (2001) nests at Yaniklar and Akgöl beach in one season. The relatively low number of nests that were made in 2011 might be due to a nomal fluctuation that occurs all 7 years. Comparing all 12 years, the number of the nests in Yaniklar is higher than the number of nests in Akgöl. Over the last three years there is a steady decrease in the number of nests.

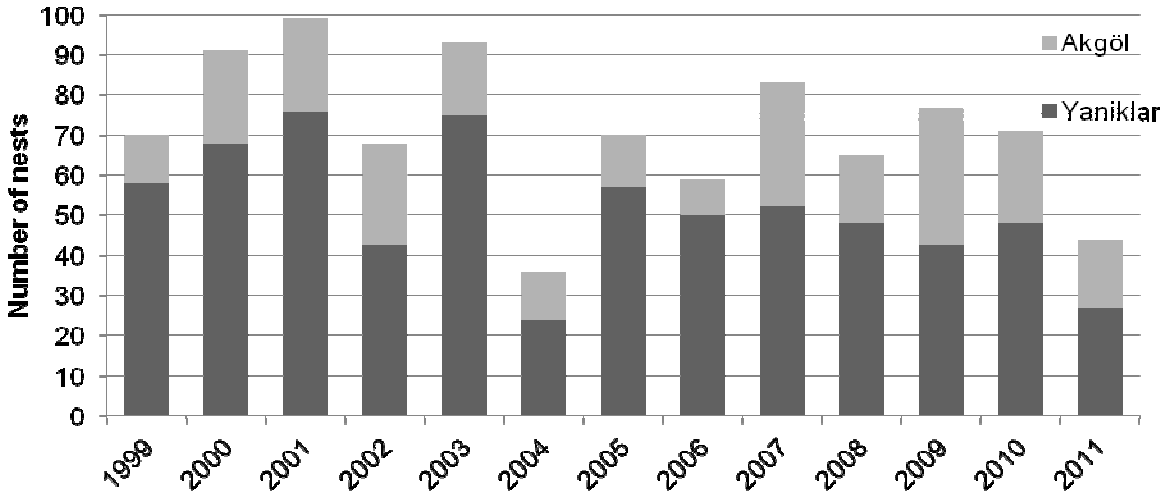


Fig. 8. Comparison of nests in the years 1999 to 2011 in Akgöl and Yaniklar.

Abb. 8. Vergleich der Nester in den Jahren 1999 bis 2011 in Akgöl und Yaniklar

This fluctuation over the last years may relate to the fact that females return every two to three years for mating, and the high peaks 1995, 1998, 2000 and 2003 may correspond to a synchronization of the females (Fig.9). When comparing the number of hatchlings having reached the sea and the number of empty egg shells from this year (2011) to the last year's numbers (2010), more hatchlings have reached the sea but less empty shells were found in 2011. This indicates less predation and/or dead hatchlings.

From the 2 July onward, only 7 adult female *Caretta caretta* were observed while nesting. The majority of nests were detected because of the appearance of hatchling tracks. Clearly the main nesting time is June. Only one nest has not hatched fully by 17 September, which was the date when the last team from Vienna left.

At Yaniklar beach, there were 10 nests more than at Akgöl. This reflects the length of Yaniklar beach (4 km), which also has a small separate sandy beach. This beach is delimited by cliffs and a small river but nonetheless regularly visited by bathers, divers and campers. This is probably due to the fine sand on which it is very comfortable to relax. This fine sand is supposably also the reason why more turtles come to this small district at Yaniklar to build nests. This season two *Caretta caretta* nests at small beach and juveniles of the African softshell turtle (*Trionyx triunguis*) were recorded during morning shifts. The adjacent beaches consist of gravel and rocks and hence are not as frequently visited by turtles as the small beach. Fewer nests were built at Akgöl. Nonetherless, it's relatively short length (1.6 km) and the large areas of unsuitable gravel beach it is a more active nesting area than Yaniklar beach based on length.

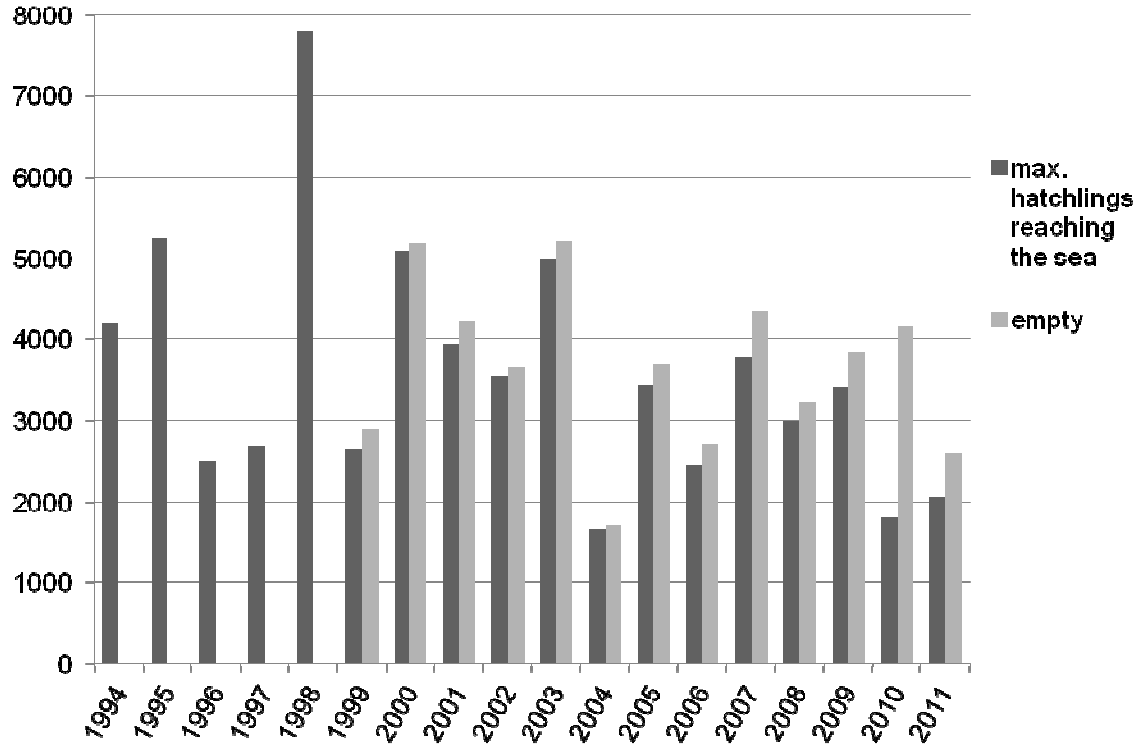


Fig. 9. Comparison of empty egg shells (= empty) and max. hatchlings reaching the sea in the years of 1994 to 2011.
Abb. 9. Vergleich aller leeren Eischalen (= empty) und max. Jungtiere die das Meer erreichten in den Jahren 1994 bis 2011.

Especially in the most western part of Akgöl, which is a small area (100 m) of fine sand, 9 nests were made. Accordingly more than half of all the nests in Akgöl were made in this short section. The total number of layed eggs at the two beaches, Akgöl and Yaniklar, show a similar picture as the built nests (Fig. 2.). There were roughly twice as much eggs layed at

Yaniklar than at Akgöl which is due to the differing amounts of nests. 60% of all layed eggs were reported as having reached the sea and 25% as unfertilized and undeveloped. The majority of undeveloped eggs were in the late embryonic stage in Akgöl as well as in Yaniklar (Fig. 5 and Fig. 7.)

Most reports of predation were on fly larvae inside nests. Although the larvae were often found in hatchling carcasses and rotten eggs, this might not have been the actual cause of death. The cause of death may have been something else and the flies appeared because of the dead organisms. The main terrestrial predation was probably by birds. These predators, especially crows and seagulls, were often encountered at the beaches, but hard to witness while predating. Another suspected, but never observed predators were crabs. Many times, crab tracks were seen near *Caretta caretta* nests. Predation by dogs was witnessed and reported. Forms of predation on land seem to be area- or beach- specific because reports about predation vary from imported Fire Ants (Solenopsis invicta) in Georgia (USA) (Moulis et al. 1997), racoons in South Carolina (USA) (Stancyk et al. 1980) to red fox (Vulpes vulpes) predation in Dalyan beach (Turkey) (Yerli et al. 1997). The hedgehog predation at nest YS22 has never been observed or reported before and has to be followed over the next seasons. The most often reported problems with nests were stones in the nest hindering hatchlings from emerging. Hatchlings on their way to the water sometimes have to pass stretches that contain many stones and rocks which are barriers. Sometimes hatchlings were found stuck underneath stones and rocks. On sandy beaches, at least in Akgöl, many more nests were built than at gravel or rocky beaches. It is much easier for hatchlings to reach the sea when crawling over a sandy beach. To increase the number of nests, and the number of hatchlings reaching the sea, the removal of sand from beaches for use as building material and the compression of sand by cars and bucket excavators (Fig. 11 and Fig. 12), as occures on some hotel beach sections, has to stop.

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http://www.seaturtlecourse.com/eng/e_index.htm (21.11.2011)

Fig. 10. Hatchling predated by hedgehog

Abb. 10. Von Igel getöteter Hatchling

Prädation Photo: C. Fellhofer

Fig. 11. Egg completely intermingled by roots

Abb. 11. Ein mit Wurzeln durchwachsenes Ei

Fig. 12 & 13. Compression of sand by bucket excavators
Abb. 12 & 13. Sandverdichtung durch Bagger

Fig.14 & 15:Hatchling tracks recorded in morning shift Photo:C.Fellhofer
Abb.14& 15: Hatchlingspuren in der Morgenschicht.

# CHANGES ON ÇALIŞ BEACH 2011

Miriam Gross

KURZFASSUNG

Seit 1994 nehmen Studenten der Universität Wien an einem Artenschutz- und Forschungsprojekt teil, um die Niststrände der Unechten Karettschildkröte (*Caretta caretta*) in Çaliş, nahe Fethiye an der Südwestküste der Türkei gelegen, zu erhalten.

Es handelt sich um einen kleinen Strand bestehend aus der Strandpromenade in Çaliş und dem westlichen Teil von Çiftlik, von insgesamt etwa 3,5km Länge, der zu einer Special Environment Protected Area (SEPA) gehört und auch sehr beliebt bei Touristen ist.

Tourismus ist in der Tat einer der Gründe, weshalb der Strand sich zu einem für die Nistaktivitäten der Unechten Karettschildkröte immer weniger geeigneten Platz entwickelt.

Mit der stetig wachsenden Zahl an Touristen in der Region, steigen nicht nur die Anzahl der Hotelbetten, Sonnenliegen, Sonnenschirmen und Strandbars von Jahr zu Jahr, sondern auch der Lärm und die Lichtverschmutzung entlang des Strandes. Nicht nur Touristen, sondern auch Einheimische kommen gerne an den Strand um zu grillen und teilweise sogar am Strand zu übernachten.

Aufgrund dieser Störungen, sammelt das Team des Meeresschildkröten-Praktikums Daten über die Nistaktivitäten in Çaliş und den westlichen Teil des Strandes, der zu Çiftlik gehört, um Veränderungen zu dokumentieren, wie zum Beispiel die steigende Anzahl der Sonnenliegen und Schirme. Insgesamt wurden in Çaliş und Çiftlik 1624 Sonnenliegen und 711 Sonnenschirme gezählt. Im Vergleich zum Vorjahr bedeutet das einen Anstieg von 26.1% bei Sonnenliegen und 10.4% bei Sonnenschirmen. Besonders hoch war der Zuwachs von anderen Strandmöbeln, wie Sitzsäcke und Tische. 183 Tische bedeuten einen Anstieg um 357.1% im Vergleich zum Jahr 2010. Weiters wurden 130 Sitzsäcke im Jahr 2011 gezählt, was eine Steigerung um 225% bedeutet. Zusätzliche Hindernisse, die den weiblichen Schildkröten das Nisten erschweren oder die frisch geschlüpften Schildkröten daran hindern ins Meer zu gelangen, werden wenn möglich entfernt oder zumindest dokumentiert.

Häufige Störungen und Hindernisse sind die bereits erwähnten Sonnenliegen, die Barrieren für eine Schildkröte darstellen, oder die angepflanzten Akazienbäume, die es ihnen kaum mehr möglich machen ein Nest in der Nähe dieser Bäume zu graben. Die Situation ist noch problematischer für die schlüpfenden Schildkröten. An manchen Strandabschnitten sind Kunststoffmatten ein Problem, da sie die potentielle Nistfläche reduzieren oder den Weg der aus dem Nest schlüpfenden Schildkröten blockieren.

Wie jedes Jahr wurden neue Strandbuden aufgebaut, wie z.B. Kaan Beach, Surf Alani und ein noch unbenannter Komplex in Çiftlik. Von einem Jahr zum nächsten sind verschiedene Veränderungen wahrnehmbar, aus Sicht der Meeresschildkröten sind es meist Verschlechterungen. Vor kurzem hat die Organisation MEDASSET den Fall, der sich konstant verschlechternden Bedingungen, der Special Environment Protected Area der Berner Konvention vorgelegt. Nach Jahren der Bemühungen, die Bedingungen am Strand für die nistenden Schildkröten zu verbessern, konnten in diesem Jahr auch einige wenige positive Änderungen festgestellt werden. Weiterhin gibt es jedoch Bereiche, die sich noch nicht verbessert oder gar verschlechtert haben.

ABSTRACT

Since 1994, students from the University of Vienna have taken part in a conservation and research field course, in order to protect the nesting beach of the loggerhead turtles (*Caretta caretta)* in Çaliş, located near Fethiye on the southwestern coast of Turkey.

It is a small beach consisting of the promenade in Çaliş and the western Çiftlik area, all together about 3.5 km long, which belongs to a Special Environment Protected Area, which is also popular with tourists. Tourism is in fact one of the reasons why the beach is turning into a less suitable place for nesting activities of the loggerhead turtles.

With more tourists coming to the region, not only have the numbers of hotel beds, sunbeds, parasols and bars risen from year to year, but also the noise and light pollution along the beach has increased. Both tourists and local residents like spending time at the beach, having barbecues and sometimes they even stay overnight. Due to these disturbances, the sea turtle team collects data about nesting activities in Çaliş, and the western part of the beach belonging to the area of Çiftlik, and documents changes like the rising numbers of sunbeds and parasols. Altogether 1624 sunbeds and 711 parasols were counted in Çaliş and Çiftlik. Compared to the previous year this is an increase by 26.1% of sunbeds and 10.4% of parasols. The increase of other beach furniture like beanbags and tables was esspecially high. 183 tables represent a plus by 357.1% compared to the year 2010. Furthermore, 130 beanbags, and therefore an increase by 225%, were counted in 2011.

Additional obstacles that may prevent a female loggerhead turtle from nesting or hatchlings from reaching the sea are removed if possible or at least documented.

Frequent disturbances and obstacles are the already mentioned sunbeds, which form barriers that can prevent a turtle from ascending on the beach, and the introduced acacia trees, which

make it difficult to dig a nest near the trees. The situation is even more problematic for the turtle hatchlings.

On some areas of the beach, mats consisting of synthetic material are a big problem: they reduce the potential nesting area or block the hatchlings‘ emergence.

As every year, new beach huts were built, like the Kaan Beach, the Surf Alani and a yet unnamed complex at Çiftlik. From one year to the next, different changes take place. For the sea turtles they are mostly for the worse. Recently, an organisation called MEDASSET brought the case of the worsening conditions of the Special Environment Protected Area to the Bern Convention. After years of trying to improve the beach for the turtles, this year some alterations were made for the better. Other things, however, haven’t improved yet or have even gotten worse.

## INTRODUCTION

Çaliş Beach, located near the city of Fethiye, is one of 20 nesting beaches of *Caretta caretta* (Loggerhead sea turtle) along the Mediterranean southwestern coast of Turkey and belongs to one of three Special Environment Protected Areas (besides Dalyan and Patara). Since 1994 students from the University of Vienna have been cooperating with students from varying Turkish universities in a conservation and research project in Çaliş in order to protect the nests and hatchlings of *Caretta caretta*. From June on, Turkish students patrolled the beach, looking out for nesting loggerhead females; in July, Austrian students joined in. Furthermore, the general condition of the nesting beach was observed and documented. This involves counting the numbers of lights along the promenade, sunbeds and parasols and also collecting data about new buildings and other changes along the promenade of Çaliş beach and the beach section westward of the promenade, including the so-called picnic area that is a part of Çiftlik. From the beginning of the project 17 years ago on, the conditions for the turtles, the adults as well as the hatchlings, seemed to change for the worse (Ilgaz et al., 2006).

The number of sunbeds and parasols increases from year to year, and the same is true for beach huts and bars, which are not only build up but also expanded constantly to keep up with the increasing number of tourists. Tourism is the source of many problems sea turtles are confronted with. Hotels and bars are built as close as possible to the promenade to offer a nice seaview. Clearly, this is a source of disturbance for turtles. The noise and the light can prevent an adult turtle from nesting and cause it to return to the sea. The enormous light pollution on the promenade can also cause the hatchlings, which in most cases hatch at night, to run in the

wrong direction. Normally they orientate towards the brightest horizon, which is - under natural conditions - always the seaward horizon. Natural moonlight gets reflected more by water than by land and, in addition, the landward horizon is often darkened by dunes and vegetation. Not only the promenade but also the beach is used for several activities, both day and night.

During the day, the beach as well as the shallow water is crowded. Watersports activities such as kite surfing and boats close to the beach can harm female turtles, who wait in the shallow water for the night when they approach the beach for nesting. The kite surfers‘ activity in 2011 was mainly to advertise and to attract tourists to beach parties at the Surf Cafe located in the Çiftlik area of the beach. Many tourists as well as residents are unaware, that it is prohibited to walk on the beach at night or to camp on the beach and light bonfires, which happens particularly in the picnic area of Çiftlik. Althought this section of the beach is also part of the Special Environment Protected Area and nesting place of *Caretta caretta*, visitors camp on the beach. Local residents in particular bring large carpets for more comfort, stay in tents overnight, listening to loud music and having barbecues.

A tiny hatchling can easily be overlooked by visitors and stepped on. Also adult turtles may be frightened off by campfires or by tourists disturbing them by making noise and taking photos with flash. Such activities can cause turtles to leave without nesting.

Importantly, the females always return to the beach of their own birth: they can’t just switch to another beach.

Not only can visitors scare off nesting turtles, also carpets and tents are potential obstacles for either turtles trying to dig a nest or for hatchlings trying to dig their way up through the sand. The carpets also produce shade, which can lead to lower temperatures inside the sand. As a result, the incubation time of the eggs can be extended and also the gender of hatchlings can be altered, since it is determined by temperature. Lower temperatures produce more males than females.

While sunbeds and towels are both obstacles and produce shade, parasols pose another threat to hatchlings when they are pushed into the sand and possibly through a nest. Even though permanent parasol stands and parasols were installed at the beach, some tourists still bring their own, so they don’t have to pay rental fees for the ones owned by e.g. hotels.

Although identified nests in Çaliş are marked with protective cages, the parasols are still a risk for potential unknown nests, so-called secret nests. Furthermore, the protective cages are often removed by tourists, knocked over unintentionally and even on purpose.

## MATERIAL AND METHODS

The beach of Çaliş was partitioned into the western Çiftlik part and the promenade. The sunbeds and parasols in Çiftlik can be assigned to the different bars and restaurant. Therefore they were also counted separately (Tab 1). In the second part of the beach along the promenade, starting eastwards of the Mimoza Beach Club, all sunbeds and parasols were counted together in August21st, 2011 since they all look the same and are all held by FETAB (Fethiye Turizm Altyapı Hizmet Birliği), the Fethiye Union of Tourism and Infrastructure.

In this part the beach was divided into the lower section close to the water, a middle section and an upper section along the promenade wall. The counts were compared to the numbers in previous reports (Fig. 1).

Also photographs of the beach huts, the sunbeds, parasols and other changes at or near the beach were taken (Fig. 2) and compared with the photos and data from previous years.

## RESULTS

This year‘s counts revealed increasing numbers of beach furniture in both Çaliş and Çiftlik. On the Çiftlik side of the beach, reaching from Mimoza Beach Club to the eastern end of the beach at Çaliştepe, a total number of 847 sunbeds and 328 parasols (Tab. 1) were counted on August 21st, 2011. Compared with 722 sunbeds and 296 parasols in the year before, that presents an increase by 17.3% of sunbeds and a decrease by -0.6% of all parasols on Çiftlik.

Note here, that instead of parasols, 3 beach huts used fixed roofs instead of or additionally to parasols, which shade a large area of the beach. Furthermore, 183 tables were counted on Çiftlik. In 2010 there were only 28 tables in that area. This is an increase by 357.1%. The number of beanbags of different beach bars and huts totalled to 40 in 2010. This year’s investigation showed 130 beanbags, i.e. an increase by 225%.

Table 1: Results of sunbed and parasol counts in Çiftlik 2010 and 2011
Tab. 1: Anzahl der Sonnenliegen und Sonnenschirmen in Çiftlik 2010 und 2011

| Beach Section | Sunbeds 2010 | Sunbeds 2011 | Parasols 2010 | Parasols 2011 | Others 2010 | Others 2011 |
|---|---|---|---|---|---|---|
| Otlantic 61 Cafe | 16 | 0 | 10 | 0 | 1 table | - |
| Birlik Restaurant | 51 | 55 | 25 | 25 | - | - |
| Unknown new Building | - | 25 | - | 20 | - | 5 tables |
| Sand Beach Bar | 51 | 58 | 14 | -* | 33 beanbags | 13 tables, 34 beanbags |
| Mutlu | 49 | 60 | 18 | 8* | | 4 tables, 9 beanbags |
| Sunset Garden Beach Club | 60 | 4 | 28 | 8 | 2 tables, 7 beanbags | - |
| Miss Dudu's | 44 | 62 | 11 | 6 | - | 9 tables |
| Kutup Vildiz Hotel | 0 | 0 | 0 | 0 | - | - |
| Sörf Cafe | 90 | 62 | 46 | 38 | 25 tables | 15 tables, 31 beanbags |
| Surf Alani | - | 41 | - | 23 | - | - |
| Sunset Beach Club | 48 | 87 | 31 | 38* | - | 21 tables |
| Dirlic Cafe | 35 | 24 | 10 | 10 | - | - |
| Özgür's Restaurant | 29 | 24 | 16 | 12 | - | 6 tables |
| Kaan Beach | - | 22 | - | 6 | - | 7 tables |
| Güven's Restaurant | 69 | 75 | 28 | 21 | - | 15 tables |
| Yörük Cadiri | 66 | 57 | 39 | 29 | - | 16 tables |
| Yücel Hotel | 40 | 43 | 20 | 20 | - | 19 tables |
| Mimoza Beach Club | 74 | 148 | 34 | 64 | - | 53 tables, 56 beanbags |
| **Sum Ciftlik** | **722** | **847** | **330** | **328** | **28 tables, 40 beanbags** | **183 tables, 130 beanbags** |

*instead of parasols/additionally fixed roofs were used

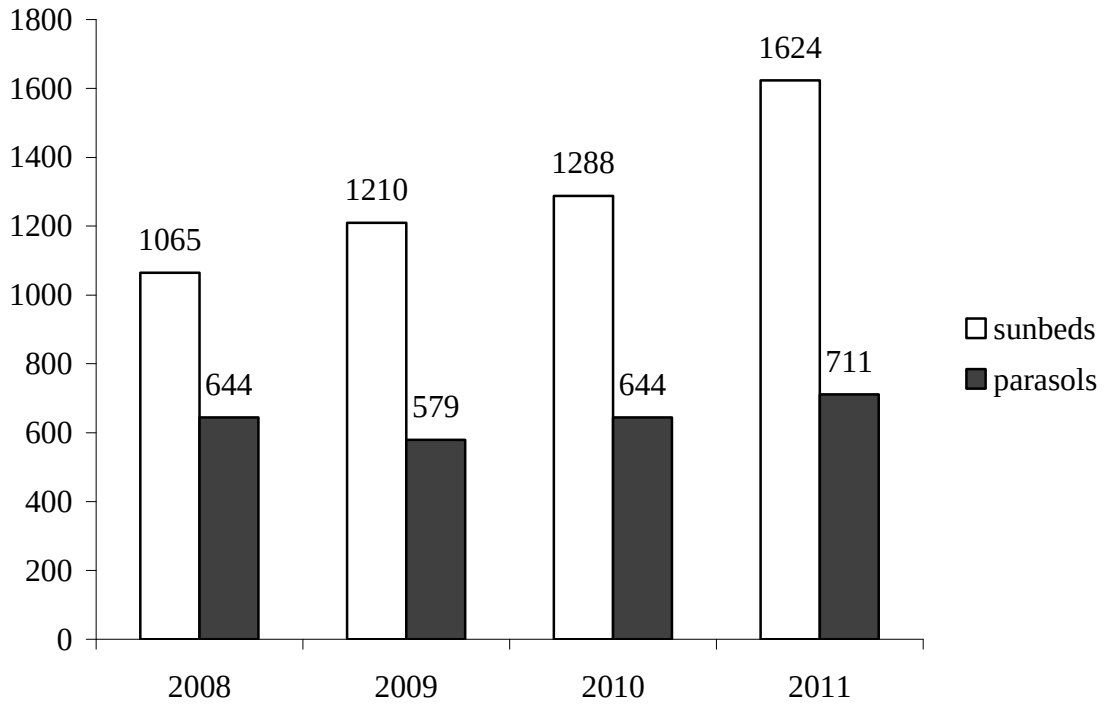


Fig. 1: Comparing the numbers of sunbeds and parasols from 2008 to 2011 in Çaliş
Abb. 1: Vergleich der Anzahl der Sonnenliegen und Sonnenschirme von 2008 bis 2011 in Çaliş

At the Çaliş part of the beach along the promenade 276 sunbeds, forming barriers for turtles (Fig. 3), were counted in the upper section, 2 in the middle section and 499 in the lower section. This adds up to a total of 777 sunbeds. Compared to 566 sunbeds in 2010, the number increased by 37% in 2011.

139 parasols were counted in the upper section, 5 in the middle and 239 in the lower section close to the water. The number of parasols sums up to 383 and therefore has decreased by 10% since past year. No tables and beanbags were observed at the beach along the promenade of Çaliş. Even though the middle row of sunbeds has largely been removed, the number of sunbeds has overall increased on Çaliş beach.

Altogether, 1624 sunbeds and 711 parasols were detected on Çaliş and Çiftlik combined. Compared to 1288 sunbeds and 644 parasols in 2010, this is an increase by 26.% concerning sunbeds and 10.4% concerning parasols. In this year, Çiftlik beach contained 52.2% of all sunbeds and 46.1% of parasols on the whole beach.

Compared to 2010, Otlantic 61 Cafe, the Sunset Garden Beach Club, Sörf Cafe, Dirlic Cafe, Özgür's Restaurant and Yörük Cadiri reduced their number of sunbeds and, except for Birlik Cafe, they also reduced the number of their parasols.

Still the total numbers have increased, since new buildings like the Kaan Beach, Surf Alani and an unknown new building set up new sunbeds and parasols in 2011 (Tab. 1).

Another growing problem of the past few years are acacia trees along the beach of Çiftlik. They were planted on the beach to produce shade for tourists and mark borders of properties. Not only is the shade a problem for the development of sea turtle eggs, but the dense root systems of those trees make it practically impossible for an adult female to dig a nest into the sand or for hatchlings to dig their way through the roots. Since those trees are fast growing, the roots grow fast as well, and digging out the roots is not an effective and sustainable way to get rid of them.

The already mentioned Surf Cafe on the western part of the beach is one of the bars that have changed a lot over the past few years - mostly for the worse. Not only their regular beach parties and fireworks can prevent turtles from laying their eggs but also plastic mats (Fig. 4), which cover a large area of the beach in front of the Surf Cafe, reducing the nesting area of the loggerheads. The purpose of those mats is, to make it easier to pull boats und surf boards into the water and to make it more comfortable for people to walk on the beach, which consists mostly of pebbles and cobbles in that area. At least some of the green mats were reduced this year. In 2009 and 2010 they were placed on the side and in front of the sunbeds (Sommer & Dittmann, 2010; Blasnig & Schachner, 2009). The latter were removed this year, and instead a wooden walkway was build and a square shaped mat for depositing the boats and surfboards remained (Fig. 5).

All of the mats on the beach in front of the “Sunset Garden Beach Club“ 2010 were removed in 2011, as was the childrens playground, which was set up in 2009 for the first time: it was not built up this year. But a gazebo tent can be mentioned as a negative alteration that occurred at the end of August in front of the “Sunset Garden Beach Club“. Such tents can shade nests and additionally the nails and hooks used to set up the tent pose a threat. One positive change is that the wooden pier, which was erected in front of the “Sunset Garden Beach Club“ in 2009, was removed.

A rectangular section of the gravel beach in front of the Surf Cafe was, just like in previous years, covered with a sand layer and surrounded by large stones to mark its border. On that sandy ground, beach furniture was placed. The fine sand layer is apparently a suitable place for nesting, despite the sunbeds and parasols, since at least one nest was found inside that rectangle in 2011. Unfortunately the number of hatchlings reaching the sea from that nest was very low because it was exposed to a lot of shade due to the surrounding parasols and some-

times it was also shaded with cardboard by the staff (Fig. 6). Secondly the sand was watered artificially to reduce dust. Therefore the humidity inside the sand was higher than usual and perhaps less suitable for the egg development. Water also compacts the sand and if it gets too dense then the hatchlings cannot emerge.

While the stones around the sandlayer may not be an obstacle for an adult loggerhead, they can be a big problem for a hatchling.

Once during the night shift, when controlling the nests, students observed, that a protective cage on the area in front of the Surf Cafe was removed from the beach while a beach party took place (Fig. 7). Sometimes the cages are also mistaken for trash cans (Fig. 8) even though they all have signs identifying them as protective cages for sea turtle nests in Turkish, English and German language. Not only is waste thrown into the cages, but even more often it is left on the beach where it poses a threat to hatchlings. Litter has always been a problem in Çaliş due to increasing tourism, as is also shown in the reports of previous years (Sommer & Dittmann, 2010). In the promenade area, especially the number of plastic bottles, beer bottles and cigarette butts (Fig. 9) is enormous whereas in the picnic area the major problems are food leftovers (Fig. 10) from campers and picnickers. The food per se doesn't harm the turtles, but dogs and birds are attracted by it and these animals represent a threat to the hatchlings.

Overall, the conditions at the beach and the promenade are simply unacceptable for a beach with the status of a Special Environment Protected Area.

One of the recent alterations in Çaliş beach along the promenade was that the beach is now no longer administrated by the hotels but by the FETAB.

Hotels are no longer in charge of the beach section and the sunbeds and parasols. Therefore, they no longer regard themselves as responsible for removing the garbage on the beach left by their guests. Our observations indicate that FETAB doesn't have the resources to collect garbage.

Recently, however, first positive changes happened thanks to MEDASSET (Mediterranean Association to Save the Sea Turtles), a non-governmental organisation founded in 1988, which submitted a complaint and brought the case of the ongoing deterioration of the nesting area to the Bern Convention. (http://www.medasset.gr)

2011 seemed to be the first year, in which positive alterations were noticed.

Local residents and picnickers are no longer able to drive and park their cars on the beach at of Çiftlik since trenches were excavated that make it impossible to enter the beach with a car (Fig. 11). In some recent years, such trenches, about half a meter deep and half a meter wide,

were dug by students manually. This year, action was taken on the Turkish side. Despite the good intentions, the trenches were oversized, which led to new problems.

The new trenches, on average one metre deep and one metre wide, posed a threat not only to adult turtles, hatchlings and other animals, but also to people. Besides, the trenches were used for trash. Food leftovers, empty and full bottles as well as clothes were thrown inside (Fig. 11) and mixed up with groundwater coming from underneath. Although people were no longer able to drive on the beach, the trenches did not prevent them from camping (Fig. 12) and leaving their waste (Fig. 9) and food (Fig. 10) on the beach and in the trenches. Observations from July to September showed that the number of visitors in this area is constantly high on weekends, and in general only decreased during the time of Ramadan.

As far as the light pollution along the beach is concerned, the situation is a major threat for the turtles (See also Böswart in this volume). Little is done to reduce the effect light has on adults or hatchlings. At least, the tall lamps are shaded on the seaward side to shield the light, but the effect is minimal. In front of Hotel Ceren on the promenade, one such lamp was not shaded; exactly under that lamp, the light attracted eleven hatchlings. They ran in circles below the lamp, unable to find the direction towards the sea on their own because their natural behaviour and instinct lead them towards the brightest direction.

Research shows that there are lots of different ways to reduce light pollution (Witherington & Martin, 2011).

A step in the right direction is the three newly erected signs that indicate the beach of Çaliş as a Special Environment Protected Area. Two of them were positioned along the promenade of Çaliş by the stairs leading down to the beach (Fig. 13). The third one is positioned at the beginning of the picnic area (Fig. 14), where especially local campers are supposed to see it. The signs show the life cycle of sea turtles and some information in Turkish and English language including pictograms on how to behave at the beach. Also new garbage bins have been set up at the promenade of Çaliş in 2011(Fig. 15).

## DISCUSSION

Despite the efforts of students, certain local residents and various organisations over the last decade, little has changed to improve Çaliş as a nesting area for *Caretta caretta*.

The changes to the surrounding nature and the beach and the increasing numbers of beach furniture seem to rise with the amount of tourists coming to the coast near Fethiye. With the

urge to bring more visitors and therefore more money into the region, the sea turtles' nesting zones are increasingly being destroyed and reduced.

In order to keep the status of a Special Environment Protected Area and to conserve the nesting beaches, a lot of alterations will have to be carried out in the near future.

Sunbeds that form barriers for turtles should be stacked overnight and stored outside the beach area. The mats in the Çiftlik area have to be removed during the nesting and hatching season, as should all kinds of wooden walkways and other sorts of barriers on the beach. Residents and bar owners have to be provided with information, and a closer cooperation between locals and the conservationists is needed. Light pollution, the noise and loud music at the promenade and beach huts have to be reduced especially at night during the nesting and hatching season. To accomplish that, tourism has to be involved and informed about nesting activities on Çaliş beach. A few signs along the beach are simply not enough to raise awareness and understanding among tourists. Hotels and travel agencies will have to be involved and work in collaboration with the conservation and research team. Hotels could provide all of their guests with information about the Special Environment Protected Area. An example would be a briefing on what to avoid on a nesting beach.

It is important to inform people why they shouldn't walk on the beach at night and why it is so significant to reduce light pollution and noise. Over the long term, travel agencies and hotels will have to decide whether they want mass tourism on an artificial, unnatural beach or sustainable tourism of a higher value, which allows natural nesting activities of sea turtles.

Without rethinking and changing the beach- and tourism management, the nesting beach in Çaliş is not heading for a bright future.

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APPENDIX

Fig. 2: Documenting changes 2011
Abb.2: Dokumentieren der Veränderungen 2011
(Photo: M. Gross)

Fig. 3: Through a Labyrinth of sunbeds
Abb. 3: Durch ein Labyrinth von Sonnenliegen
(Photo: M. Gross)

Fig. 4: Green carpets in front of Surf Café 2009
Abb. 4: Matten vor dem Surf Café 2009
(Photo: M. Stachowitsch)

Fig. 5: Still carpets in front of Surf Café 2011
Abb. 5: Teppiche Vor dem Surf Café 2011
(Photo: M. Gross)

Fig. 6: Shaded nest, Surf Cafe 2011
Abb. 6: Beschattetes Nest, Surf Cafe 2011
(Photo: M. Morhart)

Fig. 7: Protective cage removed during a beach party at Surf Cafe
Abb. 7: Entfernter Schutzkäfig wärhend einer Strandparty im Surf Café.
(Photo: M. Gross)

Fig.: 8: Litter and stones in a protective cage
Abb. 8: Müll und Steine im Schutzkäfig
(Photo: M. Morhart)

Fig. 9: Litter on the beach, 2011
Abb. 9: Müll am Strand, 2011
(Photo: M. Morhart)

Fig. 10: Food leftovers at the picnic area, 2011
Abb. 10: Essenreste in der Picknickzone, 2011
(Photo: M. Gross)

Fig. 11: Trenches at the picnic area, 2011
Abb. 11: Gräben vor der Picknickzone, 2011
(Photo: M. Stachowitsch)

Fig. 12: Tent and carpets in Çiftlik 2011
Abb. 12: Zelt und Teppiche in Çiftlik 2011
(Photo: M. Morhart)

Fig. 13: New sign at the promenade, 2011
Abb. 13: Neues Schild auf der Promenade, 2011
(Photo: M. Gross)

Fig. 14: Sign at Çiftlik, 2011
Abb. 14: Schild in Çiftlik, 2011
(Photo: M.Gross)

Fig. 15: New rubbish bins at the promenade
Abb. 15: Neue Mülleimer auf der Promenade
(Photo: M. Stachowitsch)

# Changes at Yaniklar/Akgöl, Turkey 2011

Alina Wiemers

KURZFASSUNG

Dieser Bericht behandelt, im Rahmen eines Projektpraktikums zum Schutz der Meeresschildkröten, die Strandveränderungen am Strand von Yaniklar und Akgöl bei Fethiye. Besonders berücksichtigt wird dabei die Veränderungen am Strand durch den Tourismus und im speziellen durch Erweiterungen der Hotelanlagen, Campingplätzen und Restaurants. Gemeint sind vor allem die Hotelanlagen Majesty Club Tuana und Lykia Botanika & Fun Club. Beide Resorts haben in den letzten Jahren stark deren Freizeitangebot erweitert. Von 2010 auf 2011 kann bei beiden Hotelanlagen ein Rückgang an Liegen verzeichnet werden. Die Ferienanlage Majesty Club Tuana verringerte die Anzahl der Liegen von 233 auf 201 und das Lykia Botanika von 157 auf 120. Die Sonnenschirme (2009 = 33 „Tuana“; 34 „Botanika“) am Strand wurden 2010 bei beiden Hotelanlagen durch 2 Reihen Sonnendächer (2010 = 40, 2011 = 34 „Tuana“; 2010 und 2011 = 80 „Botanika“) ausgetauscht und die Holzstege am Strand wurden 2011 entfernt. 2011 wurden die Liegen auf den hinteren Strandabschnitt versetzt und ab Mitternacht wurden die Lichter auf den beiden Anlegestegen des Hotels „Botanika“ und „Tuana“ abgedreht. Jeweils an den beiden Enden des Strandes (Yaniklar, Akgöl) wurden 2 Special Protected Area Schilder aufgestellt und ein *Caretta caretta* Informationsschild wurde beim Hotel Botanika errichtet. Am letzten Abschnitt des Akgöl Strandes wurde eine Barriere errichtet. Eine Reihe an Pflöcken wurde angebracht und Gräben wurden errichtet um den Strand vom Parkbereich abzugrenzen und zu verhindern, dass der Strand mit Fahrzeugen befahren wird. Weiters konnten Bau- und Planierungsarbeiten am Strand des Hotels „Tuana“ und am Small Beach verzeichnet werden. Am hinteren Abschnitt des Akgöl Strandes wurde ein sehr großer Bereich der Vegetation und des Erdreiches abgetragen um Müll darunter zu vergraben. Am Buffet Restaurant Akmaz wurden Umbauarbeiten durchgeführt und Bäume gepflanzt. Weitere Störfaktoren am Strand sind die zunehmende Bepflanzung des Strandes und die Zunahme des Strandmülles vor allem des Plastikmülls durch Strandbesucher. Um den Strand weiterhin als Niststrand für Meeresschildkröten aufrecht zu halten, müssen Maßnahmen ergriffen werden, die diesen Störfaktoren entgegen wirken.

ABSTRACT

This part of the annual report deals with changes on the nesting beaches of Yaniklar and Akgöl, by Fethiye. Every year students from two universities (Austria–Turkey) work together during the summer for the sea turtle project field course, to collect data about the status at the beaches and of the nesting habits of *Caretta caretta*. The hotels Majesty Club Tuana and Lykia Botanika & Fun Club are discussed in more detail. Both hotels have increased their recreation facilities in recent years. In 2011, a decrease of sun beds was documented, from 157 (2010) to 120 (2011) in "Lykia Botanika" and from 233 (2010) to 201 (2011) in "Majesty Club Tuana". 2011, both hotels placed 2 rows of sunbeds on the beach and they were displaced to the back of the beach, with no wooden footbridge in between, as had been the case in past years. In 2010 the parasols of "Tuana" and "Botanika" were replaced by sun pavilions, from 34 parasols (2009) to 80 sun pavilions (2010, 2011) at "Lykia Botanika" and from 33 parasols (2009) to 40 (2010) to 34 (2011) sun pavilions at "Majesty Club Tuana". In 2011 the lights of the pier of both hotels were switched off at midnight, but loud music and parties still lasted long into the night. At the final end of the beaches (Yaniklar, Akgöl), two new Special Protected Area signs were erected. One *Caretta caretta* information sign was set up at the "Lykia Botanika". Also tracks of different kinds of vehicles were detected on the beach. In Akgöl, ditches were dug and wooden stakes were hammered down into the ground to prevent people from driving on the beach. A long stretch of vegetation was destroyed during excavation work at the end of Akgöl beach, and waste was buried there. Excavation work was also done at the beach of "Tuana" and Small Beach to flatten the ground. Further disturbing factors are the increasing number of planted trees at buffet restaurant Akmaz and the high amount of trash on the beach. There are also problems with stray dogs, which dug up the nests of the sea turtles.

To maintain the beach as a nesting beach for sea turtles, steps have to be taken against the disturbing factors.

INTRODUCTION

The species *Caretta caretta,* or loggerhead turtle, is part of the family Chelonidae, which is one of two still existing sea turtle families. *Caretta caretta* has a global dispersion in tropical and temperate waters. Loggerheads are well adapted to different ocean habitats, with a range from pelagic and offshore areas to benthic and coastal areas. Beaches are also a habitat for female sea turtles as nesting areas. Females come back on their natal beach every 2 – 4 years for nesting. During one breeding season the females can dig 2 to 4 nests into which around 23

– 134 eggs are laid in each. The typical incubation time of the nests ranges from 44 – 64 days (field course handout 2011).

*Caretta caretta* is the most frequently occurring sea turtle in the Mediterranean with about 5000 individuals (Demetropoulos, A. & Hadjichristophorou, M. 1995). The nesting areas of loggerheads in the Mediterranean are the eastern regions with the main nesting areas in Greece, Turkey and Cyprus (Bolton & Witherington, 2003). There are 14 known major nesting beaches of *Caretta caretta* on the coast of Turkey and 3 of them are declared as Special Protected Areas in the protocol of the Barcelona Convention, including our beach in Fethiye, Dalyan and Patara. The beach in Fethiye has 3 regions Akgöl, Yaniklar and Çaliş (Fig. 1).

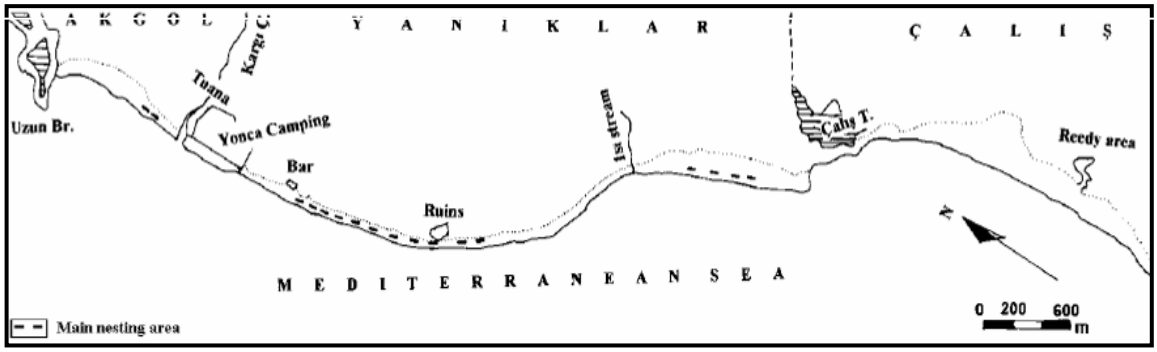


Fig. 1: Sketch map of Fethiye beach (Turkozan et al,2005)
Abb.1: Skizze von den Stränden von Fethiye

*Caretta caretta* is listed on the IUCN red list as an endangered species.

The quality of the beach is very important for a successful breeding season. Thus fine sand is important for the adult females for digging an optimal egg chamber, to generate optimal temperatures inside the nests, for a successful emergence from the nest and for the hatchings to successfully reach the sea.

Some reasons for unsuccessful breeding on the beach in Yaniklar and Akgöl are pollution on the beach generated through beach visitors, local residents and hotels in form of trash, light and noise. Further problems are cars and quads driving on the beach, which harden the sand and sometimes also destroy the nests by driving over them. Hatchlings can't emerge from the nest if the sand is too hard or too many stones are in the nest. Hatchlings can get caught in car tracks so they can't orient to the direction of the, leading to death, due to exhaustion. New planted trees at hotels and camping sites can destroy the nests when their roots grow inside the nest. Trees and trash on the beach can hinder the females to find an optimal place to lay their eggs. Hatchlings can become trigged by stucking under big stones and trash on the

beach, decreasing the chance of the hatchlings to successfully reach the sea and increasing the chance of predation.

Because the beach is used by tourists and locals as a vacation destination and the beach quality is sinking, the “sea turtle project“ has a lot of work to do, to protect the sea turtles and maintain and improve the conditions on the beach to increase the nesting success of *Caretta caretta*. Students from Turkish universities work together with the University of Vienna during the summer to improve the situation by using a number of methods. The observed changes on the beach during the last years will be explained and changes of the beach in Yaniklar and Akgöl between the years 2010 and 2011 will be discussed in more detail.

## MATERIAL & METHODS

### Barrier construction

To prevent cars and quads from driving on the beach, a barrier was constructed at the end of the beach in Akgöl. The corridors without vegetation were used for driving with the car on the beach and the beach served as a parking place. To separate the beach and the parking place two types of barriers were constructed. At the vegetation-free places, a single row of wooden stakes (Fig.1b) were hammered down into the sand, so no car could pass through. The installation of the wooden stakes was ordered by ÖCK (Özel Cevre Koruma – Special Protected Area). During excavation work behind the Akgöl beach, a caterpillar buried trash under a large area and destroyed long stretches of the vegetation to build a large area for parking. Instead of the vegetation as a natural barrier, a large ditch was dug with a wall in front to prevent people driving on the beach. Two more ditches were dug on vegetation-free places at the end of Akgöl beach and one on a second entrance to the beach, preventing cars from entering the beach. Detail information on the barrier construction can be find in in the volume “Vehicles on a Turkish nesting beach for loggerhead sea turtles” (P. Jambura). Another new prevention of cars driving on Akgöl beach was a metal chain on the entrance road to the beach, and a guard was often there as well.

### Photodocumentation

A photodocumentation was made systematically along the beach to compare and analyse the changes between 2010 and 2011 and to document the fluctuation of sun beds, parasols and other facilities of the hotels “Majesty Club Tuana” and “Lykia Botanika & Fun Club” to compare between the last years and 2011. The reconstruction of the “Buffet – Restaurant” Akmaz and excavation work on Akgöl beach, the Small Beach and “Majesty Club Tuana”

were photographed. Also the construction of two new *Caretta caretta* Information signs on Yaniklar and Akgöl beach and the placement of new trash containers and other changes were recorded. This year no photo documentation from the air was made.

## RESULTS

### Barrier construction

This year, at the end of Akgöl beach, a single row of stout wooden stakes were constructed (Fig.1a, 1b) to prevent people from driving on the beach. Additionally to the stakes, at the entrances to the Akgöl beach, the students dug out small ditches and built up a wall with the excavated sand to form a protective barrier along the ditch. Further information about barrier construction and results can be find in the volume "Vehicles on a Turkish nesting beach for loggerhead sea turtles" (P. Jambura).

### Photo documentation and censuses

Akgöl beach

| | |
|---|---|
| Wooden pavilions | 3 |
| Parasols | 13 |

In part due to the sand removals recorded in recent years, the quality of the beaches decreased. Instead of fine sand, often big pebbles and cobbles remain at the beach, and erosion has apparently strengthened this effect. Fine sand still remains on certain stretches of Yaniklar beach and on the end of the Akgöl beach (Fig. 3) and offers good conditions for female *Caretta caretta* to lay their eggs. These beach conditions are also very attractive to seaside visitors, who swim and picnic here or stay over the night. Mainly Turkish tourists from the countryside come there for recreation. As in previous years, tracks of cars and old fireplaces were documented. To prevent the people driving on the beach, barriers were constructed (Fig. 1b). In July at the end of Akgöl beach, a long section of the vegetation was removed by an excavator and waste was disposed of (Fig. 2a, 2b). A new trash container was then set up (Fig. 3). Also a new Special Protected Area sign (Fig. 7) was erected in the middle of Akgöl beach close to the Starfish Café (former name 2010). In Akgöl, in the morning fisherman were often observed fishing with a small boat and a fine-meshed fishing net (Fig. 4). On the main road to the end of Akgöl beach, a metal chain (Fig. 5) was set up over the street and a guard was present.

Tab. 1: Type and number of facilities offered by Starfish Café
Tab.: 1: Art und Anzahl des Strandangebotes vom Starfish Café

| **Facilities** | **Number (2011)** |
|---|---|
| Sun beds | 22 |

Next to the Starfish Café (Tab. 1), the camping site Gün Batimi (former name 2010 “Sunset Restaurant”) was located. This year the camping site was closed and they removed the wooden footbridge from the beach. The camping place was apparently used as living quarters by employees of the hotel “Tuana” (Fig. 6).

Majesty Club Tuana

Of the tourist facilities, on the beaches in Yaniklar and Akgöl, the Majesty Club Tuana has the biggest expansion towards the beach. This year they flattened the beach at the moist zone in front of the sun bed area and the boat landing stage. They moved the excavated sand next to the Kargi river and build up a mound (Fig. 9). Like the years before at the Majesty Club Tuana, every night loud music played at the disco, sometimes until 2 a.m. ((Gratzer, B. & Pichler, C. 2009)). On some nights they organized fireworks and special celebrations. During the night the light of the pier was turned off, with just a small light at the end. We recorded a decrease of sun beds and beach umbrellas (Tab. 2). This year they situated the sun beds more to the back and were only set two rows on the beach. Instead of parasols, they installed big sun pavilions as sun protection (Fig. 10). The wooden footbridge between the sun bed rows was also removed. Like in the years before, they offered jet skis, parasailing, paddleboats, canoes and banana boats to tourists, whereby speedboats are theoretically not allowed to cruise around within one sea mile from May to September (Gratzer, B. & Pichler, C. 2009).

Tab. 2: Type and number of facilities offered by Majesty Club Tuana
Tab. 2: Art und Anzahl vom Strandangebot des Majesty Club Tuana

| **Facilities** | **Number (2005)** | **Number (2006)** | **Number (2007)** | **Number (2008)** | **Number (2009)** | **Number (2010)** | **Number (2011)** |
|---|---|---|---|---|---|---|---|
| Sun beds | 214 | 248 | 310 | 326 | 268 | 233 | 201 |
| Parasols | 33 | 33 | 33 | 33 | 33 | ** | ** |
| Sun pavilions | 0 | 0 | 0 | 0 | 0 | 40 | 34 |
| Paddleboats* | 2 | * | * | 0* | 2 | ** | ** |
| Canoes* | 11 | * | * | 0* | 8 | ** | ** |
| Sailing boats* | 1 | * | * | 2 | 2 | ** | ** |
| Motorboats | 3 | 4 | 6 | 6 | 8 | 8 | ** |
| Jet skis | 0 | 0 | 6 | 0* | 5 | ** | ** |

*Paddleboats, canoes and sailing boats apparently are shared between “Lykia Botanica & Fun Club” and “Majesty Club Tuana” , ** No records

Yaniklar

The beach in Yaniklar is much longer and therefore we detected more nests along this so called long way. Some parts of the beach in Yaniklar were more often visited by Turkish tourists, for example the part between “lonely tree” and the Akmaz river, the area in front of the Buffet-Restaurant Akmaz and the “small beach”. Like in the years before people sometimes drove on the beach. Car tracks were observed and also cars parking on the beach. At the area near the Akmaz river, a group of people drove along the beach with a tractor (Fig. 11). Some car tracks went directly over the nest, at the end of Yaniklar and at the small beach. Compared to Akgöl Beach the sand is composed of larger stones and fewer sand patches (Fig. 11). The slope of the beach generally was higher, too. There were large amounts of trash on the beach. Some of the trash was washed up from the sea, but much was also left by visitors, including water bottles, cigarettes and all kind of plastics or packing material. A lot of trash was found inside the forest, part of which is used as camping site (Fig. 12), after the Akmaz river. Also at the end of Yaniklar beach, a new Special Protected Area Sign was erected (Fig. 8). Fishermen were often observed at the beach, with one or more fishing-rods per person, mainly nearby the Akmaz river and also nearby the Onur Camp. One dead moray was found with a fishing-rod on the beach (Fig. 13).

Small Beach

At the Small Beach, the northern end of the Yaniklar beach, excavation work was also done by heavy machines. The upper part of the beach and the road were flattened, and on the river bank, the excavated sand was raised to a wall (Fig. 16a). After the excavation work, five *Trionyx triunguis* hatchlings were found on the street. We were unable to find the nest, but it was assumed to be under the excavated sand. The small beach has no barrier to the street, and many car tracks were therefore documented on the beach (Fig. 16b). Also large groups, mainly Turkish, camped on the beach, setting up tents, cooking barbeque, for more than one night.

Onur & Doğa Camps

At Doğa Camp, in August, a new wooden footbridge, for a wheelchair user, was placed in front of an apartment and stretched across the beach to the moist zone. One of our secret nests was situated under the footbridge, so we relocated the footbridge beside the nest and, after the

hatching, returned it to the original place. At Onur Camp, instead of parasols one sun pavilion was present (Tab. 3). Further, hatchlings of two nests were disoriented by the lights of the bar at Yonca Lodge and of the apartments at Doğa Camp. Students collected them and released them at dark places to the sea. At these nests, a barrier was constructed to lead the hatchlings to the sea.

Tab. 3: Type and number of facilities offered by Onur Camp, Yonca Lodge, Doğa Camp
Tab. 3: Art und Anzahl der Sonnenliegen bzw. -schirmen vom Onur Camp, Yonca Lodge, Doğa Camp

| **Facilities** | **Number (2011) Onur Camp** | **Number (2011) Yonca Lodge** | **Number (2011) Doğa Camp** |
|---|---|---|---|
| Sun beds | 17 | 20 | 11 |
| Wooden pavilions | ** | 1 | 0 |
| Parasols | 0 | ** | ** |
| Sun pavilions | 1 | 0 | 0 |

Lykia Botanika & Fun Club

This hotel complex is located further away from the beach then the Majesty Club Tuana, but it has facilities on the beach as well. Near the beach they offer, like in previous years, dining areas, playgrounds, bars, one volleyball-court and recreation facilities (Tab. 4). In 2007 a large net was set up at the volleyball-court and both were still present 2011. In 2010, this hotel replaced the 34 parasols with 80 sun pavilions and, based on the photodocumentation, a slight decrease of sun beds was recorded (Tab. 4). The two rows of sun beds and sun pavilions were located more to the back of the beach and the wooden footbridge between the rows was removed (Fig. 17a, 17b). Further, the lights of the pier were turned off during the night (Fig. 14), like at “Tuana”, and the final lamp of the path through the protected forest of “Botanika” was painted black on the sea directed side (Fig. 15).

Tab. 4: Type and number of facilities offered by Lykia Botanika & Fun Club
Tab. 4: Art und Anzahl vom Strandangebot vom Lykia Botanika & Fun Club

| **Facilities** | **Number (2003)** | **Number (2004)** | **Number (2005)** | **Number (2006)** | **Number (2007)** | **Number (2008)** | **Number (2009)** | **Number (2010)** | **Number (2011)** |
|---|---|---|---|---|---|---|---|---|---|
| Sun beds | 151 | 144 | 150 | 153 | 134 | 191 | 157 | 157 | 120 |
| Parasols | 42 | 41 | 22 | 40 | 45 | 53 | 34 | ** | ** |
| Sun pavilions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 80 | 80 |
| Paddleboats* | * | * | * | 2 | ** | 2 | 2 | ** | ** |
| Canoes* | * | * | * | 7 | ** | 4 | 4 | ** | ** |
| Sailing boats* | * | * | * | 2 | ** | 0 | 0 | ** | ** |
| Motorboats | * | * | * | * | ** | 0 | 1 | 1 | ** |
| Jet skis | * | * | * | * | ** | 0 | 2 | ** | ** |

*Paddleboats, canoes and sailing boats apparently are shared between “Lykia Botanica & Fun Club” and “Majesty Club Tuana” , ** No records

The hotel also erected a new sea turtle sign, with the lifecycle and explanations about *Caretta caretta*, between the forest path and the beach bar (Fig. 18a, 18b).

Buffet Restaurant Akmaz

The Akmaz Restaurant was reconstructed during 2011. Workers demolished the old pavilion in July and built up new wooden ones (Fig. 19a, 19b, 19c). Also new trees were planted between the already planted other, young trees. An area in front of the restaurant and a way to the beach was flattened to set stones. As the last students left Turkey in September, the construction work still was not finished.

Caretta Beach Bar

The Caretta Beach Bar, at the Yaniklar beach, was closed 2009 for construction work, and open again 2010 and 2011 (Gratzer, B. & Pichler, C. 2009).

DISCUSSION

On the beaches in Yaniklar and Akgöl, tourism is one of the biggest problems the Special Protected Area has to deal with. There is still too little information for tourists at hotels and on the beach about the features of a *Caretta caretta* nesting beach and how to behave as a tourist. Also many Turkish visitors have insufficient knowledge about the nesting beach and how to act, for example that it is prohibited to drive on the beach. Some of the Turkish visitors are very interested in *Caretta caretta* and the work of the students for the sea turtles, but communication barriers between the Turkish visitors and the Austrian students complicate the situation. The position of the two new big Special Protected Area signs, erected this year, was not optimal. Both were installed somewhere at the end of the beaches, so that people who enter the beach on another place have no idea that the signs exist. A better solution would be to set up new signs at the entrances to the beaches. The problem of cars driving on the beach is still not solved. This year the barrier construction with the wooden stakes together with the ditches was effective. To solve the problem, the complete area must be closed for all cars or better designated parking areas must be created away from the beach. The tracks of cars were also problematic for the small turtles. The hatchlings are disoriented by the tracks, which hinder them from reaching the sea. Car tracks were observed nearly all over the beach. Another disorientation of hatchlings was caused by light pollution. This year hatchlings from two nests, one at Doğa Camp and one at Yonca Lodge, were totally disorientated and crawled

to the direction of the bright lights of the lamps (apartment, bar). One positive development was the turning off of the lights on the piers of “Botanika” and “Tuana”. The rows of sun beds that were shifted to the back generated more space on the beach in front of the hotels. The removal of the wooden footbridges between the sun beds decreased the possibility of hatchlings and female adults to get stuck. It would also be important to remove trees planted on the beach to enlarge nest space for the turtles. The roots of the trees also grow into nests and destroy eggs, and dense roots prevent turtles from digging a nest. Stray dogs were the main predator on the beaches. In Akgöl one stray dog excavated one of our nests in August and predated the hatchlings and eggs. We build up a fence on the nest, and fortified it with stones to stop the predation by the stray dogs. These stray dogs also need to be removed from the beach. A small population of beach crabs were detected on both ends of the beaches (Akgöl, Small Beach). Such crabs are presumed to be natural predators of hatchlings. This year, like last year, more nests than on average were found at the end of Akgöl beach. The Akgöl beach is still more natural, with fine sand, making it increasingly attractive for the female loggerhead turtles and making it easier for hatchlings to reach the sea. On other parts of the beach, next to hotels, restaurants and camping sites, more tourists and turkish visitors are present. Female turtles are disturbed by lights, humans, loud music, fireworks and fire at night. They turn back to the sea, don’t lay their eggs or release them into the sea under stress conditions. It also can be more difficult for female turtles to dig a nest due to tree roots, cars driving over the beach and excavation work on the beach, what can harden the sand. Also sun beds, wooden footbridges and other facilities on the beach hinder female turtles from digging a nest and hatchlings from finding the sea. Further threats for hatchlings are all kind of pollution on the beach, including light pollution, which leads them in the wrong direction and plastic trash such as water bottles, cups, canisters and fishing-rods and nets and much more. The amount of trash on the beach is still high. It needs much more than one beach cleanup to get rid of all the litter, and burying the waste at the beach is also no solution.

For the future, more should be done on information work with local visitors and tourists. Better signs should be constructed and more waste containers will be needed.

Like in the last years, also this year the sea turtle project proved to be important for the protection of *Caretta caretta*. Local residents know already that every year students are coming to protect the sea turtles by observing the nests and beaches. It is important to continue maintaining the beach as a nesting area for *Caretta caretta* and to hopefully increase the number of hatchlings successfully reaching the sea and female turtles coming back for breeding.

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Fig. 1a: End of Akgöl beach without wooden stakes (2010) (Photo: M. Stachowitsch)
Abb. 1a: Am Ende des Akgöl Strandes, ohne Holzpflöcke (2010).

Fig.1b: End of Akgöl beach with wooden stakes, (2011) (Photo: M. Stachowitsch)
Abb. 1b: Am Ende des Akgöl Strandes, mit Holzpflöcke als Barriere (2011)

Fig. 2a: End of Akgöl beach before the excavation work 2011 (Photo: P. Jambura)
Abb. 2a: Am Ende des Akgöl Strandes, vor den Grabungsarbeiten 2011

Fig. 2b: End of Akgöl beach after the excavation work 2011 (Photo: P. Jambura)
Abb. 2b: Am Ende des Akgöl Strandes, nach den Grabungsarbeitn

Fig. 3: New waste container at Akgöl beach (Photo: M. Stachowitsch)
Abb. 3: Neuer Müllkontainer am Strand von Akgöl

Fig. 5: Fishermen on the beach of Akgöl (Photo: M. Stachowitsch)
Abb. 4: Fischer am Strand von Akgöl

Fig. 4: Metal chain at the entrance to Akgöl beach (Photo: M. Stachowitsch)
Abb. 5: Metallkette bei der Durchfahrt zum Strand von Akgöl

Fig.6: Closed Sunset Bar at Akgöl Beach, without the wooden Footbridge (Photo: M. Stachowitsch
Abb. 6: Geschlossene Sunset Bar am Strand von Akgöl, ohne Holzsteg


Fig. 7: Special Protected Area sign on Akgöl Beach (Photo: C. Fellhofer)
Abb. 7: Special Protected Area Schild am Strand von Akgöl

Fig. 8: Special Protected Area sign on the end of Yaniklar Beach and tracks (Photo: C. Fellhofer)
Abb. 8: Special Protected Area Schild am Strandende von Yaniklar, Autospuren

Fig. 9: Excavation work on the beach of the Majesty Club Tuana (Photo: P. Steiner)
Abb. 9: Bauarbeiten am Strand vor dem Hotel “Tuana”

Fig. 10: The sun beds of Majesty Club Tuana, without wooden footbridge (Photo: M. Stachowitsch)
Abb. 10: Sonnenliegen des “Tuana”, nach hinten versetzt und ohne Holzsteg

Fig. 11: Poeple driving on the beach in Yaniklar, making fire (Photo: C. Fellhofer)
Abb. 11: Strandbesucher fahren mit Traktoren über den Strand, entfachen ein Lagerfeuer

Fig. 12: Waste in the forest behind the Yaniklar beach (Photo: A. Wiemers)
Abb. 12: Müllansammlung im Wald hinter dem Strand von Yaniklar

Fig. 13: On the beach of Yaniklar, dead moray with fishing-rod (Photo: A. Wiemers)
Abb. 13: Tote Moräne, mit Angelschnur, am Strand von Yaniklar

Fig. 14: Ligthening on the pier of Lykia Botanika 2010 (Photo: M. Stachowitsch), in 2011 this pier was not illuminated at night
Abb. 14: Beleuchtung am Steg von Lykia Botanika 2010, 2011 wurde der Steg in der nacht nicht beleuchtet.

Fig. 15: Lamp of „Lykia Botanika“ (Photo: M. Stachowitsch)
Abb. 15: Zum Strand hin verdunkelte Lampe des “Lykia Botanika”

Fig. 16a: Excavation work at small beach, northern end of Yaniklar beach (Photo: C. Fellhofer)
Abb. 16a: Bauarbeiten am Small Beach, dem nördlichen Ende von Yaniklar Strand

Fig. 16b: Car tracks on the small beach, end of Yaniklar beach (Photo: M. Stachowitsch)
Abb. 16b: Autospuren im Sand des Small Beach, am Ende von Yaniklar

Fig. 17a: Beach of „Lykia Botanika & Fun Club“ in the year 2010 note the wooden footbridge (Photo: M. Stachowitch)
Abb. 17a: Strandabschnitt vor dem Hotel „Lykia Botanika & Fun Club (2010) mit dem Holzsteg

Fig. 17b: Beach of „Lykia Botanika & Fun Club“ without the wooden footbridgein the year 2011 (Photo: M. Stachowitch)
Abb. 17b: Strandabschnitt ohne Holzsteg vor dem Hotel „Lykia Botanika & Fun Club (2011)

Fig. 18a: New sign of the life cycle of *Caretta caretta* next to the bar of „Lykia Botanika“ (Photo: M. Stachowitsch)
Abb.: 18a:Neues Schild mit dem Lebenszyklus von *Caretta caretta* neben der Strandbar

Fig. 18b: New information sign of *Caretta caretta* next to the disco of “Lykia Botanika” (Photo: M Stachowitsch)
Abb. 18b: Neues Schild mit Informationen über *Caretta caretta* neben der Disco des “Lykia Botanika”


Fig. 19a: Akmaz restaurant before reconstruction (2010) (Photo: M. Stachowitsch)
Abb. 19a: Restaurant Akmaz vor dem Umbau im Jahr 2010

Fig. 19b: Backside of Akmaz restaurant during reconstruction (2011) (Photo: M. Stachowitsch)
Abb. 19b: Rückseite des Restaurants Akmaz während der Renovierung (2011)

Fig. 19c: Frontside of Akmaz restaurant during reconstruction (2011) (Photo: M. Stachowitsch)
Abb. 19b: Vorderseite des Restaurants Akmaz während der Renovierung (2011)

# Dead and injured turtles at Yaniklar and Çaliş beach 2011

Katharina Petschinger

KURZFASSUNG

An den Stränden von Çaliş und Yaniklar wurden in den Sommermonaten von Juli bis September im Jahr 2011 drei tote Schildkröten gefunden. Am Strand von Çaliş wurde eine Unechte Karettschildkröte tot angespült. Bei Grabungsarbeiten am Strand von Çaliş wurde eine tote Nilweichschildkröte, *Trionyx triunguis* entdeckt. In Yaniklar wurde von den ProjektteilnehmerInnen eine tote *Caretta caretta* gefunden. In den Jahren von 2000 bis 2011 konnten insgesamt 26 tote Schildkröten in den Jahresberichten der Universität Wien dokumentiert werden, jedoch beschränken sich die Daten jeweils nur auf die Funde in den Sommermonaten sowie auf nur zwei Strandabschnitte von Fethiye und daher kann diese Anzahl ausschließlich als Untergrenze der toten Schildkröten pro Jahr betrachtet werden. Knapp die Hälfte (48 %) der gefundenen Tiere weisen Verletzungen anthropogenen Ursprungs auf. Ob die letztendlich auch zum Tode geführt haben, ist nicht eindeutig nachweisbar, aber wahrscheinlich.

ABSTRACT

From July to September 2011, three dead turtles were found on Yaniklar and Çaliş beach. In Çaliş, one *Caretta caretta* was washed up dead on the beach. A different species, *Trionyx triunguis*, was found dead by a Turkish project member during excavation work at Çaliş beach. The project members found a dead *Caretta caretta* in Yaniklar. Altogether, the recent reports by the University of Vienna list 26 dead turtles that were counted between the years 2000 and 2011. Note that these data are incomplete because they refer only to two beaches of Fethiye and the project members solely documented three months of a year. Therefore this number is a minimum estimate. Furthermore, a continuing and increasing anthropogenic influence can be recognized as the cause of turtle deaths. Nearly half (48 %) of the turtles listed in the last reports clearly had died due to human impacts, although the true value is no doubt higher.

INTRODUCTION

Marine turtles have thrived for more than 200 million years. However, in the last few hundred years, humans have added a new, serious threat. The anthropogenic influence on the sea as, for example the fishing or shrimping industry along with increasing marine pollution, is the main reason why almost all sea turtles are endangered. Nevertheless, the situation for the sea turtles is not better. The female sea turtles are losing nesting space and are often disturbed by humans. This reflects the steady rise of tourism and leisure time activities such as water skiing.

Causes of death of turtles could be that they were caught by fishermen as bycatch. Moreover, fishermen often have to cut their fishing nets to free turtles and therefore they are probably not very gentle to the turtle. Especially the long lines are extremely dangerous for sea turtles. All turtles must eventually surface for air. When they are trapped in trawls or on hooks they often drown. Many dead sea turtles have fish hooks in their mouths. This probably reflects a very painful and slow death for the sea turtle because can no longer feed.

Dead turtles often showed cuts on their carapaces or on their flippers. Those injuries are mostly caused by boat collisions, especially by propellers of ships. However, a turtle could also be dead before suffering such injuries. Thus, causes of death should be seen critically unless official autopsies are available. Other fishing impacts on the turtles are so - called ghost nets, i.e. nets that have been lost and left in the sea. Promising strategies include sea turtle rescue devices like the TED (Turtle Excluder Device), which has been developed since 1980 but is unimplemented in Mediterranean Sea/is not universally applied other improvements include Circle Hooks (slightly larger hooks), which are more difficult for turtles to swallow. (Spotila, 2011). Sea turtles regularly suffer from severe shell cuts by propeller strikes. Therefore, in Dalyan a project of a Turkish foundation (Kaptan June´s Foundation) is aimed at encouraging local boat captains to fit propeller guards (Fig. 1). Finally, sea turtles are prey for sharks in the water and jackals and dogs on land. Some may also die because of diseases like the Fibropapillomatosis disease that causes tumors. Sea turtle by-catch data in the Mediterranean were reviewed and analysed with fishing effort. The results indicate over 132 000 captures per year, with probably over 44 000 incidental deaths per year, while many others are killed intentionally (Casale 2010).

All seven sea turtle species are listed on the IUCN Red List of Endangered Species and are considered as threatened or endangered. The leatherback, Kemp’s Ridley, and Hawksbill sea

turtles are critically endangered. Critically endangered (CR) means that it is considered to be facing an extremely high risk of extinction in the wild. Olive Ridley and Green sea turtles are endangered, and the Loggerhead is threatened. Only the Flatback turtle, found in the waters of Australia, is not on an endangered list, but this may be due to that fact that its conservation status is unclear due to a lack of data (Source: N. Ziegler's lecture material; iucn.org; iucnredlist.org; wikipedia.org)

## MATERIAL AND METHODS

Information about the dead and injured turtles was gained by Turkish team members, local residents, hotel managers or waiters and tourists. Two of the dead turtles were found and documented by our team members in Yaniklar and Çaliş. The other two dead or injured turtles were reported by a Turkish sea turtle project member. We documented the location where they were found, date and time. Moreover, the age, sex and species of the dead turtles were determined and their state of decay, abnormalities, injuries and measurements were photographed, if possible.

## RESULTS

On 24 July 2011, during the night shift (about 1:45 am), half of a body part of a *Caretta caretta* was found by the Austrian sea turtle project team members in Çaliş. The body was lying in the wet zone of Çaliş beach in front of the Günes Hotel. The *Caretta caretta* had many cuts and the head, three flippers and the tail were missing. The sea turtle belonged to the species *Caretta caretta*.

On 27 July 2011 the Austrian sea turtle project members found a highly decomposed sea turtle (Fig.5) of the species *Caretta caretta* at the beach of Yaniklar near Lykia Botanika hotel. This individual was strongly decayed. Therefore the sex was not determinable. The turtle had a hole on the carapace, parts of the head were missing and it had several fractures. The tail was completely bloated and expanded. The horny layer on the carapace was dissolved. We are certain that the turtle belongs to species of *Caretta caretta*, because the entoplastron (Fig. 11) is characteristic for each sea turtle species. Furthermore, we took photos of the complete skeleton in different views (Figs. 5-14) and measurements (straight carapace length: 0.57 m; straight carapace width: 0.50 m; curved carapace length: 0.63 m; curved carapace width: 0.60 m).

On 4 August 2011 a *Trionyx triunguis* was found during excavation work at Çaliş beach. The Turkish sea turtle members documented this find. The turtle shows a high degree of decay and has injuries at the carapace and a swollen tail. After the collection of photographic data, the Fethiye garbarge disposal buried the *Trionyx triunguis* near Çalištepe in 3 m depth (Fig. 15-19)

Furthermore, tourists told us at the Info desk that a big sea turtle was struggling in a fishing net in the harbor of Fethiye (Fethiye Marina Karagözler). Although we searched for this animal together with the Turkish coast guard (Fig. 2), we couldn't find this sea turtle.

Table 1: Dead and injured adult sea turtles found at Fethiye from July till September 2011
Tabelle 1: Tote und verletzte Schildkröten gefunden in Fethiye von Juli bis September 2011

| Turtle | Individual 1 | Individual 2 | Individual 3 |
|---|---|---|---|
| Species | *Caretta caretta* | *Caretta caretta* | *Trionyx triunguis* |
| Date of find | 24.7.2011 (01:45 a.m.) | 27.07.2011 | June 2011 |
| Site of find | Çaliş | Yaniklar | Çaliş |
| Location | in front of Gunes Hotel | In the near of hotel Botanika | Estern end of Çaliş (Şat) |
| Injuries | Lowest grade of decay, but only a half of the species and many cuttings | High grade of decay, hole in carapace | High grade of decay, injuries at the carapace |
| Sex | n.d. | n.d. | n.d. |
| Estimated age | Adult | Adult | n.d. |
| Tagged | n.d. | n.d. | n.d. |
| Probable cause of death | Probably collision with a boat / ship propeller | Probably dead by humans and maybe strokes on the head | n.d. |

A new data sheet for dead and injured sea turtles is presented. The data sheet of last year's report (2010) is extended and corrected. The data interpretation of the report of 2010 is incorrect. There are 25 dead turtles on the beaches of Fethiye listed in the abstract, because the authors counted the injured and dead turtles. The correct data are that 23 dead turtles were counted until August 2010 and therefore between July 2000 and August 2011, 26 dead turtles were found on two beaches of Fethiye during a three-month period per year.

Table 2: Dead and severely injured adult turtles found in Çaliş (C) and Yaniklar (Y) during the last 11 years (f = female, m = male, n.d. = not determined, a = adult, j = juvenile)
Tabelle 2: Tote Schildkröten gefunden in Çaliş (C) und Yaniklar (Y) in den letzten 11 Jahren (f = weiblich, m = männlich, n.d. = nicht aufgenommen, a = adult, j = juvenil)

| Year | Species | Site of find | Date of find | Sex | Age | Injuries | Probable cause of death |
|---|---|---|---|---|---|---|---|
| 2000 | *Caretta caretta* Tagno. TR035 | F | 31.07 – 31.08. | f | a | still alive with injuries of the head and carapace | alive! Injured by a blunt object |
| 2001 | *Caretta caretta* | C | n.d. | f | a | swallowed a large fish hook | fish hook |
| 2002 | *Caretta caretta* | F | n.d. | n.d. | n.d. | very decomposed, age and sex unknown | n.d. |
| 2003 | *Caretta caretta* | Y | 04.09 | m | n.d. | decomposed and gnawed, especially in the skull area | n.d. |
| | *Chelonia mydas* | F | n.d. | f | n.d. | bursted carapace; broken flipper | ship propeller |
| 2004 | *Chelonia mydas* | C | 24.08 | m | j | small right hind limb; raw parts on bottom side of throat | caught up in a fisherman's net, drowned |
| | *Caretta caretta* | F | end of june | n.d. | n.d. | carapace torn open | ship propeller |
| 2005 | no dead turtles recorded | | | | | | |
| 2006 | *Caretta caretta* | C | June | f | a | right hind limb missing, perhaps hereditary | n.d. |
| | *Caretta caretta* | C | 19.08 | f | a | front extremity and eyes missing | n.d. |
| | *Caretta caretta* | C | 25.08 | n.d. | n.d. | back part of body missing | n.d. |
| | *Caretta caretta* | Y | July | m | n.d. | head and body skeletonized, hole in skull | ship propeller |
| | *Chelonia mydas* | C | September | f | j | one eye missing | n.d. |
| | *Trionyx triguis* | C | August | n.d. | n.d. | no external injuries | n.d. |

| Year | Species | Site of find | Date of find | Sex | Age | Injuries | Probable cause of death |
|---|---|---|---|---|---|---|---|
| 2007 | *Caretta caretta* | C | 07.08 | m | a | head injuries; decomposed | maybe collision with a boat |
| | *Chelonia mydas* | C | 05.08 | f | j | head injuries; parts of the flipper missing | maybe killed by a human |
| | *Cehlonia mydas* | C | 02.09 | f | j | carapace torn open, injury extending down to the plastron | ship propeller |
| | *Chelonia mydas* | F | 04.09 | m | a | still alive! no external injuries; unable to dive | alive |
| 2008 | *Caretta caretta* | Y | 02.07. | M | n.d. | scars on top of head, cut on the side of the body, carapace damaged | maybe boat accident |
| | *Caretta caretta* | C | 04.07. | F | n.d. | n.d. | n.d. |
| | *Caretta caretta* | C | 15.07. | M | n.d. | fishing line around neck, 80% of carapace missing | n.d. |
| | *Caretta caretta* | F | 30.07. | n.d. | n.d. | n.d. | n.d. |
| 2009 | *Caretta caretta* | C | 04.08 | F | a | Left flipper entangled with a fishing net, fishing hook | n.d. |
| | *Chelonia mydas* | C | 05.08 | F | n.d. | n.d. | n.d. |
| 2010 | *Caretta caretta* | Y | 21.07 | F | A | decomposed | maybe strike on the head |
| | *Trionyx triunguis* | C | 16.08 | n.d. | n.d. | hole in the carapace | ship propeller |
| 2011 | *Caretta caretta* | C | 24.07 | n.d. | A | decomposed, cuttings on carapace, head, three flippers and tail missing | boat collision |
| | *Caretta caretta* | Y | 27.07 | n.d. | A | hole in carapace, hole in carapace, head missing | maybe strike on the head |
| | *Trionyx triunguis* | C | June | n.d. | n.d. | decomposed, carapace injuries | n.d. |

DISCUSSION

Most sea turtle injuries are caused by impacts with watercraft, accidental capture in fishing gear and nets, and unfavorable environmental factors including anthropogenic effects.

Consequently, the most common problems with rescued sea turtles are:
Traumatic injury, ingestion of fishing hooks and monofilament lines, entanglement in fishing lines or nets, gastrointestinal obstruction, buoyancy disorders, emaciation, hypothermia, intoxication by petroleum products.

Traumatic injury can occur when boat propellers cut into the turtle or the impact of a boat hitting the turtle causes internal injury. Injury can also be associated with fishing activities when turtles get caught in nets, knocked against the ship's deck, purposefully harpooned and injured by fishermen or entrapped in trawl nets.

Ingestion of fishing hooks can cause severe esophageal, stomach and intestinal lesions. The ingestion of monofilament lines contributes to severe intestinal lesions.
Entanglement of sea turtles in a variety of fishing gear, cables, plastic wastes and packaging string impede feeding or surfacing for air. Some trapped turtles may be found in a comatose and anoxic state. Trailing debris can constrict the neck or flippers and even amputate the limbs, which could lead to death from infection.

Gastrointestinal obstruction is caused by the ingestion and accumulation in the digestive tract of non-biodegradable wastes thrown into the sea by humans. Emaciation could be attributed to different causes: the most common are esophageal lesions caused by hooks, ingestion of anthropogenic debris, excessive presence of ectoparasites, for instant leeches and barnacles, and endoparasites such as protozoans and helminths.

Buoyancy disorders, characterized by the inability to normally float on the surface or submerge, are caused by the escape of air from the respiratory tract, usually, a result of trauma to the lungs; in such cases air becomes trapped in the coelom cavity. Abnormal buoyancy may also result from excessive gas in the gastrointestinal tract, sometimes, provoked by an obstructive lesion. A sea turtle affected by buoyancy disorders floats on the surface, cannot dive and is ultimately more prone to be hit by a boat.

Buoyancy disorders can regress spontaneously if the sea turtle is left undisturbed in a small volume of water. However, most can no longer be released into their natural habitat. Another solution to help them compensate for abnormal buoyancy is to apply a belt fitted with weights.

Hypothermia occurs when a turtle is exposed to cold water. As the core body temperature of the turtle drops, it is unable to function properly. Inshore populations of sea turtles are more susceptible to cold stunning because the water temperature can rapidly change in shallow waters. Sea turtles affected by this condition become inactive and vulnerable to any type of infection, for example those localized in the lungs caused by a bacterial or mycotic induced pneumonia (RAC/SPA, 2004).

These injuries can lead to death: surgical operations can cause complications or negative consequences for the turtle, and such procedures should only be performed if strictly necessary.

Loggerheads are an endangered species and are protected by the International Union for the Conservation of Nature (annual report of sea turtle rescue centre, 2010). Bycatch by fishery is one main reason for loggerhead deaths, calling for stricter rules regarding the fishing industry. At the same time, the fishermen's standard of living and income must be considered. This is only one of the many problems that must be dealt with in the species management of sea turtles. The government should introduce more laws to protect the turtles and there should be more controls in the SPAs. Another important task for the government is to create an awareness of saving sea turtles for local people as well as for tourists.

Another major management problem is a lack of information about the sea turtle population. Evaluating the progress of conservation programs is difficult because many sea turtle populations have not been assessed adequately or long enough. Most information on sea turtle populations comes from counting nests on beaches, but this doesn't provide a full picture of the overall sea turtle population.

Moreover, the turtles in the Mediterranean face depredation of eggs by predators, disorienting light pollution that can confuse nesting females and disorient hatchlings, and degradation of important habitat, including sea grass beds.

Finally, sea turtles do not reach sexual maturity until they are 10-30 years old. This reduces the ability of populations to recover. (http://www.seaturtle.org/)

The death of any adult sea turtle is a problem. As few as 1 in 1000 hatchlings survives to adulthood, making every loss of an adult a blow to the future survival of sea turtle species.

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Table 2 was taken and updated from last year’s report (2010).

# Dead or injured sea turtles

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

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

Stranding location: on beach □ at sea □ inshore (lake, river) □
Location description:……

Sex: undetermined □ male □ female □

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

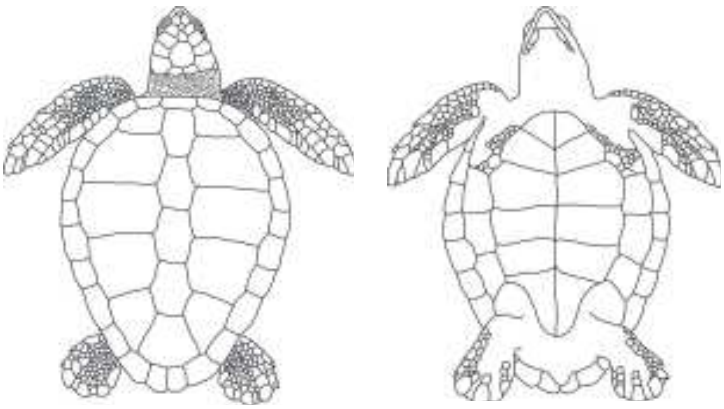
Condition: 1 alive □
2 freshly dead □
3 decomposed □
4 dried carcass □
5 skeleton / bones only □

Tags: Checked for tags? Yes □ no □ Tag number:……..
Tag location:…….....
Return address:……

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

Photos taken? Yes□ no□
Nr. of photos:

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



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

Notes:

Abb. 1: Propellerabdeckung, um Meeresschildkröten zu schützen, entwickelt von E. Marin
Fig. 1: Propeller guard, a construction for saving sea turtles, developed by E. Marin (Photo: M. Stachowitch)


Abb. 2: Türkische Küstenrettung beim Sucheinsatz im Hafen von Fethiye
Fig. 2: Turkish coast guard while searching for *Caretta caretta* in Fethiye Harbor, 12.07.2011, Individual 1 in Tab.1 (Photo: K. Petschinger)

Abb. 3: *Caretta caretta*, Calis beach, Gesamtansicht, 24.07.2011, Individuum 1 in Tab. 1
Fig 3: *Caretta caretta*, Calis beach, complete view, 24.07.2011, individual 1 in Tab. 1
(Photo: B. Pontiller)

Abb. 4: *Caretta caretta*, Calis beach, Detail einer Hinterflosse mit 2 Krallen, 24.07.2011, Individuum 21in Tab. 1
Fig 4: *Caretta* caretta, Calis beach, detail of backflipper with two claws, 24.07.2011, individual 1 in Tab. 1 (Photo: B. Pontiller)

Abb. 5: Angespülte *Caretta caretta*, 27.07.2011, Individuum 2 in Tab. 1, Yaniklar
Fig. 5: Washed up *Caretta caretta*, 27.07.2011, individual 2 in Tab. 1, Yaniklar (Photo: P. Jambura)

Abb. 6: Skelett der toten *Caretta caretta*, Schädel mit Oberkiefer fehlt, 27.07.2011, Individuum 2 in Tab. 1, Yaniklar
Fig. 6: Skeleton of dead *Caretta caretta*, missing skull with upper jaw, 27.07.2011, individual 2 in Tab. 1, Yaniklar (Photo: P. Jambura)

Abb.7: Vermessung einer toten *Caretta caretta*, SCL, 27.07.2011, Individuum 2 in Tab. 1, Yaniklar
Fig.7: Measuring a dead *Caretta caretta*, SCL, 27.07.2011, individual 2 in Tab. 1, Yaniklar
(Photo: M. Lampropoulos)

Abb.8: Vermessung einer toten *Caretta caretta*, CCL, 27.07.2011, Individuum 2 in Tab. 1, Yaniklar
Fig.8: Measuring a dead *Caretta caretta*, CCL, 27.07.2011, individual 2 in Tab. 1, Yaniklar
(Photo: M. Lampropoulos)

Abb.9: Ventralansicht einer toten *Caretta caretta*, 27.07.2011, Individuum 2 in Tab. 1, Yaniklar
Fig.9: Buttom up view of a dead *Caretta caretta*, 27.07.2011, individual 2 in Tab. 1, Yaniklar (Photo: M. Lampropoulos)

Abb.10: Unterkiefer der toten *Caretta caretta*, 27.07.2011, Individuum 2 in Tab. 1, Yaniklar
Fig. 10: Lower jaw of a dead *Caretta caretta*, 27.07.2011, individual 2 in Tab. 1, Yaniklar (Photo: M. Lampropoulos)

Abb.11: Entoplastron der toten *Caretta caretta*, 27.07.2011, Individuum 2 in Tab. 1, Yaniklar
Fig. 11: Entoplastron of dead *Caretta caretta*, 27.07.2011, individual 2 in Tab. 1, Yaniklar (Photo: M. Lampropoulos)

Abb.12: Loch im 5. Vertebralschild der toten *Caretta caretta*, 27.07.2011, Individuum 2 in Tab. 1, Yaniklar
Fig. 12: Hole in the fifth vertebral shield of dead *Caretta caretta*, 27.07.2011, individual 2 in Tab. 1, Yaniklar (Photo: M. Lampropoulos)

Abb.13: Dorsalansicht der Pleuralknochen des Rückenpanzers der toten *Caretta caretta*, 27.07.2011, Individuum 2 in Tab. 1, Yaniklar
Fig. 13: Dorsal view of the carapace of dead Caretta *caretta*, 27.07.2011, individual 2 in Tab. 1, Yaniklar (Photo: M. Lampropoulos)

Abb. 14: Ventralansicht des Schädelknochens der toten *Caretta caretta*, 27.07.2011, Individuum 2 in Tab. 1, Yaniklar
Fig. 14: Ventral view of skull bone of dead *Caretta caretta*, 27.07.2011, individual 2 in Tab. 1, Yaniklar (Photo: M. Lampropoulos)

Abb. 15: Tote *Trionyx triunguis*, Individuum 3 in Tab.1
Fig. 15: Dead *Trionyx triunguis*, individual 3 in Tab. 1(Photo: I. Kara)

Abb. 16: Tote *Trionyx triunguis* im Detail, Individuum 3 in Tab.1
Fig. 16: Dead *Trionyx triunguis* in detail, individual 3 in Tab. 1 (Photo: I. Kara)

Abb. 17: Tote *Trionyx triungui*, Kopfregion, Individuum 3 in Tab.1
Fig. 17: Dead *Trionyx triunguis*, head region, individual 3 in Tab. 1 (Photo: I. Kara)


Abb. 18: Ausheben einer Mulde für die tote *Trionyx triunguis*
Individuum 3 in Tab.1, Calistepe
Fig. 18: Digging a grave for a dead *Trionyx triunguis*, individual 3 in Tab. 1, Calistepe (Photo: I. Kara)

Abb. 19: Tote *Trionyx triunguis in* 3 m tiefem Loch, man beachte die Schnüre und den schwarzen Plastiksack
Fig. 19: Dead *Trionyx triunguis* in 3 m deep gap, notice the black plastic bag, (Photo: I. Kara)

# DEKAMER - Sea turtle research, rescue and rehabilitation centre

Katharina Petschinger

KURZFASSUNG

Das Sea Turtle Rescue Centre in Dalyan ist einzigartig in der Türkei und wurde 2008 von Doç. Dr. Yakup Kaska, Professor an der Pamukkale Universität gegründet. Im Juli 2011 wurden drei schwer verletzte Schildkröten, eine *Chelonia mydas* und zwei *Caretta caretta* im Rescue Centre, versorgt. Das Sea Turtle Rescue Centre kann bis zu sieben verletzte Schildkröten aufnehmen, medizinisch versorgen und so lange pflegen, bis sie wieder freigelassen werden können. Die meisten Verletzungen der Meeresschildkröten im Rescue Centre sind durch anthropogene Einwirkung entstanden. Jedes Jahr verfasst das Sea Turtle Rescue Center unter der Leitung von Yakup Kaska und June Haimoff („Kaptan June“) einen Jahresbericht, welcher wichtige Forschungsarbeiten über die Meeresschildkröten in der Türkei, vor allem über *Caretta caretta* und *Chelonia mydas*, enthält. Aktualisierungen der Forschungsdaten, zum Beispiel Satellite Tagging Daten sowie allgemeine Informationen über die Meeresschildkröten in der Türkei, werden auf der Homepage des Sea Turtle Rescue Centres: http://caretta.pamukkale.edu.tr veröffentlicht.

ABSTRACT

The sea turtle rescue centre in Dalyan, known as DEKAMER, was founded by Doç. Dr. Yakup Kaska, professor at the Pamukkale University, in 2008. In July 2011 the rescue centre took care of three injured sea turtles, one *Chelonia mydas* and two *Caretta caretta*. The sea turtle rescue centre is able to deal with seven injured sea turtles at the same time and they get medical help and can stay until they are independent enough to be released. Most sea turtle injuries are caused by anthropogenic impacts. Every year the directors of the rescue centre, Yakup Kaska and June Haimoff (“Kaptan June”), write a report, which includes research data, especially about *Caretta caretta* and *Chelonia mydas*. Special research data, for example the satellite tagging data, as well as general information about sea turtles in Turkey, is published on the homepage of the sea turtle rescue centre: http://caretta.pamukkale.edu.tr.

## INTRODUCTION

Injured sea turtles are sometimes rescued and rehabilitated by professional organizations like the DEKAMER – Sea turtle research rescue and rehabilitation centre. Such organizations are very important for species management. They also do public relations work (Fig. 13). It is very important that the local residents and the tourists get informed about the nesting beaches, the nesting behavior and the sea turtle conservation rules, which should be respected. Dealing with questions like: “When are we allowed to go on a Special Protected Areas?” and “How should I react if hatchlings are emerging, a female adult turtle or an injured turtle is on the beach?”. The sea turtle rescue centre can answer all such questions. The main task for the rescue centre is to ensure health care for injured sea turtles. Moreover, there are many research projects and data collected in cooperation with the Pamukkale University. Other partners of the rescue centre are the Environmental Protection Agency for Special Areas, National Parks and the General Directorate of Nature Conservation. (H. Eyre, pers. comm.)

## REPORT

The sea turtle research, rescue and rehabilitation centre was founded by Yakup Kaska, Professor at the Pamukkale University three years ago in Turkey (Figs. 3 – 4). It is directed by Yakup Kaska, who also manages the Special Protected Area (SPA) around Dalyan, and by Kaptain June, who helped make Dalyan a Protected Area. The rescue centre receives no governmental support, except from the SPA. The finances are generally based on donations and material provided by the Pamukkale University.

In July 2011, two veterinarians and students of different nationalities worked together as volunteers at the rescue centre. The volunteers stay in tents next to the rescue centre in summer. Yakup Kaska manages the volunteers. Each year about 15 to 35 volunteers work in Dalyan.

Dalyan is a well-frequented nesting area of *Caretta caretta* and *Trionyx triunguis.* If the hatching starts too late in the morning (after about 7 a.m.), the volunteers of the rescue centre collect the hatchlings and keep them in one of the big plastic tanks, filled with sea water, until the night shift starts (Fig. 11-12). There is no medical support for the hatchlings because it is too complicated to help these small individuals. The rescue centre has seven big plastic tanks

to help and rehabilitate seven sea turtles (Fig. 5). The tanks are filled with sea water, which can be exchanged every day by a modern pump system.

The most injuries caused by humans are on the turtle's head, flipper or carapace. These reflect boat collisions or manually inflicted damage. The Dalyan rescue centre is able to serve medical help like doing operations, giving antibiotics and other pharmaceuticals, injections and wound treatments. Their main goal is for the sea turtle to be able to eat and hunt independently. If the injuries of the turtle need a clarification, devices like an x-ray apparatus or CT scan are available at veterinarian stations.

In July 2011 the rescue centre took care of two turtles of different species: one *Caretta caretta* and one *Chelonia mydas*.

Selin, probably a male *Chelonia mydas,* suffered head injuries (shot in the head), a big wound from a hook stuck in one of the front flippers, injuries on the front flippers caused by a spear gun, a back flipper that was cut off and a jaw that was broken. He was found by Mr. Nihat Tig near Antalya on 14 June 2011 and has been in the rescue centre since one and a half months. Selin was estimatied15-20 years old (Figs. 6-7).

Mersin zazli is a female *Caretta caretta*, who is about 20-25 years old. She had air in her carapace, head injuries and a fishing-line was found around the front flipper. When turtles have to stay long time in pools, they often get air in their carapace. Mersin zazli was found by Mr. Mehmet Miras in Mersin on 2 June 2010. She is about 20-25 years old and has been at the rescue centre for one year. The rescue centre team is planning to release her in autumn (Figs. 8-10).

RESULTS

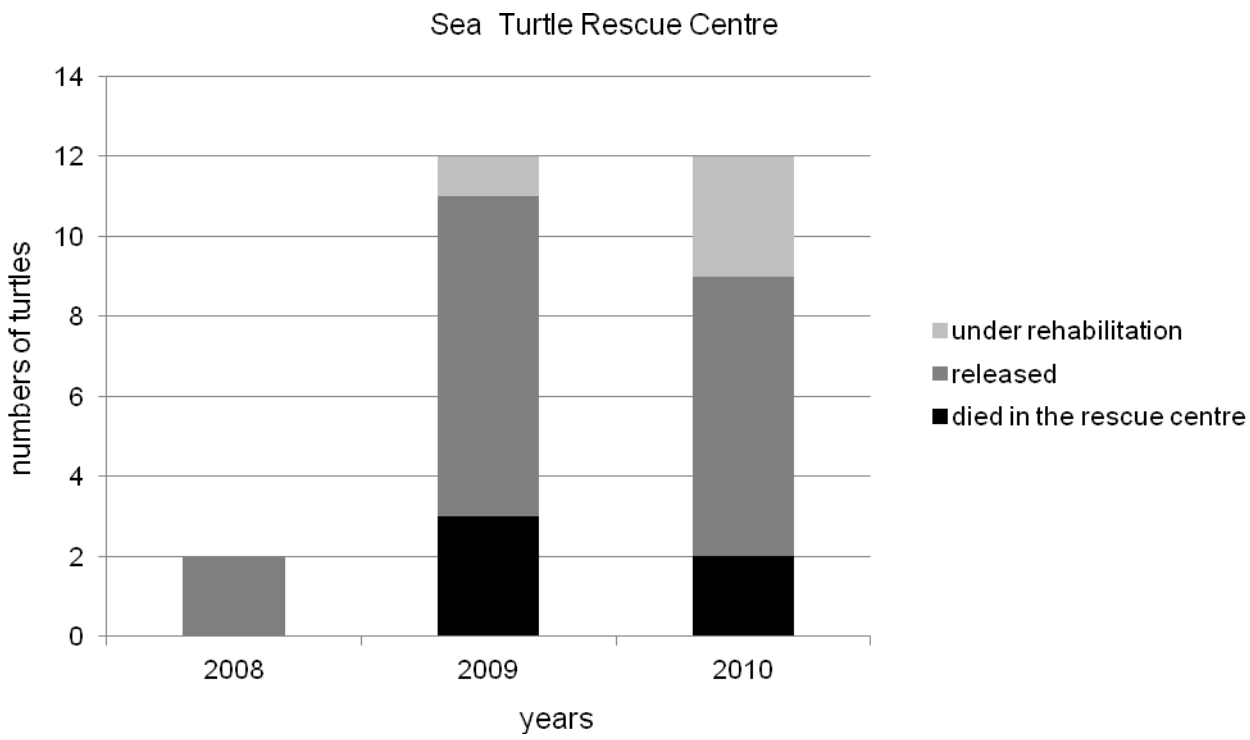



Abb. 1: Die Erfolge des Sea Turtle Rescue Centers, 2008-2010, entwickelt nach dem Report des Rescue Centers, 2010
Fig. 1: Success of the sea turtle rescue centre, 2008-2010, based on the report of the rescue centre, 2010

Figure 1 shows the success of the sea turtle rescue centre from early 2008 until 2010. In 2008, two sea turtles were medically treated and could be released in the same year. In the following year the rescue centre helped 12 turtles: 3 of them died, 8 were released and 1 stayed in the centre. In 2010 the mortality rate of sea turtles in the rescue centre was reduced by about 33 % compared to the year before. 7 turtles were released and 3 turtles remain under rehabilitation.

The injured turtles are often around 20 years old on average (H. Eyre, pers. comm.). This estimation is based on the fact that the carapace of sea turtles is not completely developed until the age of 20.

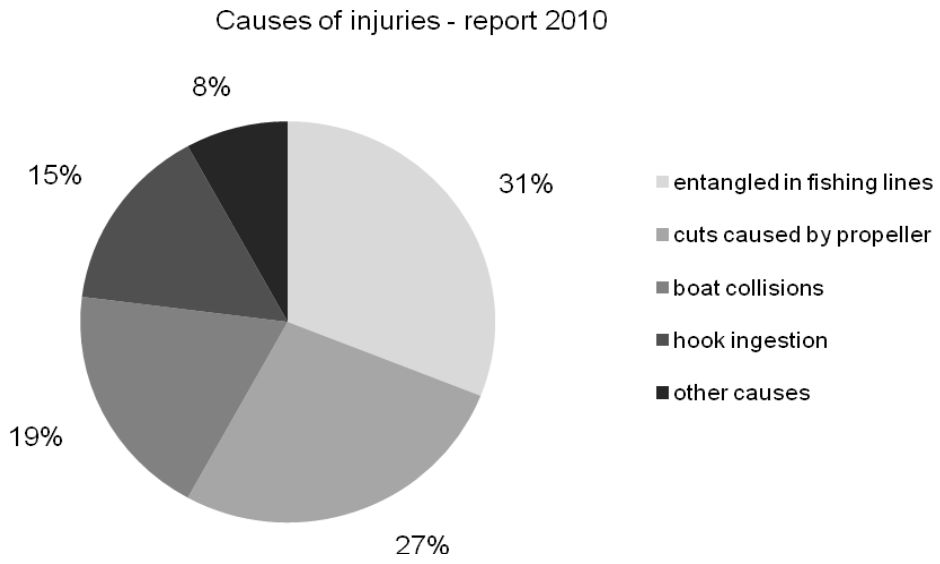



Abb. 2: Gründe der Verletzungen, der in das Rescue Center eingelieferten Meeresschildkröten, entwickelt nach dem Report des Rescue Centers, 2010
Fig. 2: Causes of injuries of the rescue centre sea turtles, based on the annual report of the rescue centre, 2010

The Figure 2 lists the percentage of the causes of injuries documented in the annual sea turtle rescue centre report, 2010. The fishing industry is responsible for the most turtle injuries: 31 % entanglement in fishing lines and 15 % hook ingestion.

Ship traffic, such as for tourism activities, by fishermen and commercial trade, are responsible for the injuries caused by boat collisions and cuts caused by propellers. Other causes can be diseases and wounds made by natural predators.

Summarizing the report of the rescue centre, 2010, clearly shows that the humans and especially the fishing industry have a negative impact on sea turtles.

## DISCUSSION

Injured wild animals should only be medicated and remain in rescue centres if there is a possibility that they will recover completely. The animals should feed and hunt independently and later be released. It makes no sense to medicate a sea turtle, for example, which needs medical help the rest of its life and is unsuitable for later release. The animal should not merely be kept alive because of tourism interests or scientific research. The main goal and final step of a rehabilitation process is releasing the turtle into its natural environment. The turtle should be completely recovered and should not stay longer than necessary at the rescue centre (RAC/SPA, 2004).

Keeping hatchlings in pools filled with sea water is a contentious issue (Figs. 11-12). The hatchlings apparently tire quickly because they lose energy when swimming. It is also unclear whether the pools have an impact on the beach imprinting process. The turtles should not be influenced by atypical structures: it is very important that they be able to find their beach later as mature females. An alternative solution would be to keep the hatchlings in buckets filled with moist sand covered with a dark fabric, until they are released at night. The reason why the hatchlings are caught and retained by team members in the morning is that it is too late for release into the sea. During the day it is very risky for the young turtles to emerge because of predators. In this alternate approach, the hatchlings stay sheltered in a bucket, expend less energy and are subject to lower stress levels, until their release at night (RAC/SPA, 2004).

H. Eyre stated in an interview that the tanks of the rescue centre are filled with sea water and that it can be exchanged every day by a modern pump system. In pools with 1000 liter capacity, the water should be replaced 3 to 4 times every 12 hours. In smaller pools, water replacement should occur 7 to 8 times every 12 hours (RAC/SPA, 2004).

Another potentially suboptimal fact is that the pools of the DEKAMER rescue centre are placed such that visitors can go directly to the pools and touch them from the out- and the inside. The tanks are not isolated, which can disturb the turtles and may entail a higher risk of infections. Another hygienic rule is always to wear disposable gloves while handling the sea turtle. To guarantee best hygienic conditions the tanks should be disinfected once a week (RAC/SPA, 2004).

An advantage of the position of the pools in the DEKAMER rescue centre is that every pool gets natural sunlight. It is very important to maintain the light and dark rhythm of the seasons, because constant lighting is unnatural for turtles and is likely to act as a low-level chronic stressor (RAC/SPA, 2004)

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RAC/SPA, 2004, Guidelines to improve the involvement of marine rescue centres for marine turtles, Tunis, 48 pp.

Abb. 3: Eingang zu dem Sea Turtle Rescue Center, Dalyan
Fig. 3: Entrance to the sea turtle rescue centre, Dalyan (Photo: K. Petschinger)


Abb. 3a: Innenansicht des Rescue Centers, Logos der Partner von dem Rescue Center in Dalyan
Fig. 3a: Inside view of rescue centre, logos of the partners of rescue centre in Dalyan
(Photo: K. Petschinger)


Abb.4: Innenansicht vom Rescue Center
Fig. 4: Inside view of rescue centre (Photo: K. Petschinger)

Abb. 5: Sea Turtle Rescue Center, 7 große Rehabilitationsbecken
Fig. 5: Sea turtle rescue centre, 7 plastic tanks for rehabilitation (Photo: P. Jambura)

Abb.6: Selin, *Chelonia mydas*, Kopfverletzungen, abgeschnittene Rückenflosse, gebrochenes Kiefer, Verletzungen an der Vorderflosse verursacht durch einen Haken und einer Schusswaffe
Fig. 6: Selin, *Chelonia mydas*, head injuries, back flipper cut off, broken jaw, injuries on front flipper caused by hook and gun (Photo: K. Petschinger)

Abb. 7: Selin, *Chelonia mydas*, Detailaufnahme des Kopfes, Rescue Center
Fig. 7: Selin, *Chelonia mydas*, photo of the head, rescue centre (Photo: P. Jambura)

Abb. 8: Mersin nazli, *Caretta caretta*, weiblich, Kopfverletzungen, Verletzung an der Vorder- und Hinterflosse, verursacht durch eine Fischerleine, gefunden im Juni 2010, Pläne bzgl. der Auswilderung im Herbst
Fig. 8: Mersin nazli, *Caretta caretta*, female, head injuries, front and hint flipper injury caused by fishing line, found in Juni 2010, will be released in autumn (Photo: K. Petschinger)

Abb. 9: Mersin nazli,*Caretta caretta*, weiblich
Fig. 9: Mersin nazli, *Caretta caretta*, female (Photo: K. Petschinger)

Abb. 10: Mersin nazli, *Caretta caretta*, Detailansicht der Kopf- und Vorderflossenverletzung
Fig. 10: Mersin nazli, *Caretta caretta*, detail of head- and front flipper injury (Photo: P. Jambura)

Abb. 11: 4 Hatchlinge, die in einem Wassertank schwimmen, Dalyan
Fig. 11: 4 hatchlings swimming in a plastic tank, Dalyan (Photo: K. Petschinger)

Abb.12: Ein Hatchling, der in einem Wassertank schwimmt, Dalyan
Fig. 12: One hatchling swimming in a plastic tank, Dalyan (Photo: K. Petschinger)


Abb. 13: Das Schild weist auf Nistzonen hin und bietet generelle Informationen über Meeresschildkröten, Dalyan
Fig.13: Informationboard of the nesting beach and general information about sea turtles, Dalyan (Photo: K. Petschinger)

# Satellite Tagging in Calis (Fethiye/Turkey)

Mariana Renella

KURZFASSUNG

Satellite Tagging ist eine Methode, um Tiere mit komplexen und unerforschten Migrationsmustern - in diesem Fall *Caretta caretta* - mittels Sender- und Satellitensystem zu orten und somit deren weltweite Routen und Habitate zu verfolgen und zu ergründen.
Das Hauptziel dieser Forschungsrichtung ist es, mit diesem neuen Wissen die verschiedenen und essentiellen Lebensräume (z.B. Nahrungs- und Überwinterungsgebiete, Migrationsrouten) zusätzlich zu den Niststränden zu schützen.

Mit diesem hier beschriebenen wissenschaftlichen Vorhaben haben Mitarbeiter der zoologischen Station Anton Dohrn (Italien) in Zusammenarbeit mit der Pamukkale Universität (Türkei) am 10. Juli 2011 um 01:00 nachts bei Akgöl (Fethiye) ein adultes *Caretta caretta* Weibchen nach einem Nistversuch gefangen und per Auto nach Calis (Fethiye- Türkei) transportiert.
In einer etwa zweieinhalbstündigen Prozedur wurde direkt am Strand von Calis der Carapax des Weibchens von sämtlichen Epibionten befreit, geschliffen und mit Aceton poliert um auf ihm anschließend mit einem Zweiphasenkleber einen speziellen Transmitter mit der Tagnummer TR48 zu befestigen.

Insgesamt wurden diese Saison erstmals drei Meeresschildkröten in Fethiye mit einem Transmitter ausgestattet; am 1. Oktober 2011 wurden zwei Männchen (Fethi und Ylker, beide im Hafen von Fethiye ansässig und dort gefangen) ebenfalls mit einem Transmitter versehen.

Wenn die Meeresschildkröten auftauchen, senden diese Transmitter regelmäßige Signale an sieben Satelliten, die wiederum an eine Bodenstation geleitet werden. Aus dieser Information wird die aktuelle Position ermittelt, und kann unter folgendem link verfolgt werden (http://www.seaturtle.org/tracking/index.shtml?tag_id=46525).

ABSTRACT

Satellite tagging is a satellite-based method to locate animals with complex and unknown migration models - in this case the Loggerhead sea turtle - to track and elucidate their worldwide routes and habitats. The main aim of this research branch is to enable the protection of the different and essential habitats (foraging- and wintering grounds, migration models, etc.) besides the nesting beaches.

A cooperation of the Stazione Zoologica Anton Dohrn (Italy) and Pamukkale University (Turkey) was devoted to this approach. On 10 July 2011 an adult female *Caretta caretta* was caught after a failed nest attempt at Akgöl beach (Fethiye- Turkey) and transported by car to Calis beach (Fethiye).
During a two-and-a-half-hour procedure the females' carapace was cleaned of all epibionts and polished with sandpaper and acetone to apply, with a two-phase glue, a special transmitter with the tag number TR48 on it.

This season two more sea turtles were tagged in Calis with transmitters: on 1 October 2011 two males (Fethi and Ylker, both residents of Fethiye harbour and caught there), got a satellite tag.

When the sea turtles surface, these transmitters send at periodic intervals signals to seven satellites, which send them further on to earth receiving stations. The information about the latest position of the seaturtle can be calculated there. Interested parties such as biologists can follow the routes on (http://www.seaturtle.org/tracking/index.shtml?tag_id=46525).

MATERIAL AND METHODS

The female *Caretta caretta* were caught at Akgöl beach and transported in a wooden box (about 1m x 1,50m) by car to Calis beach. During all following working steps the turtle stayed in this box and was held by 5- 8 persons to permit the leading expert, Fulvio Maffucci (Stazione Zoologica Anton Dhorn), to attach the transmitter. A cloth was put on her head to block off the surrounding lights and noise.
At first the carapace was polished with a piece of sandpaper (Fig. 2), and all barnacles were eliminated by a chisel (Fig. 3) and the carapace then was cleaned with acetone (Fig. 4).
Then the hydrodynamically formed transmitter was attached: a Telonics model TAM 441 that weights about 200g (Fig. 1). A two-phase glue ("Power Fast") was blended and applied centrally on the carapace (Fig. 5); the transmitter, also roughened, was then positioned (Fig. 6). The remaining glue was applied carefully around the transmitter (Fig. 7).
After a one-hour drying time (Fig. 8) the sea turtle was tagged additionally with a conventional metal tag (TR 48) on her right front flipper and then released to the sea (Fig. 9).
The satellite tag can last for about two years on the carapace, then it detaches. Figure 10 shows her route along the south turkish coast until 28 November 2011.

Two more sea turtles named Fethi and Ylker (both male) from Fethiye were tagged with

transmitters this season and released in Dalyan. As Fethiye residents they both turned back home meanwhile. Fethi got lost first in the Köycegiz lake (Fig 11). Latest location at 3 December 2011 shows his way back to Fethiye bay. The last position of Ylker was registrated on 27 November 2011.

A combination of two systems enables exact locating and analysing: ARGOS, which includes the satellites, receiving stations and processing centers represents the basic system, and
STAT (Satellite Tracking and Analysing Tool) an additionally integrated system for archiving, analysing and mapping animal tracking data.
ARGOS is the satellite-based system. The transmitter broadcasts signals to seven orbiting satellites at periodic intervals. The satellites determine the exact position by the Doppler Effect and relay the collected data in real time back to earth to receiving stations. Processing centers collect all incoming data; once the data arrive at a processing center, locations are automatically calculated and information made available for users.
STAT is an additional technical system. It logs into the ARGOS computer network each day (that involves expenses) and downloads all available relevant and associated data for each user. It was specially created for biologists who work on animal tracking.

## DISCUSSION

The tagging procedure causes obviously a very stressful situation for the loggerhead sea turtle (lights, flashlights, people, noise, holding, pushing the head down, pain, etc.). On the other hand this individual could bring as the first loggerhead turtle ever tagged in Fethiye interesting and important data for conservation work. Furthermore this event takes the opportunity to sensitise Fethiye's habitants and tourists for this topic by interviews with experts.

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http://www.seaturtle.org/tracking/index.shtml?tag_id=108909&full=1&lang=; 4 December 2011, 22:36
Interview with Fulvio Maffucci on 9 July 2011 at 10 P.M.

Fig.1: transmitter model Telonics TAM 4410
Abb.1: Transmitter Modell Telonics TAM 4410

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 2: The carapace gets roughened with a piece of sandpaper; Fig.3: Fulvio removes barnacles of the carapace; Fig. 4:The team polishes the carapace with acetone; Fig. 5: A two-phase glue gets applied on the carapace

Abb. 2: Das Rückenschild wird mit Schleifpapier aufgeraut; Abb. 3: Der Carapax wird mit einem Meißel von Seepocken befreit; Abb. 4: Das Team poliert den Panzer mit Aceton; Abb. 5: Der Zweiphasenkleber wird auf den Carapax aufgetragen

Fig. 6

Fig. 7

Fig. 8

Fig. 9

Fig. 6: The Transmitter gets imprinted on the glue; Fig. 7: The Transmitter gets embedded with glue; Fig. 8: The team members tame the turtle during the drying time (about an hour); Fig. 9 The turtle gets released

Abb. 6: Der Transmitter wird auf den Kleber gepresst; Abb. 7: Der Transmitter wird mit Kleber eingebettet; Abb. 8: Die Teammitglieder halten die Schildkröte während der Kleber trocknet (etwa eine Stunde); Abb. 9: Die Schildkröte wird freigelassen

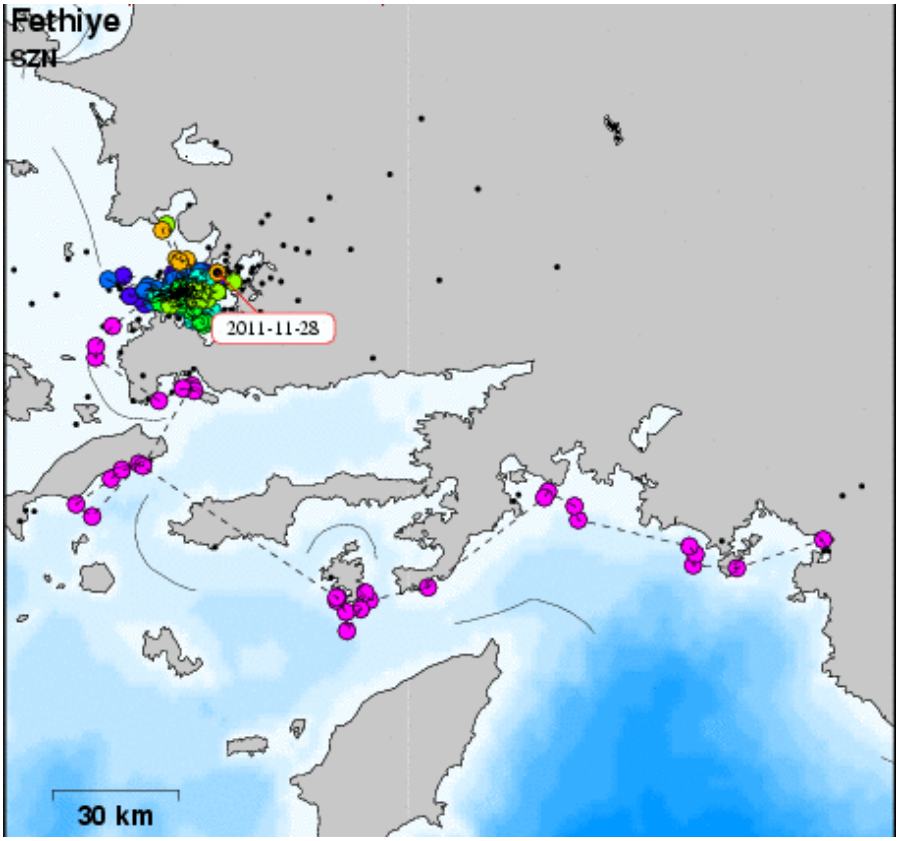


Fig. 10: TR 48's route along the Turkish coast until the latest registrated stay at 28 November 2011
Abb.10: TR 48s Route entlang der türkischen Küste mit ihrem aktuellsten Aufenthaltsort am 28 November 2011

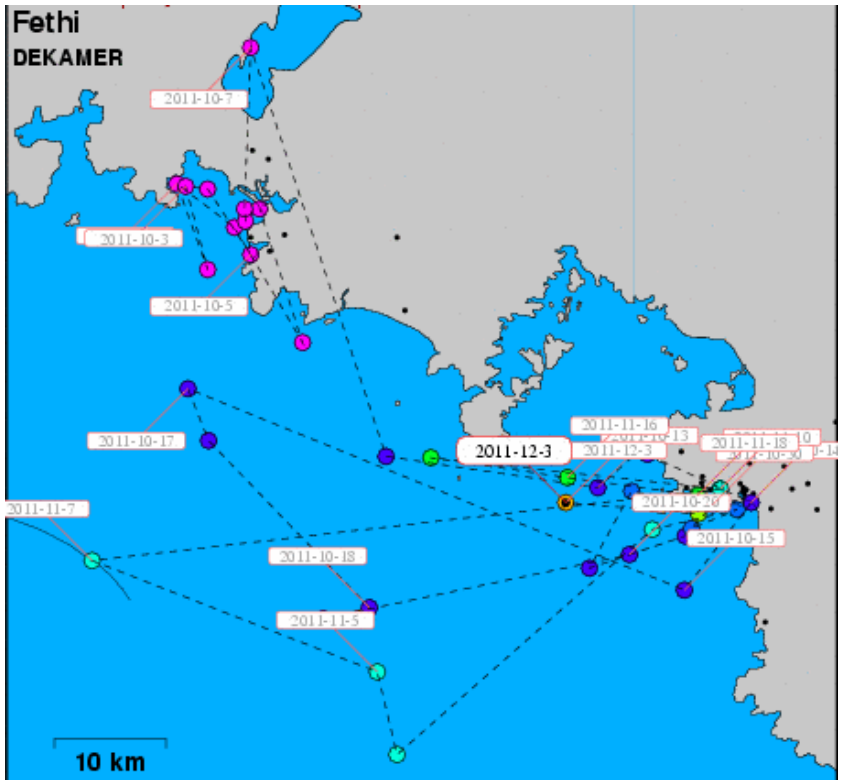


Fig. 11: Fethi's route from Dalyan to the Köycegiz lake and back to Fethiye bay
Abb. 11: Fethis Route von Dalyan zum Köycegiz See und zurück zur Bucht vonFethiye

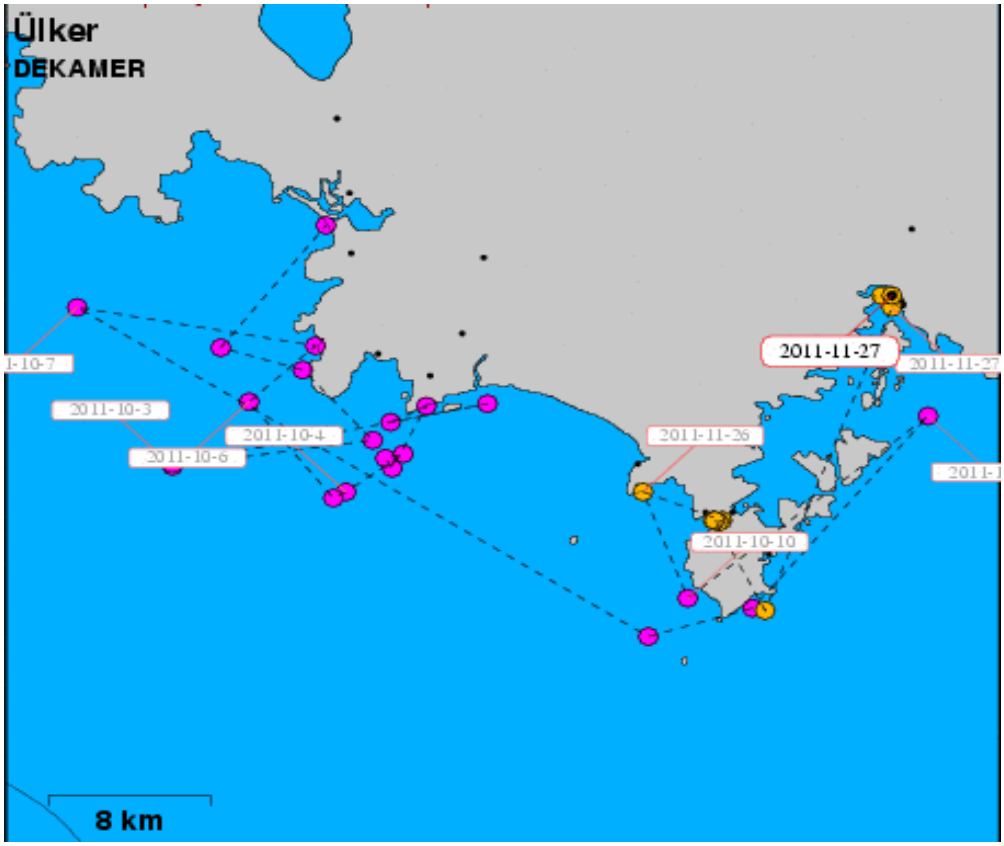

Fig. 12: Ylkers route from Dalyan back to Fethiye bay
Abb. 12: Ylkers Weg von Dalyan zurück zum Fethiye Hafen

Tab. 1: Emergence of tagged adult female *Caretta caretta* at Akgöl beach (1994-2011)
Tab. 1: Auftreten der markierten *Caretta caretta* Weibchen am Strand von Akgöl (1994-2011)

| Tag number | 2011 | 2010 | 09 | 08 | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 | 99 | 98 | 97 | 96 | 95 | 94 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 763 | | | | | | | | | | | | | | | | 1 | | |
| TR179 | | | | | | | | | 1 | | | | | | | | | |
| TRC2141 | | 1 | | | | | | | | | | | | | | | | |
| TRC2137 | | 1 | | | | | | | | | | | | | | | | |

Tab. 2: Number of nests of tagged adult female *Caretta caretta* at Akgöl beach (1994-2011)
Tab. 2: Anzahl der Nester der markierten *Caretta caretta* Weibchen am Strand von Akgöl (1994-2011)

| Tag number | 2011 | 2010 | 09 | 08 | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 | 99 | 98 | 97 | 96 | 95 | 94 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | | | | | | | | | | 1 | | | | | | | | |
| 15 | | | | | | | | | | 1 | | | | | | | | |
| 31 | | | | | | | | | | | | 1 | | | | | | |
| 232 | | | | | | | | | | | | | | 1 | | | | |
| 245 | | | | | | | | | | | | | | 1 | | | | |
| 246 | | | | | | | | | | | | | | 1 | | | | |
| 248 | | | | | | | | | | | | | | 1 | | | | |
| 278 | | | | | | | | | | | | | | | 2 | | | |
| 280 | | | | | | | | | | | | | | | 1 | | | |
| 281 | | | | | | | | | | | | | | | 1 | | | |
| 283 | | | | | | | | | | | | | | | 1 | | | |
| 357 | | | | | | | | | | | | | 2 | | | | | |
| 359 | | | | | | | | | | | | | 1 | | | | | |
| 364 | | | | | | | | | | | | | 1 | | | | | |
| 366 | | | | | | | | | | | | | 1 | | | | | |
| 370 | | | | | | | | | | | | | 1 | | | | | |
| 372 | | | | | | | | | | | | | 1 | | | | | |
| 373 | | | | | | | | | | | | | 1 | | | | | |
| 375 | | | | | | | | | | | | | 1 | | | | | |
| 403 | | | | | | | | | | | | | | | | | 1 | |
| 406 | | | | | | | | | | | | | | | | | 2 | |
| 411 | | | | | | | | | | | | | | | | | 1 | |
| 413 | | | | | | | | | | | | | | | | | 1 | |
| 427 | | | | | | | | | | | | | | | 1 | | 2 | |
| 432 | | | | | | | | | | | | | | | | | 2 | |
| 434 | | | | | | | | | | | | | | | | | 2 | |
| 436 | | | | | | | | | | | | | | | | | 2 | |
| 440 | | | | | | | | | | | | | | | | | 1 | |
| 457 | | | | | | | | | | | | | | | | | | 2 |
| 458 | | | | | | | | | | | | | | | | | | 1 |
| 459 | | | | | | | | | | | | | | | | | | 1 |
| 464 | | | | | | | | | | | | | | | | | | 2 |
| 465 | | | | | | | | | | | | | | | | | | 3 |

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| Tag number | 2011 | 2010 | 09 | 08 | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 | 99 | 98 | 97 | 96 | 95 | 94 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 467 | | | | | | | | | | | | | | | 1 | | | |
| 471 | | | | | | | | | | | | | | | | | | 1 |
| 472 | | | | | | | | | | | | | | | | | | 1 |
| 474 | | | | | | | | | | | | | | | | | | 1 |
| 475 | | | | | | | | | | | | | | | 1 | | | 1 |
| 476 | | | | | | | | | | | | | | | | | | 1 |
| 478 | | | | | | | | | | | | | | | | | 1 | |
| 480 | | | | | | | | | | | | | | | | | | 1 |
| 481 | | | | | | | | | | | | | | | | | | 2 |
| 482 | | | | | | | | | | | | | | | | | | 1 |
| 487 | | | | | | | | | | | | | | | | | 3 | |
| 490 | | | | | | | | | | | | | | | | | 2 | |
| 492 | | | | | | | | | | | | | | | | | 2 | |
| 494 | | | | | | | | | | | | | | | 2 | | 2 | |
| 496 | | | | | | | | | | | | | | | | | 2 | |
| 538 | | | | | | | | | | | | | 1 | | | | | |
| 560 | | | | | | | | | | | | | 1 | | | | | |
| TR 004 | | | | | | | | | | | | | 1 | | | | | |
| TR 035 | | | | | | | | | | | | 1 | | | | | | |
| TR 179 | | | | | | | | | 1 | | | | | | | | | |
| O 752 | | | | | | | | | | | | | 2 | | | | | |
| Bodrum 55 | | | | | | | | | | 1 | | | | | | | | |
| TRC2141 | | 1 | | | | | | | | | | | | | | | | |
| TRC2137 | | 1 | | | | | | | | | | | | | | | | |

Tab. 3: Emergence of tagged adult female *Caretta caretta* at Çaliş beach (1994-2011)
Tab. 3: Auftreten der markierten *Caretta caretta* Weibchen am Strand von Çaliş (1994-2011)

| Tag number | 2011 | 2010 | 09 | 08 | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 | 99 | 98 | 97 | 96 | 95 | 94 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | | | | | | | | | 1 | | | | | | |
| 17 | | | | | | | | | | | | 1 | | | | | | |
| 18 | | | | | | | | | | | | 1 | | | | | | |
| 19 | | | | | | | | | | | | 1 | | | | | | |
| 20 | | | | | | | | | | | | 1 | | | | | | |
| 23 | | | | | | | | | | | | 1 | | | | | | |
| 27 | | | | | | | | | | | | 2 | | | | | | |
| 21 | | | | | | | | | | | | 1 | | | | | | |
| 22 | | | | | | | | | | | | 1 | | | | | | |
| 171 | | | | | | | | | 2 | | | | | | | | | |
| 172 | | | | | | | | | 1 | | | | | | | | | |
| 191 | | | | | | | | 1 | | | | | | | | | | |
| 192 | | | | | | | | 1 | | | | | | | | | | |
| 239 | | | | | | | | | | | | | 1 | | | | | |
| 240 | | | | | | | | | | | | | 2 | | | | | |

Tab. 3: Emergence of tagged adult female *Caretta caretta* at Çaliş beach (1994-2011)
Tab. 3: Auftreten der markierten *Caretta caretta* Weibchen am Strand von Çaliş (1994-2011)

| Tag number | 2011 | 2010 | 09 | 08 | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 | 99 | 98 | 97 | 96 | 95 | 94 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 268 | | | | | | | | | | | | | 1 | | | | | |
| 276 | | | | | | | | | | | | | | | 1 | | | |
| 277 | | | | | | | | | | | | | | | 2 | | | |
| 278 | | | | | | | | | | | | | | | 1 | | | |
| 284 | | | | | | | | | | | | | | | 1 | | | |
| 300 | | | | | | | | | | | | | | | 1 | | | |
| 372 | | | | | | | | | | | | | 1 | | | | | |
| 401 | | | | | | | | | | | | | | | | | 2 | |
| 403 | | | | | | | | | | | | | | | | | 2 | |
| 406 | | | | | | | | | | | | | | | | | 11 | |
| 408 | | | | | | | | | | | | | | | | | 5 | |
| 411 | | | | | | | | | | | | | | | | | 1 | |
| 413 | | | | | | | | | | | | | | | | | 1 | |
| 415 | | | | | | | | | | | | | | | | | 1 | |
| 427 | | | | | | | | | | | | | | | | | 2 | |
| 429 | | | | | | | | | | | | | | | | | 9 | |
| 432 | | | | | | | | | | | | | | | | | 1 | |
| 434 | | | | | | | | | | | | | | | | | 8 | |
| 436 | | | | | | | | | | | | 2 | | | | | 1 | |
| 437 | | | | | | | | | | | | | | 2 | | | | |
| 438 | | | | | | | | | | | | | | | | | 1 | |
| 440 | | | | | | | | | | | | | | | | | 1 | |
| 458 | | | | | | | | | | | | | | | | | | 1 |
| 459 | | | | | | | | | | | | | | | | | | 1 |
| 478 | | | | | | | | | | | | | | | | | 1 | |
| 487 | | | | | | | | | | | | | | | | | 4 | |
| 490 | | | | | | | | | | | | | | | | | 7 | |
| 494 | | | | | | | | | | | | | | | | | 7 | |
| 492 | | | | | | | | | | | | | | | | | 1 | |
| 496 | | | | | | | | | | | | | | | | | 1 | |
| 498 | | | | | | | | | | | | | | | | | 1 | |
| 500 | | | | | | | | | | | | | | | | | | 1 |
| 538 | | | | | | | | | | | | | 1 | 2 | | | | |
| 560 | | | | | | | | | | | | | | | | | 1 | |
| 763 | | | | | | | | | | | | 1 | | | | | | |
| 843 | | | | | | | | | | | | | | | | 1 | | |
| 844 | | | | | | | | | | | | | | | | 2 | | |
| TR 021 | | | | | | | | | | | | 1 | | | | | | |
| TR 48 | 1 | | | | | | | | | | | | | | | | | |
| TR 051 | | | | | | | | | | | 2 | | | | | | | |
| TR 052 | | | | | | | | 2 | | | 1 | | | | | | | |
| TR 053 | | | | | | | | | | | 1 | | | | | | | |
| TR 054 | | | | | | | | | | | 2 | | | | | | | |

Tab. 3: Emergence of tagged adult female *Caretta caretta* at Çaliş beach (1994-2011)
Tab. 3: Auftreten der markierten *Caretta caretta* Weibchen am Strand von Çaliş (1994-2011)

| Tag number | 2011 | 2010 | 09 | 08 | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 | 99 | 98 | 97 | 96 | 95 | 94 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TR 055 | | | | | | | | | | | 1 | | | | | | | |
| TR 056 | | | | | | | | | | | 1 | | | | | | | |
| TR 057 | | | | | | | | | | | | | | | | | | |
| TR 058 | | | | | | | | | | | 1 | | | | | | | |
| TR 066 | | | | | | | | | | | 1 | | | | | | | |
| TR 076 | | | | | | | | 1 | | | | | | | | | | |
| TR 077 | | | | | | | | 1 | | | | | | | | | | |
| TR 078 | | | | | | | | 1 | | | | | | | | | | |
| TR 079 | | | | | | | | 2 | | | | | | | | | | |
| TR 080 | | | | | | | | 1 | | | | | | | | | | |
| TR 081 | | | | | | | | 6 | | | | | | | | | | |
| TR 082 | | | | | | | | 2 | | | | | | | | | | |
| TR 190 | | | | | | | | | 1 | | | | | | | | | |
| TR 381 | | | | | | | | 1 | | | | | | | | | | |
| TR 394 | | | | | | | 2 | | | | | | | | | | | |
| TR 731 | | | | | | 2 | | | | | | | | | | | | |
| TR 746 | | | | | | 1 | | | | | | | | | | | | |
| TR 747 | | | | | | 1 | | | | | | | | | | | | |
| TR 748 | | | | | | 1 | | | | | | | | | | | | |
| TR 749 | | | | | 2 | 1 | | | | | | | | | | | | |
| TR 750 | | | | | | 1 | | | | | | | | | | | | |
| TR 804 | | | 1 | | | | | | | | | | | | | | | |
| M 522 | | | | | | | | | | | | | | | | | | 2 |
| M 530 | | | | | | | | | | | | | 1 | | | | | |
| M 536 | | | | | | | | | | | | | | 1 | | | | |
| M 538 | | | | | | | | | | | | | 1 | | | | | |
| M 540 | | | | | | | | | | | | | | 1 | | | | |
| M 557 | | | | | | | | | | | | | | | | | | 3 |
| TRC 2205 | | | | | 1 | | | | | | | | | | | | | |
| TRC 2207 | | | | | 1 | | | | | | | | | | | | | |
| TRC 2145 | | 1 | | | | | | | | | | | | | | | | |
| TRA 0988 | | 1 | | | | | | | | | | | | | | | | |
| TRA 0975 | | 1 | | | | | | | | | | | | | | | | |

Tab. 4: Number of nests of tagged adult female *Caretta caretta* at Çaliş beach (1994-2011)
Tab. 4: Anzahl der Nester der markierten *Caretta caretta* Weibchen am Strand von Çaliş (1994-2011)

| Tag number | 2011 | 2010 | 09 | 08 | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 | 99 | 98 | 97 | 96 | 95 | 94 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | | | | | | | | | 1 | | | | | | |
| 17 | | | | | | | | | | | | 1 | | | | | | |
| 18 | | | | | | | | | | | | 1 | | | | | | |
| 19 | | | | | | | | | | | | 1 | | | | | | |
| 20 | | | | | | | | | | | | 1 | | | | | | |
| 22 | | | | | | | | | | | | 1 | | | | | | |

Tab. 4: Number of nests of tagged adult female *Caretta caretta* at Çaliş beach (1994-2011)
Tab. 4: Anzahl der Nester der markierten *Caretta caretta* Weibchen am Strand von Çaliş (1994-2011)

| Tag number | 2011 | 2010 | 09 | 08 | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 | 99 | 98 | 97 | 96 | 95 | 94 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27 | | | | | | | | | | | | 1 | | | | | | |
| 169 | | | | | | | | | 1 | | | | | | | | | |
| 170 | | | | | | | | | 1 | | | | | | | | | |
| 171 | | | | | | | | | 1 | | | | | | | | | |
| 173 | | | | | | | | | 1 | | | | | | | | | |
| 192 | | | | | | | | 1 | | | | | | | | | | |
| 240 | | | | | | | | | | | | | 2 | | | | | |
| 268 | | | | | | | | | | | | | 1 | | | | | |
| 276 | | | | | | | | | | | | | | | 1 | | | |
| 277 | | | | | | | | | | | | | | | 1 | | | |
| 284 | | | | | | | | | | | | | | | 1 | | | |
| 372 | | | | | | | | | | | | | 1 | | | | | |
| 377 | | | | | | | | 3 | | | | | | | | | | |
| 401 | | | | | | | | | | | | | | | | | 1 | |
| 406 | | | | | | | | | | | | | | | | | 1 | |
| 408 | | | | | | | | | | | | | | | | | 1 | |
| 411 | | | | | | | | | | | | | | | | | 1 | |
| 415 | | | | | | | | | | | | | | | | | 1 | |
| 430 | | | | | | | | | | | | 2 | | | | | | |
| 434 | | | | | | | | | | | | | | | | | 1 | |
| 437 | | | | | | | | | | | | | | 2 | | | | |
| 438 | | | | | | | | | | | | | | | | | 1 | |
| 440 | | | | | | | | | | | | | | | | | 1 | |
| 458 | | | | | | | | | | | | | | | | | 1 | |
| 459 | | | | | | | | | | | | | | | | | 1 | |
| 487 | | | | | | | | | | | | | | | | | 2 | |
| 490 | | | | | | | | | | | | | | | | | 1 | |
| 494 | | | | | | | | | | | | | | | | | 2 | |
| 500 | | | | | | | | | | | | | | | | | | 1 |
| 538 | | | | | | | | | | | | | 1 | 2 | | | | |
| 560 | | | | | | | | | | | | | | | | | 1 | |
| 763 | | | | | | | | | | | | 1 | | | | | | |
| TR 051 | | | | | | | | | | 2 | | | | | | | | |
| TR 052 | | | | | | | | 2 | | | | | | | | | | |
| TR 053 | | | | | | | | | | 1 | | | | | | | | |
| TR 057 | | | | | | | | | | | | 1 | | | | | | |
| TR 058 | | | | | | | | | | | | 1 | | | | | | |
| TR 066 | | | | | | | | | | | | 1 | | | | | | |
| TR 076 | | | | | | | | 1 | | | | | | | | | | |
| TR 077 | | | | | | | | 1 | | | | | | | | | | |
| TR 078 | | | | | | | | 1 | | | | | | | | | | |
| TR 079 | | | | | | | | 2 | | | | | | | | | | |
| TR 080 | | | | | | | | 1 | | | | | | | | | | |

Tab. 4: Number of nests of tagged adult female *Caretta caretta* at Çaliş beach (1994-2011)
Tab. 4: Anzahl der Nester der markierten *Caretta caretta* Weibchen am Strand von Çaliş (1994-2011)

| Tag number | 2011 | 2010 | 09 | 08 | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 | 99 | 98 | 97 | 96 | 95 | 94 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TR 081 | | | | | | | | 2 | | | | | | | | | | |
| TR 082 | | | | | | | | 1 | | | | | | | | | | |
| TR 731 | | | | | | 1 | | | | | | | | | | | | |
| TR 746 | | | | | | 1 | | | | | | | | | | | | |
| TR 747 | | | | | | 1 | | | | | | | | | | | | |
| TR 749 | | | | | 2 | | | | | | | | | | | | | |
| TR 750 | | | | | | 1 | | | | | | | | | | | | |
| TR 804 | | | 1 | | | | | | | | | | | | | | | |
| M 522 | | | | | | | | | | | | | | 1 | | | | 2 |
| M 530 | | | | | | | | | | | | | 1 | | | | | |
| M 540 | | | | | | | | | | | | | | 1 | | | | |
| M 577 | | | | | | | | | | | | | | | | | | 3 |
| TRC 2205 | | | | | 1 | | | | | | | | | | | | | |
| TRC 2207 | | | | | 1 | | | | | | | | | | | | | |
| TRC 2145 | | 1 | | | | | | | | | | | | | | | | |
| TRA 0988 | | | | | | | | | | | | | | | | | | |
| TRA 0975 | | | | | | | | | | | | | | | | | | |
| TRY 0206 | 1 | | | | | | | | | | | | | | | | | |
| TRY 0208 | 1 | | | | | | | | | | | | | | | | | |

Tab. 5: Emergence of tagged adult female *Caretta caretta* at Yaniklar beach (1994-2011)
Tab. 5: Auftreten der markierten *Caretta caretta* Weibchen am Strand von Yaniklar (1994-2011)

| Tag number | 2011 | 2010 | 09 | 08 | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 | 99 | 98 | 97 | 96 | 95 | 94 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | | | | | | | | | | 2 | | | | | | | | |
| 15 | | | | | | | | | | 1 | | | | | | | | |
| 232 | | | | | | | | | | | | | | 1 | | | | |
| 237 | | | | | | | | | | | | | | 1 | | | | |
| 238 | | | | | | | | | | | | | | 1 | | | | |
| 245 | | | | | | | | | | | | | | 1 | | | | |
| 246 | | | | | | | | | | | | | | 1 | | | | |
| 247 | | | | | | | | | | | | | | 1 | | | | |
| 248 | | | | | | | | | | | | | | 2 | | | | |
| 276 | | | | | | | | | | | | | | | 4 | | | |
| 277 | | | | | | | | | | | | | | | 3 | | | |
| 278 | | | | | | | | | | | | | | | 2 | | | |
| 279 | | | | | | | | | | | | | | | 1 | | | |
| 280 | | | | | | | | | | | | | | | 1 | | | |
| 281 | | | | | | | | | | | | | | | 1 | | | |
| 282 | | | | | | | | | | | | | | | 1 | | | |
| 283 | | | | | | | | | | | | | | | 1 | | | |
| 284 | | | | | | | | | | | | | | | 1 | | | |
| 357 | | | | | | | | | | | | | 2 | | | | | |
| 359 | | | | | | | | | | | | | 1 | | | | | |

Tab. 5: Emergence of tagged adult female *Caretta caretta* at Yaniklar beach (1994-2011)
Tab. 5: Auftreten der markierten *Caretta caretta* Weibchen am Strand von Yaniklar (1994-2011)

| Tag number | 2011 | 2010 | 09 | 08 | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 | 99 | 98 | 97 | 96 | 95 | 94 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 364 | | | | | | | | | | | | | 1 | | | | | |
| 366 | | | | | | | | | | | | | 1 | | | | | |
| 370 | | | | | | | | | | | | | 1 | | | | | |
| 372 | | | | | | | | | | | | | 1 | | | | | |
| 373 | | | | | | | | | | | | | 1 | | | | | |
| 374 | | | | | | | | | | | | | 1 | | | | | |
| TR 177 | | | | | | | | | 1 | | | | | | | | | |
| TR 178 | | | | | 1 | | 1 | | 1 | | | | | | | | | |
| TR 379 | | | | | | | | 4 | | | | | | | | | | |
| TR 380 | | | | | | | | 1 | | | | | | | | | | |
| TR 381 | | | | | | | | 1 | | | | | | | | | | |
| TR 382 | | | | | | | | 1 | | | | | | | | | | |
| TR 389 | | | | | | | 1 | | | | | | | | | | | |
| TR 393 | | | | | | | 1 | | | | | | | | | | | |
| TR 727 | | | | | | 1 | | | | | | | | | | | | |
| TR 728 | | | | | | 1 | | | | | | | | | | | | |
| TR 729 | | | | 1 | | 2 | | | | | | | | | | | | |
| TR 730 | | | | | | 1 | | | | | | | | | | | | |
| TR 801 | | | | 2 | | | | | | | | | | | | | | |
| TR 802 | | | | 1 | | | | | | | | | | | | | | |
| TR 803 | | | 1 | | | | | | | | | | | | | | | |
| TR 804 | | | 1 | | | | | | | | | | | | | | | |
| TR 805 | | | 2 | | | | | | | | | | | | | | | |
| TR 806 | | | 1 | | | | | | | | | | | | | | | |
| TR 808 | | | 1 | | | | | | | | | | | | | | | |
| TR 811 | | | 1 | | | | | | | | | | | | | | | |
| TR 824 | | | 1 | | | | | | | | | | | | | | | |
| TR 825 | | | | 1 | | | | | | | | | | | | | | |
| Bodrum EC 440 | | | | | | | 1 | | | | | | | | | | | |
| TRC 2201 | | | | | 1 | | | | | | | | | | | | | |
| TRC 2202 | | | 2 | | 3 | | | | | | | | | | | | | |
| TRC 2203 | | | | | 1 | | | | | | | | | | | | | |
| TRC 2204 | | | | | 1 | | | | | | | | | | | | | |
| TRA 0968 | | 1 | | | | | | | | | | | | | | | | |

Tab. 6: Number of nests of tagged adult female *Caretta caretta* at Yaniklar beach (1994-2011)
Tab. 6: Nestanzahl der markierten *Caretta caretta* Weibchen am Strand von Yaniklar (1994-2011)

| Tag nr. | 2011 | 2010 | 09 | 08 | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 | 99 | 98 | 97 | 96 | 95 | 94 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 180 | | | | | | | | | 1 | | | | | | | | | |
| 181 | | | | | | | | | 1 | | | | | | | | | |

Tab. 6: Number of nests of tagged adult female *Caretta caretta* at Yaniklar beach (1994-2011)
Tab. 6: Nestanzahl der markierten *Caretta caretta* Weibchen am Strand von Yaniklar (1994-2011)

| Tag nr. | 2011 | 2010 | 09 | 08 | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 | 99 | 98 | 97 | 96 | 95 | 94 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 375 | | | | | | | | | | | | | 1 | 1 | | | | |
| 401 | | | | | | | | | | | | | | | | | 2 | |
| 403 | | | | | | | | | | | | | | | | | 3 | |
| 405 | | | | | | | | | | | | | | | 1 | | 1 | |
| 406 | | | | | | | | | | | | | | | | | 5 | |
| 408 | | | | | | | | | | | | | | | | | 4 | |
| 411 | | | | | | | | | | | | | | | | | 2 | |
| 413 | | | | | | | | | | | | | | | | | 2 | |
| 415 | | | | | | | | | | | | | | | | | 1 | |
| 427 | | | | | | | | | | | | | | | 2 | | 5 | |
| 429 | | | | | | | | | | | | | | | | | 2 | |
| 432 | | | | | | | | | | | | | | | | | 3 | |
| 434 | | | | | | | | | | | | | | | | | 3 | |
| 436 | | | | | | | | | | | | | | | | | 2 | |
| 438 | | | | | | | | | | | | | | | | | 1 | |
| 440 | | | | | | | | | | | | | | | | | 1 | |
| 454 | | | | | | | | | | | | | | | | | | 2 |
| 457 | | | | | | | | | | | | | | | | | | 2 |
| 464 | | | | | | | | | | | | | | | | | | 3 |
| 465 | | | | | | | | | | | | | | | | | | 5 |
| 466 | | | | | | | | | | | | | | | | | | 2 |
| 467 | | | | | | | | | | | | | | | 1 | | | 1 |
| 468 | | | | | | | | | | | | | | | | 2 | | 2 |
| 469 | | | | | | | | | | | | | | | | | | 1 |
| 473 | | | | | | | | | | | | | | | | | | 2 |
| 474 | | | | | | | | | | | | | | | | | | 1 |
| 475 | | | | | | | | | | | | | | | 1 | | | |
| 477 | | | | | | | | | | | | | | | | | | 2 |
| 478 | | | | | | | | | | | | | | | | | 6 | 1 |
| 479 | | | | | | | | | | | | | | | | | | 1 |
| 480 | | | | | | | | | | | | | | | | | | 1 |
| 483 | | | | | | | | | | | | | | | | | | 1 |
| 484 | | | | | | | | | | | | | | | | | | 1 |
| 485 | | | | | | | | | | | | | | | | | | 1 |
| 487 | | | | | | | | | | | | | | | | | 4 | |
| 489 | | | | | | | | | | | | | | | | | | 1 |
| 490 | | | | | | | | | | | | | | | | 1 | 7 | |
| 492 | | | | | | | | | | | | | | | | | 8 | |
| 494 | | | | | | | | | | | | | | | 3 | | 4 | |
| 496 | | | | | | | | | | | | | | | | | 2 | |
| 498 | | | | | | | | | | | | | | | | | 1 | |
| 538 | | | | | | | | | | | | | 2 | | | | | |
| 560 | | | | | | | | | | | | | 1 | | | | 2 | |

Tab. 6: Number of nests of tagged adult female *Caretta caretta* at Yaniklar beach (1994-2011)
Tab. 6: Nestanzahl der markierten *Caretta caretta* Weibchen am Strand von Yaniklar (1994-2011)

| Tag nr. | 2011 | 2010 | 09 | 08 | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 | 99 | 98 | 97 | 96 | 95 | 94 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 751 | | | | | | | | | | | | | | | | 1 | | |
| 752 | | | | | | | | | | | | | | | | 3 | | |
| 753 | | | | | | | | | | | | | | | | 1 | | |
| 754 | | | | | | | | | | | | | | | | 3 | | |
| 755 | | | | | | | | | | | | | | | | 2 | | |
| 756 | | | | | | | | | | | | | | | | 1 | | |
| 757 | | | | | | | | | | | | | | | | 2 | | |
| 758 | | | | | | | | | | | | | | | | 1 | | |
| 759 | | | | | | | | | | | | | | | | 1 | | |
| 760 | | | | | | | | | | | | | | | | 1 | | |
| 761 | | | | | | | | | | | | | | | | 1 | | |
| 763 | | | | | | | | | | | | | | | | 2 | | |
| 764 | | | | | | | | | | | | | | | | 1 | | |
| 765 | | | | | | | | | | | | | | | | 1 | | |
| TR 004 | | | | | | | | | | | | | 1 | | | | | |
| TR 029 | | | | | | | | | | | | 1 | | | | | | |
| TR 035 | | | | | | | | | | | | 1 | | | | | | |
| TR 054 | | | | | | | | | | | 1 | | | | | | | |
| TR 62 | | | | | | | | | | | 2 | | | | | | | |
| TR 63 | | | | | | | | | | | 1 | | | | | | | |
| TR 69 | | | | | | | | | | | 1 | | | | | | | |
| TR 176 | | | | | | | | | 1 | | | | | | | | | |
| TR 177 | | | | | | | | | 1 | | | | | | | | | |
| TR 178 | | | | | 1 | | 1 | | | | | | | | | | | |
| TR 379 | | | | | | | | 2 | | | | | | | | | | |
| TR 380 | | | | | | | | 1 | | | | | | | | | | |
| TR 382 | | | | | | | | 1 | | | | | | | | | | |
| TR 384 | | | | | | | 2 | | | | | | | | | | | |
| TR 385 | | | | | | | 2 | | | | | | | | | | | |
| TR 386 | | | | | | | 1 | | | | | | | | | | | |
| TR 388 | | | | | | | 2 | | | | | | | | | | | |
| TR 389 | | | | | | | 1 | | | | | | | | | | | |
| TR 390 | | | | | | | 1 | | | | | | | | | | | |
| TR 391 | | | | | | | 1 | | | | | | | | | | | |
| TR 394 | | | | | | | 1 | | | | | | | | | | | |
| TR 729 | | | | | | 2 | | | | | | | | | | | | |
| TR 801 | | | | 1 | | | | | | | | | | | | | | |
| TR 805 | | | 1 | | | | | | | | | | | | | | | |
| TR 806 | | | 1 | | | | | | | | | | | | | | | |
| TR 808 | | | 1 | | | | | | | | | | | | | | | |
| O 752 | | | | | | | | | | | | | 2 | | | | | |
| O 763 | | | | | | | | | | | | 1 | | | | | | |
| TRC 2201 | | | | | 1 | | | | | | | | | | | | | |

Tab. 6: Number of nests of tagged adult female *Caretta caretta* at Yaniklar beach (1994-2011)
Tab. 6: Nestanzahl der markierten *Caretta caretta* Weibchen am Strand von Yaniklar (1994-2011)

| Tag nr. | 2011 | 2010 | 09 | 08 | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 | 99 | 98 | 97 | 96 | 95 | 94 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TRC 2202 | | | 1 | | 1 | | | | | | | | | | | | | |
| TRC 2204 | | | | | 1 | | | | | | | | | | | | | |
| 12.004 | | | | | | | | | | | | | 1 | | | | | |
| Bodrum 55 | | | | | | | | | | 2 | | | | | | | | |
| Bodrum 069 | | | | | | | | | | | 1 | | | | | | | |
| Bodrum 280 | | | | | | | | | | | 1 | | | | | | | |
| Bodrum 360 | | | | | | | | | | | 1 | | | | | | | |
| Bodrum 366 | | | | | | | | | | | 1 | | | | | | | |
| Bodrum EC( 440 | | | | | | | 1 | | | | | | | | | | | |
| 538 Monaco | | | | | | | | | | | 1 | | | | | | | |
| M 522 | | | | | | | | | | | | | | | | | | 1 |
| TRA 0968 | | 1 | | | | | | | | | | | | | | | | |

**Bachelor Thesis**

# Success of selected nests of loggerhead turtles (*Caretta caretta*): A field study at the beaches of Yaniklar and Akgöl (Fethiye, Turkey)

# Erfolg ausgesuchter Nester der Unechten Karettschildkröte (*Caretta caretta*): Eine Feldstudie an den Stränden von Yaniklar und Akgöl (Fethiye, Turkey)

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KURZFASSUNG

Diese Arbeit wurde im Rahmen des Meeresschildkröten Projekts an der Universität Wien in Zusammenarbeit mit diversen türkischen Universitäten an den Stränden von Yaniklar und Akgöl (Fethiye, Türkei) in dem Zeitraum von 2. Juli bis 17. September 2011 durchgeführt. Im Zuge dieser Bachelorarbeit wird überprüft, ob die Position der Nester der Unechten Karettschildkröte (*Caretta caretta*) am Strand Auswirkungen auf den Schlupferfolg der Schildkröten hat und welche Faktoren die Tiere an der erfolgreichen Entwicklung hindern.
Der Strand wurde in 3 Abschnitte eingeteilt: Nahe der Gezeitenzone (0 – 12.9 m), Strandmitte (13.0 – 20.9 m) und Nahe der Vegetation (> 21.0 m). Pro Abschnitt wurden die Daten von 3 Nestern sowohl in Yaniklar als auch in Akgöl erhoben.

Die Nestposition am Strand hat wesentliche Auswirkung auf die erfolgreiche Entwicklung der *Caretta caretta* Embryos. Der Vergleich der Anzahl der geschlüpften Tiere in Akgöl nahe der Gezeitenzone (0 – 12.9 m) zu den anderen Nestpositionen weist eindeutig darauf hin, dass der Erfolg jener Nester am geringsten ist.
Yaniklar weist insgesamt 627 geschlüpfte Schildkröten auf, von denen 594 Tiere erfolgreich das Meer erreichten (94,7%). Akgöl, dessen Großteil des Strandes problematisch als Nistplatz für *Caretta caretta* aufgrund des hohen Anteils an Kies und Schotter ist, weist einen Erfolg von 361 Tieren auf, welche das Meer erreichten (405 leere Eischalen, Erfolgsrate im Verhältnis zur Anzahl der leeren Eischalen: 89,1%). Die Strandmitte zeigt sowohl in Yaniklar als auch in Akgöl eine vergleichsweise hohe Schlupfrate (Yaniklar: 174 Tiere erreichten das Meer, 200 leere Eischalen, Erfolgsrate: 85%; Akgöl: 162 Tiere erreichten das Meer, 166 leere Eischalen, Erfolgsrate: 97,6%). Der Erfolg jener Nester in Akgöl nahe der Gezeitenzone (0 – 12.9 m) war mit 95 Tieren (105 leere Eischalen, Erfolgsrate: 90,5%) geringer als der Erfolg der Nester in Yaniklar im selben Abschnitt. Hier gelangten 210 Tiere erfolgreich ins Meer (211 leere Eischalen, Erfolgsrate: 99,5%).

ABSTRACT

This thesis was conducted in the framework of the sea turtle field course at the University of Vienna in cooperation with several Turkish universities on the beaches of Yaniklar and Akgöl (Fethiye, Turkey) between the 2 July and 17 September 2011. This bachelor thesis examines if the position of the nests of the loggerhead turtle (*Caretta caretta*) on the beach have an effect on the success of the embryonic developement and which factors prevent the successful development of the animals.

The beach was divided in 3 sections: Section near the intertidal zone (0 – 12.9 m), section on the center of the beach (13.0 – 20.9 m) and the section near the vegetation (> 21.0 m). The data of 3 nests per section in Yaniklar as well as in Akgöl were collected and compared.

The position of the nests on the beach has a significant impact on the succesfully development of *Caretta caretta* hatchlings. The comparison of the number of hatched turtles in Akgöl near the "intertidal" zone (0 – 12.9 m) and the other nesting positions shows that the success of those nests is the lowest.

With a total number of 627 hatched turtles, the selected nests at Yaniklar showed a success of 594 animals (94.7%). Akgöl only had a 89.1% success rate: 361 hatchlings reaching the sea (total nr. of empty eggshells: 405). Furthermore, most of Akgöl seems to have a difficult nesting terrain because pebbles and cobbles are the main substrate on the beach. The middle sections of the beach in Yaniklar as well as in Akgöl showed a comparatively high hatching rate: Yaniklar: 85% (174 hatchlings reaching the sea, 200 empty shells), Akgöl: 97.6% success (162 hatchlings reaching the sea, 166 empty eggshells). The nests in Akgöl near the tidal zone (0 – 12.9 m) showed a 90.5% success rate (95 animals reaching the sea versus 105 empty eggshells), which was lower than the value of the nests in Yaniklar in the same section. In Yaniklar, the rate was 99.5%: 210 hatchlings sucessfully reached the sea (211 empty eggshells).

## INTRODUCTION

The city of Fethiye is located in the southwest of Turkey. It is a district of Mugla province in the Aegean region of Turkey with more than 68,000 inhabitants. Since 1988, Fethiye is part of a Special Protected Area which reaches from Fethiye to 6 districts and villages and the whole coastal area (Turkozan, 2000).

The Mediterranean Sea offers a habitat for three species of sea turtles: the leatherback turtle (*Dermochelys coriacea*), the green turtle (*Chelonia mydas*) and the loggerhead turtle (*Caretta caretta*) (IUCN, 2010). *Chelonia mydas* and *Caretta caretta* are known to nest on the Mediterranean coasts. Both species are protected and classified as Endangered and Vulnerable, respectively, by the IUCN (International Union for the Conservation of Nature and Natural Resources, the World Conservation Union.). According to studies on nest numbers and nest densities among the Turkish nesting beaches, Fethiye Beach represents a key nesting site of loggerhead turtles (Türkozan, 2000; Canbolat, 2004).

Since 1993 the University of Vienna has been working in cooperation with several Turkish universities on sea turtles. This is a long-term effort to examine the nesting situation of the loggerhead turtles in Fethiye.

Every year about 2,000 to 3,000 female loggerhead turtles come to lay their eggs on the beaches in the eastern Mediterranean, most of them in Greece, Turkey, Cyprus and Libya. (Groombridge, 1990; Broderick et al., 2002)

The hatching success depends on a number of factors such as salinity, humidity, temperature in the nest, gas flow, rainfall, tidal inundation, erosion, seasonal temperature changes, shading by vegetation and predation (Türkozan et al., 2003; Godley et al., 2002).
To compare this success, this bachelor thesis examines whether the positions of the nests on the beaches have an effect on hatching success.

These main questions addressed are:

- How many hatchlings reach the sea or die?
- What was the cause of death?
- Why couldn't they leave their nest?
- Was there a barrier? (stones, hard sand, roots etc.)
- Do these barriers depend on the position of the nests?
- Was there an impact on the development by parasites or predators?

This thesis focuses on the requirements for a successful hatch and on the question, which factors hinder the succesful development of the turtles.

MATERIAL AND METHODS

Fethiye beach consists of 3 subsections: Çalis, Yaniklar and Akgöl. The research was carried out between 2 July and 17 Semptember 2011 on the beaches Yaniklar and Akgöl. During this period a total of 44 nests were recorded. Most of the nests were found together with the Turkish colleagues. Some nests, also predated ones, were found during the shifts.
The first subsection Akgöl starts from the cliff Uzun Burun in the north and reaches to the mouth of Kargi stream in the south. This area is about 1 km long and has a width of about 55 m and more (Türkozan, 2000).
Sand is the dominant substrate of the small part of the beach in the north next to Uzun Burun. This area is almost the only part of the beach, where fine sand is represented. The lower beach in the intertidal zone also consists of sand (about 2 m). The rest of the beach consists of sand mixed with pebbles up to 2 cm in diameter and cobbles. Towards the south (Kargi Çayi), cobbles predominate. Behind the beach, agricultural areas reach far inland.

Abbildung 1: Der Strand in Akgöl
Figure 1: Akgöl beach (Photo: M. Stachowitsch)

The second subsection, Yaniklar, starts from Kargi Çayi and ends at Çalistepe. The beach is about 4.5km long and has a width of between 50 m and 80 m. The first few metres around the intertidal zone, pebbles, stones and vegetation remains (boughs, twigs and leaves) are represented (between 5 m to 15 m).
Behind this area, fine sand is the dominant substrate. Wetlands, steppe vegetation and large patches of amber forests are located in the interior behind the beaches (Özdemir, 2006). Small streams open in different parts of the beach and marshy sites are present in the forest.

Daily morning shifts started at 6:00 by 2 groups consisting of 2-3 people each on the beach. During morning patrols, hatchling tracks coming from a nest were located, counted, recorded and followed. At attempt was made to determine the number of tracks reaching the sea.
If the number of counted tracks did not agree with the number of tracks reaching the sea, efforts were made to determine the cause of missing tracks. If tracks were interrupted, the hatchling were considered to have fallen victim to predators such as dogs, birds, foxes, crabs or other carnivores. Another factor was light sources nearby: they can also interfer with the hatchlings' orientation: instead of crawling towards the sea, the turtles crawl towards the light

When hatchlings were found alive on the beach, in or on the nests during a morning shift, they were collected and brought to the camp to release them into the sea the following night to increase their chances of survival.
Predated nests were cleared of destroyed eggs and covered with sand to their original level. Destroyed eggs were examined and the embryos inside were verified for their stage (early-, mid-, late-embryonic stage) and checked for "parasites". All such eggs and egg shells were counted and noted. After this procedure the shells and dead embryos were buried deeply in the sand far away from the nest.

Excavations were carried out about 4 days after the last hatching activity of a nest. The nests were opened and checked. The number of empty shells, retained hatchlings, unfertilized eggs and fertilized but developmentally-delayed eggs were counted and the total number of eggs were determined. Hatchlings still living inside the nest were also collected and brought to the camp for later release.

<u>The selected nests:</u>
For the present study, the beach was divided in 3 sections:

- Section near the intertidal zone (0 -12.9 m)
- Section in the center of the beach (13.0 – 20.9 m)
- Section far away from the intertidal zone, near the vegetation (> 21 m)

The data of 3 nests per section in Yaniklar as well as in Akgöl were collected and compared (Tab. 1 and Tab. 2).

The following nests were selected according to the categories. If more than 3 nests could be classified in one category, the choice was made by the random principle.
Nests with clear anthroponegic impacts were not considered.

In Akgöl:

Tabelle 1: Übersicht aller ausgewählten Nester in Akgöl, eingeteilt in den Kategorien mit Angabe zur Entfernung zum Meer (m).
Table 1: Overview of chosen nests in Akgöl, grouped in categories and with information about the distance to the sea (m).

| Category | Name of the nest | Distance to the sea (m) |
|---|---|---|
| Nests near the intertidal zone (0-12.9 m) | A2 | 9.0 |
| | A3 | 7.4 |
| | AS2 | 8.8 |
| Nests placed in the center of the beach (13.0-20.9 m) | A1 | 20.2 |
| | AS8 | 18.9 |
| | AS11 | 16.8 |
| Nests far away from the interdial zone (> 21.0 m) | AS1 | 57.0 |
| | AS3 | 43.5 |
| | AS4 | 34.1 |

In Yaniklar:

Tabelle 2: Übersicht aller ausgewählten Nester in Yaniklar, eingeteilt in den Kategorien mit Angabe zur Entfernung zum Meer (m).
Table 2: Overview of chosen nests in Yaniklar, grouped in categories and with information about the distance to the sea (m).

| Category | Name of the nest | Distance to the sea (m) |
|---|---|---|
| Nests near the intertidal zone (0-12.9 m) | YS3 | 12.2 |
| | YS7 | 10.5 |
| | YS11 | 9.2 |
| Nests placed in the center of the beach (13.0-20.9 m) | YS4 | 14.6 |
| | YS10 | 17.5 |
| | YS23 | 15.3 |
| Nests far away from the intertidal zone (> 21.0 m) | YS8 | 21.9 |
| | YS13 | 21.6 |
| | YS27 | 25.5 |

The average distance of the selected nests from the water line is 20.2 m (range 7.4 – 57.0m) The hatching success of the nests in the categories in Yaniklar and in Akgöl were compared with each other and the results of the 3 categories were compared with each other.

The excavation:

Excavations took place about 4 days after the last hatching process. These were done with gloves. During the first digging, the substrate on the top of the nest was tested for its compactness. Normally, the substrate above the egg chamber is less compact due to the oviposition by an adult female turtle.

Care was taken during the whole digging process to avoid hurting hatchlings potentially still inside the nest and, when reaching the moist zone, not to damage unhatched eggs.

When reaching the first egg shells, the depth to the top of the eggs in the egg chamber was

measured (Fig. 2).

To record all necessary data, the whole content of the egg chamber was removed and placed next to the nest (Fig. 3). After this procedure, the depth to the bottom of the egg chamber and the diameter of the nest were measured.

Abbildung 2: Messung der Tiefe der Eikammer bis zum Auftreffen der resten Eischalen in einem Nest in Akgöl. Der Kies- und Schotterstrand ist hier gut zu erkennen.
Figure 2: Measuring the depth of the top to the eggs inside the egg chamber in a nest in Akgöl. Note pebbles and stones as the main substrate on the beach. (Photo: B. Serp)

Abbildung 3: Durchführung der Nestöffnung. Hier: Zählung der leeren Eischalen.
Figure 3: Excavation: Counting the empty eggshells. (Photo: B. Serp)

The following data were collected:

- The number of empty shells and therefore the number of hatchlings reaching the sea after considertion of predation etc.
- The number of hatchlings still living inside the nest
- The number of dead hatchlings inside the nest
- The number of unfertilized eggs
- The total number of fertilized eggs
- The number of dead embryos and the classification of their development stage (early, mid, late)

Empty eggshells were counted and put back into the egg chamber (Fig. 3). They serve as an indicator for a successfully hatch. Unbroken eggs were opened, categorized in fertilized or unfertilized eggs, and counted. Unfertilized eggs can be recognized by clear wet or dry yolk and the absence of embryonic remains. Fertilized eggs were categorized by the following criteria formulated by Özdemir et al. (2008):

- The early stage embryo is small (about 10mm or less), white colored, normally with eyes and without a visible carapace. Furthermore it has blood formations on yolk or extra embryonic membranes (Fig. 4).
- The mid stage embryo has a size of about 10-30mm. The carapace is well developed, conspicuous but without dark scutes (Fig. 5).
- The late stage embryo is more than 30mm in size and has a fully developed carapace

with dark scutes (Fig. 6).

The presence of insects or “parasites” was also noted during the excavation and the opening of the eggs. The opened eggs and, when found, dead hatchlings were put back into the egg chamber and covered with sand to the original level. Hatchlings found alive in the nest were taken to the camp and released at night.

Abbildung 4: Frühembryonales Stadium
Figure 4: Early-stage embryo (Photo: B. Serp)

Abbildung 5: Embryo in mittlerem Stadium
Figure 5: Mid-stage embryo (Photo: B. Serp)

Abbildung 6: Siamesische Schildkrötenzwillinge im spätembryonalen Stadium mit Dottersack
Figure 6: Late-stage conjoined twins embryos with yolk (Photo: B. Serp)

RESULTS

During the survey in Fethiye between 2 July and 17 September 2011, a total of 44 nests were found.

In Akgöl 17 nests were located; 4 of them were monitored from oviposition until the first hatch. The mean incubation period was 45.8 days (range = 43-49 days, sd = 3.53).

In Yaniklar, 27 nests were recorded, with 2 nests being monitored from oviposition until the first hatching process. The mean incubation period was 52.5 days (range = 48-57 days, sd= 4.5).

Up to 191 nests have been recorded in Fethiye in the past, whereby each female nests on average 3 times in one season every 2-3 years (Türkozan et al., 2010).

Tabelle 3: Ausgrabungsdaten aller neun ausgewählten Nester in Akgöl
Table 3: Excavation data of all 9 selected nests in Akgöl

| Akgöl | Nest | Empty shells | Hatchlings still living inside nest | Dead hatchlings in nest + dead due to heat/predator | Unfertilized eggs | Fertilized eggs | Early-stage embryo | mid-stage embryo | Late stage embryo | Total nr of eggs | Total nr of hatchlings reaching the sea |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0-12.9 m | A2 | 0 | 0 | 0 | 57 | 33 | 24 | 3 | 6 | 90 | 0 |
| | A3 | 24 | 2 | 1 | 0 | 41 | 5 | 2 | 10 | 41 | 23 |
| | AS2 | 81 | 0 | 9 | 18 | 96 | 10 | 1 | 5 | 114 | 72 |
| 13.0-20.9 m | A1 | 37 | 5 | 0 | 3 | 41 | 1 | 0 | 4 | 45 | 37 |
| | AS8 | 51 | 3 | 4 | 4 | 57 | 3 | 1 | 2 | 61 | 47 |
| | AS11 | 78 | 0 | 0 | 2 | 81 | 1 | 1 | 1 | 83 | 78 |
| >21.0 m | AS1 | 50 | 9 | 17 | 21 | 71 | 14 | 2 | 3 | 90 | 33 |
| | AS3 | 28 | 2 | 10 | 35 | 79 | 11 | 2 | 38 | 114 | 18 |
| | AS4 | 56 | 6 | 3 | 4 | 88 | 3 | 0 | 20 | 83 | 53 |
| Total | | 405 | 27 | 44 | 144 | 587 | 72 | 12 | 88 | 721 | 361 |

Tabelle 4: Ausgrabungsdaten aller neun ausgewählten Nester in Yaniklar.
Table 4: Excavation data of all 9 selected nests in Yaniklar.

| Yaniklar | Nest | Empty shells | Hatchlings still living inside nest | Dead hatchlings in nest + dead due to heat/ predator | Un-fertilized eggs | Fertilized eggs | Early-stage embryo | mid-stage emb. | Late stage emb. | Total nr. of eggs | Total nr of h. reaching the sea |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0-12.9 m | YS3 | 113 | 7 | 0 | 5 | 114 | 0 | 0 | 1 | 119 | 113 |
| | YS7 | 4 | 0 | 0 | 84 | 7 | 3 | 0 | 0 | 91 | 4 |
| | YS11 | 94 | 0 | 1 | 2 | 101 | 1 | 2 | 3 | 102 | 93 |
| 13.0-20.9 m | YS4 | 63 | 0 | 1 | 32 | 64 | 0 | 0 | 1 | 87 | 62 |
| | YS10 | 71 | 4 | 0 | 1 | 72 | 0 | 0 | 1 | 73 | 71 |
| | YS23 | 66 | 2 | 25 | 3 | 78 | 0 | 0 | 12 | 81 | 41 |
| >21.0 m | YS8 | 65 | 0 | 2 | 4 | 68 | 2 | 0 | 1 | 72 | 63 |
| | YS13 | 68 | 2 | 1 | 1 | 68 | 0 | 0 | 0 | 69 | 67 |
| | YS27 | 83 | 0 | 3 | 5 | 87 | 0 | 1 | 3 | 92 | 80 |
| Total: | | 627 | 15 | 33 | 128 | 659 | 6 | 3 | 22 | 786 | 594 |

A total of 1032 empty egg shells were recorded in the 18 nests (Tab. 3 and Tab. 4). Nests on Yaniklar beach showed a total of 594 hatchlings reaching the sea (95.2% of the total number of fertilized eggs in Yaniklar), while the value in Akgöl was 361 (89.1% of the total number of fertilized eggs in Akgöl) (Tab. 3 and Tab. 4).

The mean number of eggs in a clutch in Yaniklar and Akgöl combined was calculated as 83.7 (range 41 – 119). Baran and Türkozan (1996) recorded the mean clutch size as 82.9 eggs on Fethiye beach in their research of 1994. Worldwide, the mean clutch size for loggerhead turtles has been recorded between 101 and 126 eggs (Hirth, 1980).

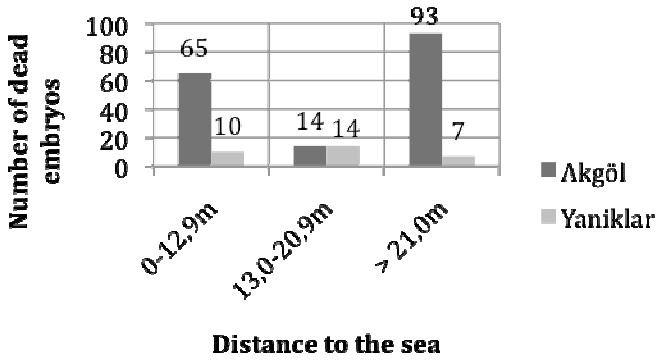


Abbildung 7: Die Gesamtanzahl der toten Embryos (Früh-, Mittel-, Spät-Stadium) im Vergleich zur Entfernung zum Meer, sowohl in Akgöl, als auch in Yaniklar.
Figure 7: The total number of dead embryos (early-, mid-, late-stage) in relation to the distance to the sea in Akgöl and in Yaniklar.

The total number of dead embryos was much higher in Akgöl (172 embryos) than in Yaniklar (31 embryos) (Tab. 3 and Tab. 4). Especially in Akgöl, near the tide line (65 embryos) and near the interior (93 embryos) the values were very high (Fig. 7). The situation in Yaniklar was less conspicuous. There was no link between dead embryos and nest position.

Akgöl (Fig. 8): The higher number of hatchlings reaching the sea from the nests on the center of the beach was clearly evident. Compared to the total number of fertilized eggs in this category (179), the hatching success in this section was 90.5% (162 turtle hatchlings). Based on the total number of hatchlings reaching the sea from the 9 nests (361) (Tab. 3), the center of the beach contributed 44.9%. The average number of turtles reaching the sea in this section was 54. In comparison, in the area near the water line, fewer animals reached the sea (95 hatchlings, hatching success compared with the total number of fertilized eggs in the section near the water line 55.9%, contribution to the total number of hatchlings reaching the sea from the 9 nests 26.3%, average number of hatchlings reaching the sea 31.6). The hatching success in the posterior section near the vegetation was, in relation to the total quantity of fertilized eggs in this category, 43.7% (104 hatchlings). Based on the total number of hatchlings reaching the sea from the 9 nests, the contribution was 28.8% (Tab. 3). The average number of hatchlings reaching the sea was 36.6 per nest (Fig. 8).

In Yaniklar, the hatching success on the center of the beach was - in comparison to the other beach sections - low. Compared to the total number of fertilized eggs in this second section (214) (Tab. 4), 81.3% of the turtles reached the sea (174 hatchlings) (Fig. 8). This is 29.3% of the total number reaching the sea from the 9 nests (594). The average number of hatchlings reaching the sea in this category is 58 per nest. There is an increasing tendency for success

towards the interior and the waterzone. Near the water line the hatching success was 94.6% (210 hatchlings reached the sea, 222 fertilized eggs). Compared to the total number of hatchlings reaching the sea from the 9 nests in Yaniklar, the success rate is 35.5% (Tab. 4). In average, 70 hatchlings in this section reached the sea. In the area close to the interior the percentage of the hatchlings reaching the sea compared to the total number of fertilized eggs was 94.2% (210 hatchlings, 223 fertilized eggs). This is on average 70 turtles reaching the sea and 35.5% of the total number of hatchlings reaching the sea from these 9 nests (Tab. 4 and Fig. 8).

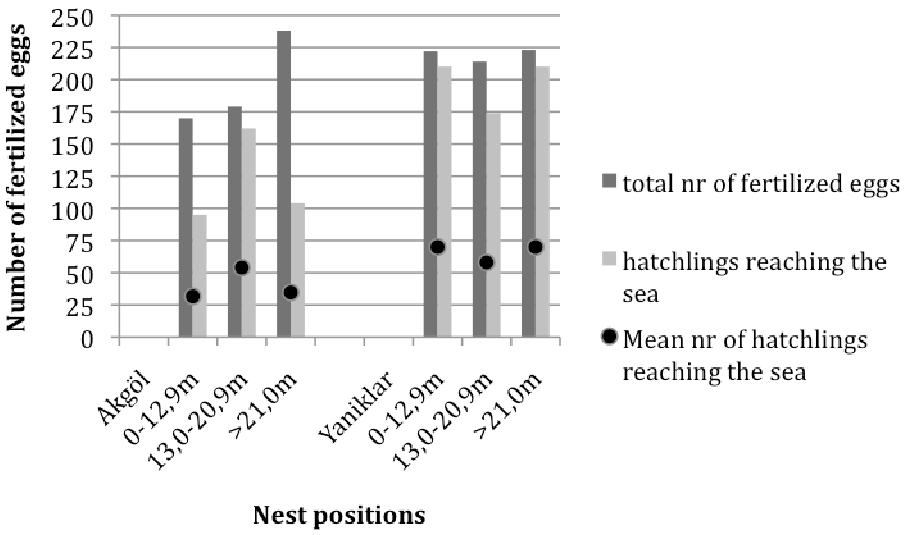


Abbildung 8: Vergleich zwischen der Anzahl befruchteter Eier und dem Erfolg jener Unechten Karettschildkröten-Schlüpflinge, welche das Meer erreicht hatten, aus den Nestern der unterschiedlichen
Kategorien der Strände in Akgöl und in Yaniklar.
Figure 8: Comparison between the total number of fertilized eggs and the actual success of *Caretta caretta* hatchlings reaching the sea in the different subsections of the beaches in Akgöl and in Yaniklar.

Parasites and other factors:

Parasites in the nest can endanger the successful development of the hatchlings. This factor was also recorded during the excavations.

All 3 nests in Akgöl in the last third (> 21.0m) were infested by parasites. Those were the only parasite-infested nests on this beach. The most common parasites were larvae of Diptera and Tenebrionidae beetles. In Yaniklar all nests except YS23 were infested, mostly by Diptera larvae (5 of 9 nests). Another often found parasite was Nematoda.

Some nests in Akgöl and in Yaniklar were positioned in root areas next to the vegetation. In Akgöl, 3 eggs were pierced by roots growing into the nest (AS1, distance to sea: 57 m,

predated hatchlings: 26 minimum). This nest had the highest number of predated hatchlings and was also infested by parasites.
In the same section, another nest (AS3, distance to sea: 43.45 m) had a piece of moist wood inside the egg chamber; it had started to rot inside the nest.

Although the main substrate in Yaniklar beach was sand, the main problems there were hard compact sand on the entrance to the egg chamber and bigger stones inside the nest.
Especially 3 nests had a variety of big stones (> 5 cm diameter), lying in the mid third (YS4, distance to sea: 14.6 m; YS10, distance to sea: 17.5 m) as well as in the last third of the beach sectors (YS27, distance to sea: 25.5 m). Several nests on every sector of the beach showed hard compact sand inside the nests or at the entrance of the egg chamber. Nest YS23 (15.3m) had 16 dead hatchlings stuck in the nest; YS8 (21.9m) had 2 dead hatchlings due to sun/heat.
Furthermore, 3 loggerhead hatchlings were predated by cats or foxes and hedgehogs, one in nest YS3 (distance to sea 12.2m), one in nest YS4 (distance to sea 15.6m) and one in nest YS23 (distance to sea 15.3m).

## DISCUSSION

Sand temperature, moisture and salinity inside the egg chamber are only a few factors which can influence nesting success (Mrosovsky & Yntema, 1980). When sand gets wet, it is harder for turtles to excavate egg-chambers. This problem seems to be mainly in the subsection near the water zone (0-12.9 m). Due to the changing tidal zone, the risk for nests to become flooded is high. The moisture and salinity affects hatchling development in the eggs and the mortality once hatched. Especially in Akgöl, the 3 nests in the category 0-12.9 m are very near the water zone (average distance to the sea 8.4 m), which may help explain the high number of incompletely developed and dead hatchlings. Due to a greater distance to the water mark, even in the category 0-12.9 m (average distance to sea: 10.6m), Yaniklar is less affected. The average distance in the first section as well as the average distance in the third section (>21.0 m: 23 m) seems to bring the best results, based on the proportions of dead and survived hatchlings (Fig. 8). Scattered places of cobbles and pebbles are mostly distributed on the center of the beach in Yaniklar. This may cause a higher risk for the hatchlings to get stuck in the nest and therefore to get predated by carnivores. Nests located in the subsection over 21.0m, if vegetation is present nearby, seem to have a higher risk of getting pierced or destroyed by plants or plant remains (e.g. wool or pine cones in the nest) and therefore getting infested by parasites such as tenebrionid or dipteran larvae.

Except for the small section at the end, Akgöl seems to be a difficult nesting terrain. It is clear from the results above (Tab. 1, Fig. 7 and Fig. 8) that the substrate on the beach has a considerable influence on the development of hatchling embryos, first of all due to the heat- and oxygen circulation inside the nest as well as providing the possibility for the hatchlings to leave the nest. Increasing human activities and beach development threaten the turtle populations. Sand extractions and bulldozing in several parts of Akgöl over the past years seem to be a problem. Most parts of this subsection are unsuitable for nesting because an approximately 300-400 m stretch is covered with pebbles and cobbles (Türkozan, 2000) (Fig. 9). Such substrate makes the hatching process more difficult or impossible. Much more energy has to be expended, leading to exhaustion, dehydration or death due to sun or heat if they are stuck in the nest.

Compared to Akgöl, the sandy parts of Yaniklar are much more suitable for nesting. This area is mostly covered with fine sand, the ideal situation for unproblematic oviposition and hatching process.

Abbildung 9: (P1050138) Der Strand in Akgöl, der Großteil des Strandes besteht aus Kies und Steinen. Einige Nester sind auf diesem Bild mit weißen Schildern gekennzeichnet. Nur der kleine Teil hinter der Flussmündung, angrenzend zum Uzun Burun, besteht aus feinem Sand.
Figure 9: Akgöl beach, most of which is covered with pebbles and cobbles. Some nests are marked with white signs. Only the part behind the river mouth, adjacent to Uzun Burun, consists of fine sand. (Photo: B. Serp)

This raises the question of whether hatcheries, especially in Akgöl, could be the better solution against the high mortality rate. The location of hatcheries should be chosen with respect to the high water mark, in Akgöl especially on the small sandy part of the beach next to Uzun Burun in the area between 13.0m and 21.9m and in Yaniklar in the sandy parts in the average level of about 12.2m or of about 23m, avoiding the scattered pebble parts and the zones with more abundant plant remains (Vásquez, 1994). McGowan et al. (2001b) reported that transplanted nests had fewer infested eggs. This could be explained by the fact that transplanted nests tended to be located at a greater depth in the sand column when compared to natural nests: this may be the main factor involved and not transplantation per se. Another preventative measure to reduce insect infestations during a hatchery is to install a number of separate hatchery sites each season (Broderick, 1997).

Tourism and light pollution seem to be a problem in Akgöl. About 26 *Caretta caretta* hatchlings of nest AS1 (> 21.0m) got lost in the vegetation, certainly because of a restaurant situated in the middle of the beach. The beach in front of this restaurant is developed with umbrellas and beach chairs. A bar and camping site are located next to the place. The lights of this building illuminate part of this beach (Türkozan, 2000). If a hatchling is attracted away from the ocean towards a direct or indirect source of light, it becomes disoriented and crawls away from the ocean towards the bright light. During this disorientation, hatchlings exhaust valuable energy and are more vulnerable to nocturnal predators and dehydration.
Light rays have a wide range; therefore the position of the nests on the beaches is probably less relevant.

Parasite infestation has been found in Akgöl as well as in Yaniklar. The main cause of hatchling death in Akgöl was tenebrionid and dipteran larvae (Özdemir et al., 2006).
As Özdemir (2006) believes, Tenebrionidae can find the exact position of a nest due of the smell of damaged eggs and the fluid leaking inside the egg chamber. Rotting eggs and dead embryos could explain the parasite infestation in the nests in Akgöl near the vegetation (> 21.0 m). There, 2 of 3 nests had pieces of wood or plants inside the nest, which pierced the eggs and hindered hatching. Besides, tenebrionid larvae were frequently found in nests close to low vegetation and in fine sand (Baran et al., 2001).
Water accumulation and swampy parts in the vegetation and the forests in Yaniklar could help explain the high infestation by diptera larvae (Özdemir et al., 2006).

Particularly in Yaniklar a high predation by parasites (mostly Tenebrionidae, Diptera and Nematoda) has been recorded in the nests. There, the positions of the nests on the beaches seemed to have no impact on the intensity of the infestation. These data were recorded to indicate the best locations on the beaches in Akgöl and Yaniklar for sucessful hatching and which factors influence this progress. Altough a hatchery is an anthropogenic interference, in some cases a hatchery should be taken under consideration, especially on the beaches of Akgöl and Yaniklar with pebbles as the main substrate and nests located near the water zone (under 10m). Due to the small number of nests investigated here, it is difficult to arrive at a generally valid conclusion, but a further investigation into this topic would be advisable.

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# Bachelor Thesis

Beach debris on Yaniklar beach (Turkey)

Strandmüll am Strand von Yaniklar (Türkei)

Lisa Strebinger

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ABSTRACT

Littering is one of the major problems of our environment. One species which suffers from it is the sea turtle *Caretta caretta*. Classified on the red list of the IUCN (International Union for Conservation of Nature) as threatened, it must face not only natural threats, such as predators, but also numerous anthropogenic threats.

This study documents the wide range in beach debris on Yaniklar beach in Fethiye, on the Mediterranean coast of Turkey, and indicates which possible effects this could have on *Caretta caretta*. Litter on the beach, for example, can act as barriers for freshly emerged hatchlings on their way to the sea or can be mistaken for natural food items and can in the worst case lead to death. The data were different to those of a similar study of 2004 which was conducted on the same beach, and the possible causes for the differences are discussed.

Litter was collected at four different transects (each 20 m wide and 100 m long) and was classified into nine material categories and four size classes. The number of items was determined and the size and density distribution over the beach was calculated. 7654 items were found in total; 4241 of those (55.4 %) were made of plastic, followed by foam (18.3 %) and on third place, organic garbage (6.6 %). Also in terms of weight, plastic made up the main part with 38167.2 kg (42.9 %), followed by rubber (19.8 %) and the category “others” (11.3 %). The average debris density was 11.1 g/m ² or 0.9 items/m². In terms of size, items between 3.5 and 10 cm were most common on Yaniklar beach.

Most of the plastic items were bottle caps, plastic bottles and plastic bags. Rubber objects mostly included remnants of bicycle tires, rubber boots or water hoses. Tiles or chipboard,s for example, counted among the category "others". Organic garbage mostly consisted of food leftovers, horse feces or biological remnants of cigarette butts. Most of the items were presumably deposited on the beach by visitors rather than washed ashore by the waves.

ZUSAMMENFASSUNG

Vermüllung wird zu einer immer größeren Problematik unserer Umwelt. Auch die Meeresschildkröte *Caretta caretta* hat darunter zu leiden. Bereits auf der Roten Liste der IUCN (International Union for Conservation of Nature) als bedroht eingestuft, muss sie nicht nur natürlichen Gefahren, wie Prädatoren, trotzen, sondern findet vor allem im Menschen ihren größten Feind.

Diese Studie dient dazu, die breite Palette an Strandmüll auf dem Yaniklar Strand in Fethiye, an der türkischen Mittelmeerküste, zu dokumentieren und zeigt auf, welche möglichen Folgen dieser für *Caretta caretta* haben könnte. Unter anderem stellt der Müll Barrieren für frisch

geschlüpfte Schildkröten auf ihrem Weg ins Meer dar oder wird im Wasser mit natürlichen Nahrungsressourcen verwechselt und kann zum Tod führen. Die, in dieser Studie, gesammelten Daten unterscheiden sich zum Teil zu jenen einer ähnlichen Arbeit, die 2004 am selben Strand durchgeführt wurde, und die möglichen Ursachen für die Unterschiede werden hier diskutiert.

Müll wurde an vier verschiedenen Stellen gesammelt (je 20 m breit und 100 m lang), auf Materialbeschaffenheit und Größe bestimmt und die Dichteverteilung über den Strand berechnet. 7654 Gegenstände wurden gesammelt, davon waren 4241 (55,4%) aus Plastik, an zweiter Stelle stand Schaumstoff (18.3%) und an dritter organischer Müll (6.6 %). Auch im Hinblick auf das Gewicht machte Plastik, mit 38167,2 kg (42.9 %), den größten Anteil aus, gefolgt von Gummi (19.8%) und der Kategorie „anderes“ (11,3%). Die durchschnittliche Müllverteilung über den Strand betrug 11,1 g/m² und 0,9 Gegenständen/m². Die meisten gefundenen Gegenstände waren zwischen 3,5 und 10 cm groß.

Der Großteil der Plastikgegenstände bestand aus losen Flaschenstöpsel, Plastikflaschen und Plastiktüten. Gummigegenstände waren vor allem Reste von Fahrradreifen, Gummistiefel oder Wasserschläuche. Zur Kategorie „anderes“ zählten zum Beispiel Fliesen oder Spanplatten. Zu organischem Müll zählten unter anderem Essensreste, Grillkohle oder Pferdekot zählten. Der meiste Müll wurde vermutlich nicht vom Meer angespült, sondern von Besuchern am Strand abgelagert.

## INTRODUCTION

Two different sea turtle families exist today: the Dermochelyidae to which the leatherback sea turtle belongs (*Dermochelys coriacea*) and the Cheloniidae containing six species: green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata),* Kemp`s ridley (*Lepidochelys kempii),* olive ridley *(Lepidochelys olivacea),* flatback *(Natatur depressus)* and loggerhead sea turtle *(Caretta caretta)* (Lutz, 2003; Rhodin, 2010). All species show a trend of decreasing population (Spotila, 2004) and therefore they are all listed in the IUCN (International Union for Conservation of Nature) Red List of Threatened Animals; the exception is the flatback sea turtle, which is listed as data deficient. Loggerhead, green and Kemp’s ridley sea turtles are listed as “endangered”, leatherbacks and hawksbills as “critically endangered” and olive ridley sea turtles as “vulnerable” (www.iucnredlist.org). *Caretta caretta* is also listed in Appendix I of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) and protected by CMS (Convention on Migratory Species) (Bonin 2006; Hykle, 1999).

*Caretta caretta* is the second most widespread species in tropical and subtropical oceans (after *Chelonia mydas*). *Caretta caretta*'s main nesting sites are in Florida, Northern Australia, Antilles and in Africa, as well in the Mediterranean: in Libya, Greece, Cyprus and Turkey (Bonin, 2006). The species is known as the largest hard-shelled turtle in the world and adults can reach a weight of 80 to 200 kg (Ernst, 2010). When the eggs hatch, the newborns make their way to the sea using their visual senses. The sea reflects the moon and the stars, presenting the brightest point, which is used as an aid for orientation. On their way to the sea they probably also learn magnetic compass bearings which they need for navigation. This is especially important for females; it guides them the way back to their birthplaces, where they lay the eggs (Miller, 2000; Spotila 2011). Until the juvenile stage, the newborns spend their lives in the pelagic environment, for example hidden behind in floating *Sargassum* fields, feeding on zooplankton and medusas (Bonin, 2006; Wynne, 1999). As adults they spend their lives in the open sea and in shallow coastal waters (Spotila, 2004). Mating takes place along the migration routes, between their foraging and breeding areas. Finally, the females return to their nesting sites (Bustard 1972, Cooper 2002), where they lay 100 to 150 eggs per nest, and up to three different nests per season (Bolton, 2003).

Nesting usually takes place at night in darkness. The females tend to be nervous while digging: in the early phases, they can be interrupted easily and as a consequence may turn back to sea (Bonin, 2006). Loggerheads have many natural predators. On the beach, eggs and hatchlings (in the nest, as well on their way to the sea) are threatened by oligochaetes, beetles, various larvae, crabs, snakes and rats. Further predators, even of the nesting females, include dogs or raccoons. Marine predators of juveniles and adults include birds, sharks and other larger fish, as well as orca whales, monk seals and many more (Ernst, 2009). Beyond these natural enemies, however, humans pose the greatest threat to loggerheads. Overall, only one in about 1000 eggs is thought to reach adulthood (Spotila, 2011). That is why it is so important to protect these animals. Archelon (http://www.archelon.gr) identifies five major human threats to sea turtles in general:

1. Capture by fishermen for exploitation purposes (meat, accessories)
2. Poaching of eggs for consumption
3. By-catch in fishing gear resulting in drowning or being killed by fishermen.
4. Nesting beaches are dramatically shrinking because of development, especially tourist development.

    a) Lights shining on the beaches disorient both nesting females and hatchlings trying to get to the sea

b) Sand compaction due to vehicular traffic may disturb the balance of gases in the sand and their absorption by the eggs

c) Beach furniture on the nesting areas often makes an impenetrable wall that blocks access to the back of the beach for nest digging

d) Heavily trafficked beach paths, planting shade trees, or setting up umbrellas result in lower sand temperatures, which impacts the incubation of the nest

e) Human presence on the nesting beaches at night can frighten off sea turtles trying to nest

f) Vehicle tracks may trap hatchlings on their way to the sea.

5. Marine pollution: turtles often mistake discarded plastic bags for jellyfish and tar balls or pieces of polyethylene for something to eat. If they consume these foreign substances their intestines may become clogged and they may die.

Beach and marine debris can be differentiated in marine or land-based litter. In 1991 the United Nations Joint Group of Experts on the Scientific Aspects of Marine Pollution estimated that nearly 80% of the pollution in the sea and on the beaches was land-based (Sheavly, 2007). About 24,000 tons of plastic are dumped into the sea every year, most of it washed from the beaches into the oceans. In a survey conducted on Yaniklar beach, Turkey, in July 2004, about 31 kg of debris were collected on 2400 m². The most often collected material was plastic (26.1 % of the total mass), followed by rubber (29.3%) and clothes (16.8%). Organic matter made up 6.6%, with metal contributing 4.0 %, glass 2.0% and paper 1.5% (Trießnig, 2006).

In the sea, turtles can mistake the litter for food. Plastic sheets, bags and balloons resemble jellyfish, and plastic and foam pellets look like zoo plankton to them. Such debris causes different health problems, including intestinal occlusion, asphyxia, malnutrition, starvation or ulcerations. *Caretta caretta* is positioned on top of the food chain, and many toxins build up at each step in this chain ("bioaccumulation"). The debris contains toxic compounds such as polychlorinated biphenyls, mercury and pesticides that could reduce sea turtle numbers (National Research Council, 1990; Spotila, 2011). The toxins may accumulate in internal tissues and may cause the production of thin eggshells, various tissue damage or deviation from normal behaviors (National Research Council, 1990).

Worldwide, hundreds of beach debris surveys are done every year, but none address a potential link to sea turtles and their decreasing numbers. Trießnig (2004), in Fethiye, Turkey, was one of the very few scientists who tried to determine whether and how beach litter harms sea turtles: she was the very first who documented the strong negative impact of beach debris on

loggerhead hatchlings on their way to the ocean. Field experiments were conducted with 199 hatchlings on Yaniklar beach in 2004. Synthetic obstacles (plastic bottles, Styrofoam cups, open-ended plastic containers and fishing nets) were placed between the ocean and the nests. The plastic bottles were the only barrier that all hatchlings could successfully overcome. Over 80 % of the hatchlings were trapped in the plastic canisters and in the heaped fishing nets. More than 50 % were trapped in a single-layer of netting and nearly 40 % in the cups (Trießnig, 2006).

The primary objective of the present work was to re-examine the density and types of marine debris on Yaniklar beach near Fethiye. This study quantifies the types, mass and number of different items and density of beach litter and furthermore compares the data with those of Trießnig`s beach survey in July 2004. The results underline the importance of clean beaches and the potential negative impact of beach debris on loggerhead sea turtles.

## MATERIAL AND METHODS

### Research area

The study area was at Yaniklar beach in Fethiye (36.22° N, 29.04°) in southwest Turkey (Fig.1). Fethiye is a well-known tourist destination where many holiday resorts, restaurants and bars are located. The beach of Fethiye is one of 14 major loggerhead nesting sites in Turkey (Ilgaz, 2007; Yerli, 1996) and is listed as the Fethiye-Göcek Specially Protected Area (SPA) in the Barcelona Convention, which was established in 1988 (Türkozan 1996; Council of Ministers' Decision 88/13019, 12.06.1988). Despite this designation, the condition of the nesting turtle population has not improved (Baran, 1989). In fact, since 1993 a continuous decline in nesting has been reported (Oruç, 2003; Türkozan, 2000). The beach is divided into three sections: Akgöl, Yaniklar (where the survey took place) and Çaliş.

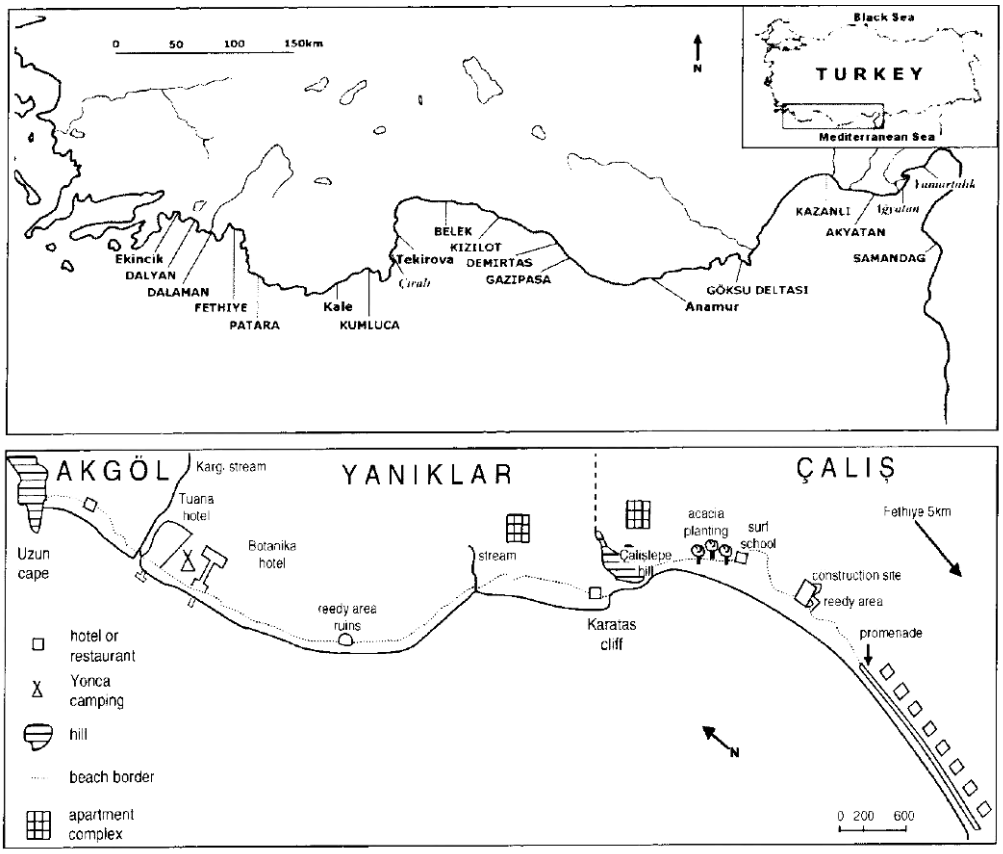


Figure 1: Map of Fethiye beach (from Ilgaz et al., 2006). (The camping site "Yonca Camping" is the now called "Yonca Lodge" and the construction site is a major apartment complex.)
Abb. 1: Landkarte von dem Strand in Fethiye (aus Ilgaz et al., 2006). (Der in der Karte genannte Campingplatz „Yonca Camping", nennt sich heute „Yonca Lodge" und die „construction site" ist ein großer Apartmentkomplex.)

Yaniklar beach is 3.3 km long (measured with GPS MAP 60 CX GARMIN), 20 to 60 m wide and stretches from the camping site Yonca Lodge over to Karataş cliffs in the east. Most of the beach surface slopes gently up from the water line to the beach, which initially consists largely of pebbles. Landwards, sandy surfaces with a mixture of sand and pebbles are present, with a hinterland consisting largely of a wetland interspersed with an amber tree forest. The amount of sand was apparently larger earlier, but sand is removed repeatedly removed and used as cheap construction material (C. Fellhofer, pers. comm.).

In the very western part of Yaniklar there are camping sites, bars and a hotel complex (Lykia Botanica Hotel), which feature deck chairs, umbrellas, wooden walkways, volleyball courts, small bars, lights at night, artificially planted bushes and trees. This infrastructure hampers the successful nesting of the turtles along those stretches. The easternmost part of the beach is a popular recreational area for local day visitors, who contribute to the pollution of the beach. Although forbidden, tourists and day visitor's camp at the beach, make barbecues and bon-fires, and even go fishing using flashlights at night.

Overall, visitors show a great lack of awareness concerning Special Environment Protected Areas and the accompanying regulations. The only sign erected by the Authority for Special Protected Areas (ASPA) in Yaniklar that refers to sea turtles is poorly positioned and not readily encountered by tourists. The main part of the beach cannot be reached by car and therefore the area is barely visited by people. Nevertheless it is also heavily polluted. In this part of the beach, the debris items are probably washed ashore from the sea. This litter can be from boats or is washed into the sea from inland by rivers and streams, for example in winter-time after heavy rains.

Beach survey

The beach survey was conducted from 25 July to 3 August 2011 on Yaniklar beach (3.3 km long, 20 to 60 m wide), with the help of a GPS device (GPS MAP 60 CX GARMIN). In order to investigate the beach, the area was divided into four separated transects, which were placed parallel to the waterline. Each transect was 100 m long and 20 m wide, resulting from the minimum width of the beach, yielding a total research area of 8000 m². With a measuring tape the 20 m width was measured from the waterline towards inland. Note that higher-lying sections, which were more than 20 m far from the waterline, were not examined because in the author's opinion this area did not belong to the typical bathing beach sections used by people, and the debris found there did not resemble traditional "beach debris". The amount of litter here, however, was in some cases higher than on the lower beach: the bushes and trees there tended to capture litter, taken there by the wind. The four examined transects were placed such that they were evenly distributed along the overall length of the beach. Thus, each was 925 m apart from the preceding one. The sectioning was set up as follows: the first transect started 925 m westwards of Yonca Lodge, and the last transect ended 925 m before the beginning of Karataş cliffs. The first three transects were located in an area which is hardly visited by people because it is impossible to reach by car and no bars or restaurants are available. In contrast the fourth transect was in a popular vacation spot for day visitors: a road goes directly to this beach sector and a beach bar is located there.

The debris of each transect was collected once during one day, from 25 until 28 July, by at least two persons. The litter that was removed from the transect and was taken to the camping site, where the classification and measurements took place. The litter was classified into nine composition categories: plastic, foam, rubber, paper, glass, organic matter, cloth, metal and others. All categories, except organic matter, are also used by The Ocean Conservancy during their Coastal Clean-up days (Trießnig, 2006). Litter entangled in a clump containing different

items or single items comprised of different materials were recorded individually. Items weighing less than 4 kg were weighed with an electronic scale (Lutron GM-500 ± 0.1 g). For heavier objects a digital hand scale was used (Heitronic, ± 0.1kg).

The objects were also measured according to their largest dimension. The first category "≥ 1.5 cm and ≤ 3.5 cm" was chosen because items smaller than 1.5 cm were poorly visible and because the most commonly found items were plastic bottle caps with a diameter of 3.5 cm. The other categories were: "> 3.5 cm ≤ 10 cm", "> 10 cm ≤ 100 cm" and "> 100 cm". A classification of the collected litter into marine-based and land-based debris was planned, but in this survey apparently mostly land-based debris was found.

## RESULTS

On the four beaches transects the debris totaled 89,024 g, equivalent to an average weight density of 11.1 g/m² (Table 1). The total amount of litter in Transect 1 was 11,755 g (5.9 g/m²); in Transect 2 it was 8,574 g (4.3 g/m²), in Transect 3 58,183 g (29.1 g/m²) and in Transect 4 11,654 g (5.8 g/m²). The weight density in Transects 1 and 4 was nearly the same; Transect 2 showed a slight decrease. The value in Transect 3 was 5.5 times higher than the average value of the three transects, which was about 5.3 g/m².

Table 1: Contribution of beach litter categories by weight of items at four investigated transects of Yaniklar beach and overall values (total).

Tab. 1: Die Gewichtsverteilung des Strandmülls von vier besammelten Stellen des Yaniklar Strandes sowie die Gesamtwerte.

| **Litter** | **TOTAL** | | **TRANSECT 1** | | **TRANSECT 2** | | **TRANSECT 3** | | **TRANSECT 4** | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Categories** | **Weight (g)** | **(%)** | **Weight (g)** | **(%)** | **Weight (g)** | **(%)** | **Weight (g)** | **(%)** | **Weight (g)** | **(%)** |
| Plastic | 38167.2 | 42.9 | 8857.3 | 75.3 | 3320.3 | 38.7 | 19448.9 | 33.4 | 6540.7 | 56.1 |
| Foam | 885.5 | 1.0 | 102.1 | 0.9 | 109.6 | 1.3 | 480.4 | 0.8 | 193.4 | 1.7 |
| Rubber | 17636.2 | 19.8 | 726.0 | 6.2 | 2980.0 | 34.8 | 13084.0 | 22.5 | 845.4 | 7.3 |
| Paper | 2158.1 | 2.4 | 38.5 | 0.3 | 12.3 | 1.4 | 1559.4 | 2.7 | 547.9 | 4.7 |
| Glass | 4121.1 | 4.6 | 999.4 | 8.5 | 5.4 | 0.1 | 2344.3 | 4.0 | 772.0 | 6.6 |
| Organic | 6920.1 | 7.8 | 263.6 | 2.2 | 749.7 | 8.7 | 4963.3 | 8.5 | 943.5 | 8.1 |
| Cloth | 5956.6 | 6.7 | 49.7 | 0.4 | 742.5 | 8.7 | 5391.3 | 9.3 | 415.6 | 3.6 |
| Metal | 3154.9 | 3.5 | 302.5 | 2.6 | 322.7 | 3.8 | 2212.8 | 3.8 | 316.9 | 2.7 |
| Others | 10024.1 | 11.3 | 416.3 | 3.5 | 331.0 | 3.9 | 8198.7 | 14.1 | 1078.1 | 9.3 |
| **Total** | **89023.8** | 100 | **11755.0** | 100 | **8573.5** | 100 | **58183.1** | 100 | **11653.5** | 100 |
| Density (g/m²) | 11.1 | | 5.9 | | 4.3 | | 29.1 | | 5.8 | |

Referring to weight, plastic dominated (42.9 % of the total) (Figure 2) followed by rubber (19.8 %) and "others" (11.3 %). The category plastic included most of the found items, including heavy items like tables, big plastic sheets and bottles. Rubber was dominated by rain boots, parts of bicycle tires and rubber hoses. The category "others" contained, inter alia, construction materials such as chipboards, slabs or roofing tiles. These heavy objects explain why these categories are in first, second and third place. Organic matter represented 7.8 %

and cloth 6.7 %. Glass comprised 4.6 %, metal 3.5 %, paper 2.4 % and foam 1.0 %.

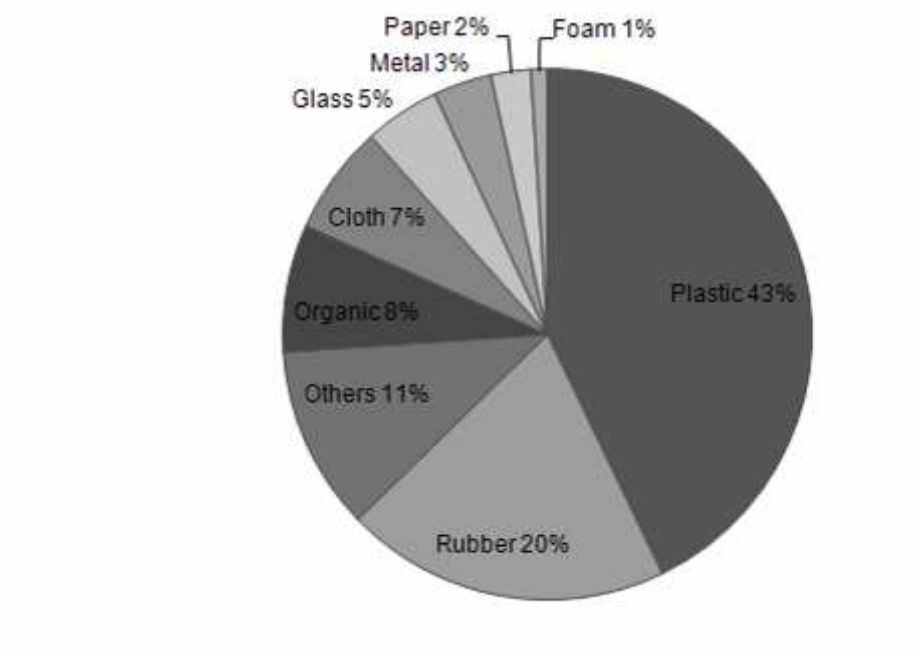


Figure 2: Percentage composition of beach litter by weight on Yaniklar beach.
Abb. 2: Prozentuelle Gewichtsverteilung des Strandmülles auf dem Yaniklar Strand.

Comparing the four transects in terms of weight, plastic dominated in all of them: Transect 1 with 75.3 %, Transect 2 38.7 %, Transect 3 33.4 % and Transect 4 56.1 %. The second most frequently found material in Transect 1 was glass (8.5 %), in Transect 2 rubber (34.2%) and in Transects 3 and 4 it was the category “others” with 14.1 % and 9.3 % of the total mass, respectively.

The beach transects yielded 7654 different items in total, equivalent to a litter density of 0.9 items/m². The value of Transect 1 was 747 items in total (0.4 items/m²), of the second transect 629 items (0.3 items/m²), of the third transect 4997 items (2.5 items/m²) and of the fourth transect 1281 items (0.6 items/m²). The item density in Transects 1, 3 and 4 was approximately the same. The item density in Transect 3 was 5.8 times higher than the average value of the three other transects, which was about 0.4 items/m².

Table 2: Contribution of beach litter categories by number of items at four investigated transects of Yaniklar beach and overall values (total).
Tab. 2: Verteilung des Mülls hinsichtlich seiner Stückzahl und der Müllkategorien von vier besammelten Stellen des Yaniklar Strandes und Gesamtwerte.

| **Litter Categories** | **TOTAL** | | **TRANSECT 1** | | **TRANSECT 2** | | **TRANSECT 3** | | **TRANSECT 4** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Nr. of items** | **(%)** | **Nr. of items** | **(%)** | **Nr. of items** | **(%)** | **Nr. of items** | **(%)** | **Nr. of items** | **(%)** |
| Plastic | 4241 | 55.4 | 384 | 51.4 | 359 | 57.0 | 2847 | 57.0 | 651 | 50.8 |
| Foam | 1402 | 18.3 | 179 | 24.0 | 190 | 30.2 | 733 | 14.7 | 300 | 23.4 |
| Rubber | 121 | 1.6 | 8 | 1.1 | 6 | 1.0 | 93 | 1.9 | 14 | 1.1 |
| Paper | 494 | 6.5 | 25 | 3.3 | 16 | 2.5 | 375 | 7.5 | 78 | 6.1 |
| Glass | 491 | 6.4 | 90 | 12.0 | 2 | 0.3 | 321 | 6.4 | 78 | 6.1 |
| Organic | 508 | 6.6 | 34 | 4.6 | 42 | 6.7 | 333 | 6.7 | 99 | 7.7 |
| Cloth | 125 | 1.6 | 3 | 0.4 | 2 | 0.3 | 109 | 2.2 | 11 | 0.9 |
| Metal | 151 | 2.0 | 17 | 2.3 | 6 | 1.0 | 96 | 1.9 | 32 | 2.5 |
| Others | 121 | 1.6 | 7 | 1.0 | 6 | 1.0 | 90 | 1.8 | 18 | 1.4 |
| **Total** | **7654** | 100 | **747** | 100 | **629** | 100 | **4997** | 100 | **1281** | 100 |
| Density (items/m²) | 0.9 | | 0.4 | | 0.3 | | 2.5 | | 0.6 | |

Most of the litter items were found in the category plastic, which correlates with the ranking of the weight data. 4241 of the total 7654 items (55.4 %) found were made of plastic. The greatest numbers of plastic items were bottle caps; other common plastic items included bottles, cups or trash bags. Also in a big amount, cigarette butts were found (they were not counted separately but weighted). Foam was the second most frequently found litter type (18.3 %). Ranked third was organic matter (508 items; 6.6 %), closely followed by paper (6.5 %) and glass (6.4 %). The category organic matter included food remains such as fruit skins or remnants of barbecues, horse feces or pieces of charcoal. The category paper included mainly cigarette boxes or pieces of newspaper. The category glass was mainly made up by broken beer bottles. Two percent of the found debris items were made of metal, the remaining categories each made up 1.6 % of the total number (“2 %” in Figure 2).

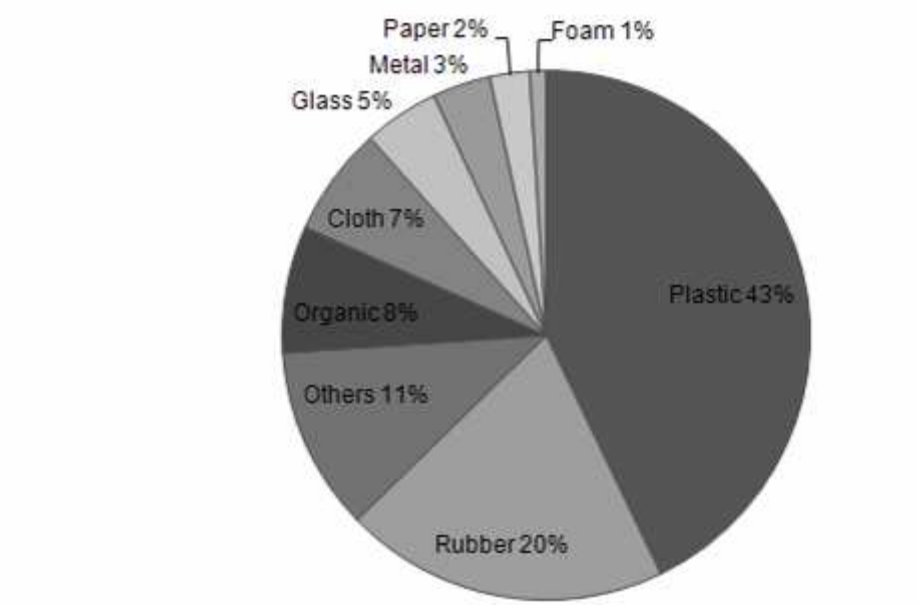


Figure 3: Percentage composition of beach litter by numbers on Yaniklar beach.
Abb. 3: Prozentuelle Verteilung der gefundenen Müllgegenstände auf dem Yaniklar Strand.

An intertransect comparison showed that plastic items were the most abundant items in all four sectors (Transect 1: 51.4 %, Transect 2 and 3 each 57.0 % and Transect 4: 50.8 %). Foam was the second most commonly found item category in all transects.

In terms of size, the category "> 3.5 ≤ 10" was the most common on Yaniklar beach, representing 39.6 % of all recorded debris items. The most abundant items in this category were plastic (1513 items), foam (823 items) and glass (250 items). The size category "≥ 1.5 ≤ 3.5" comprised the second most abundant item number: 2763 items, equivalent to 36.0 % of the total number. The third most common size category was "> 10 ≤100", accounting for 24.2 %. Very large items ">100" were rare: 20 items in total. They comprised things such as large plastic sheets, net-like items, plastic pipes or rubber hoses.

Table 3: Size distribution of beach litter items in percent at the four investigated transects.
Tab. 3: Müllverteilung hinsichtlich der Größe und des Materials der jeweiligen Objekte.

| Litter-Categories | Size-Categories (cm) ≥ 1.5 ≤ 3.5 | | > 3.5 ≤ 10 | | > 10 ≤100 | | > 100 | |
|---|---|---|---|---|---|---|---|---|
| | **Nr. of items** | **(%)** | **Nr. of items** | **(%)** | **Nr. of items** | **(%)** | **Nr. of items** | **(%)** |
| **DIST. 1** | | | | | | | | |
| Plastic | 98 | 41.5 | 173 | 48.3 | 109 | 73.6 | 4 | 80.0 |
| Foam | 51 | 21.6 | 119 | 33.2 | 9 | 6.1 | 0 | 0 |
| Rubber | 0 | 0 | 0 | 0 | 7 | 4.7 | 1 | 20.0 |
| Paper | 14 | 5.9 | 9 | 2.5 | 2 | 1.4 | 0 | 0 |
| Glass | 47 | 19.9 | 41 | 11.5 | 2 | 1.4 | 0 | 0 |
| Organic | 20 | 8.5 | 10 | 2.8 | 4 | 2.7 | 0 | 0 |
| Cloth | 0 | 0 | 0 | 0 | 3 | 2.0 | 0 | 0 |
| Metal | 6 | 2.5 | 5 | 1.4 | 6 | 4.1 | 0 | 0 |
| Others | 0 | 0 | 1 | 0.3 | 6 | 4.1 | 0 | 0 |
| **Total** | **236** | 100 | **358** | 100 | **148** | 100 | **5** | 100 |
| **DIST. 2** | | | | | | | | |
| Plastic | 105 | 45.1 | 154 | 58.6 | 98 | 74.8 | 2 | 100 |
| Foam | 93 | 39.9 | 89 | 33.8 | 8 | 6.1 | 0 | 0 |
| Rubber | 0 | 0 | 1 | 0.4 | 5 | 3.8 | 0 | 0 |
| Paper | 11 | 4.7 | 5 | 1.9 | 0 | 0 | 0 | 0 |
| Glass | 2 | 0.9 | 0 | 0 | 0 | 0 | 0 | 0 |
| Organic matter | 22 | 9.4 | 11 | 4.2 | 9 | 6.9 | 0 | 0 |
| Cloth | 0 | 0 | 0 | 0 | 2 | 1.5 | 0 | 0 |
| Metal | 0 | 0 | 0 | 0 | 6 | 4.6 | 0 | 0 |
| Others | 0 | 0 | 3 | 1.1 | 3 | 2.3 | 0 | 0 |
| **Total** | **233** | 100 | **263** | 100 | **131** | 100 | **2** | 100 |
| **DIST. 3** | | | | | | | | |
| Plastic | 1196 | 63.9 | 951 | 49.3 | 697 | 58.9 | 3 | 25.0 |
| Foam | 198 | 10.6 | 502 | 26.0 | 33 | 2.8 | 0 | 0 |
| Rubber | 3 | 0.2 | 15 | 0.8 | 66 | 5.6 | 9 | 75.0 |
| Paper | 68 | 3.6 | 127 | 6.6 | 180 | 15.2 | 0 | 0 |
| Glass | 146 | 7.8 | 165 | 8.6 | 10 | 0.8 | 0 | 0 |
| Organic matter | 235 | 12.6 | 48 | 2.5 | 50 | 4.2 | 0 | 0 |
| Cloth | 0 | 0 | 36 | 1.9 | 73 | 6.2 | 0 | 0 |
| Metal | 21 | 1.1 | 36 | 1.9 | 39 | 3.3 | 0 | 0 |
| Others | 5 | 0.3 | 49 | 2.5 | 36 | 3.3 | 0 | 0 |
| **Total** | **1872** | 100 | **1929** | 100 | **1184** | 100 | **12** | 100 |
| **DIST. 4** | | | | | | | | |
| Plastic | 142 | 35.9 | 235 | 48.1 | 273 | 68.9 | 1 | 100 |
| Foam | 169 | 42.8 | 113 | 23.1 | 18 | 4.5 | 0 | 0 |
| Rubber | 0 | 0 | 1 | 0.2 | 13 | 3.3 | 0 | 0 |
| Paper | 2 | 0.5 | 31 | 6.3 | 45 | 11.4 | 0 | 0 |
| Glass | 31 | 7.8 | 44 | 9.0 | 3 | 0.8 | 0 | 0 |
| Organic matter | 48 | 12.2 | 38 | 7.8 | 13 | 3.3 | 0 | 0 |
| Cloth | 0 | 0 | 0 | 0 | 11 | 2.8 | 0 | 0 |
| Metal | 3 | 0.8 | 17 | 3.5 | 12 | 3.0 | 0 | 0 |
| Others | 0 | 0 | 10 | 2.0 | 8 | 2.0 | 0 | 0 |
| Total | **395** | 100 | **489** | 100 | **396** | 100 | **1** | 100 |
| **TOTAL** | | | | | | | | |
| Plastic | 1541 | 55.8 | 1513 | 49.8 | 1177 | 63.3 | 10 | 50.0 |
| Foam | 511 | 18.5 | 823 | 27.1 | 68 | 3.7 | 0 | 0 |
| Rubber | 3 | 0.1 | 17 | 0.6 | 91 | 4.9 | 10 | 50.0 |
| Paper | 95 | 3.4 | 172 | 5.7 | 227 | 12.2 | 0 | 0 |
| Glass | 226 | 8.2 | 250 | 8.2 | 15 | 0.8 | 0 | 0 |
| Organic matter | 325 | 11.8 | 107 | 3.5 | 76 | 4.1 | 0 | 0 |
| Cloth | 0 | 0 | 36 | 1.2 | 89 | 4.8 | 0 | 0 |
| Metal | 30 | 1.1 | 58 | 1.9 | 63 | 3.4 | 0 | 0 |
| Others | 5 | 0.2 | 63 | 2.1 | 53 | 2.9 | 0 | 0 |
| **Total** | **2763** | 100 | **3039** | 100 | **1859** | 100 | **20** | 100 |

DISCUSSION

Referring to number of items, plastic dominated with 55.4 % of the total collected beach debris. This confirms the results of Trießnig`s survey on the Yaniklar beach in 2004 (47.6 % plastic items). Plastic is the major category of marine debris by weight and numbers worldwide and this is also documented in other regions of the Mediterranean (Golik, 1992), in Japan and Russia (Kusui, 2003) or California (Moore et al., 2001). Particularly polyethylene, polystyrene, polyvinyl chlorine or polypropylene (Pruter, 1987) are among the most important materials used to manufacture different plastic products (Derraik, 2002).

With respect to weight in Trießnig`s survey, rubber was the dominant material (26.4 %) followed closely by plastic (25.7 %), while in this analysis 42.9 % of the total litter mass was made up of plastic and 19.8 % of rubber. This probably reflects the weight of a car tire which was found by Trießnig. During this research, also three different car tires were observed on Yaniklar beach (Figure 12), but outside the examined transects, so that they did not play a rule in this study. The high percentage of plastic mass found in this study partially reflects the weight of a big plastic sheet (Figure 10), the remains of a picnic table (Figure 6) and a big plastic plank (Figure 4).

Big items like car wheels, tables or broken umbrella stands (Figure 13) on the beach can pose a threat to sea turtles because on the one hand they are barriers to hatchlings on their way to the ocean. On the other hand, heavy items can also block the hatchling's emergence when they are deposited directly on a loggerhead nest. Finally, big items can cast a shadow over the nests and change the temperature in it, which can have serious consequences in embryo development (Bolten, 2003).

The category plastic mostly included loose bottle caps, bottles, drinking cups and trash bags. Transported by wind from the beach into the sea trash bags and very small litter items are a threat to juvenile and adult loggerheads because they can be mistaken for jellyfish or plankton, which are among their natural food items (National Research Council, 1990).

Furthermore, drinking cups (43 cups found on the four transects in total) can have harmful effects for freshly emerged hatchlings because they can become caught in these "traps". An experiment showed that about 40 % of tested hatchlings were unable to escape and overcome this barrier (Trießnig, 2006). Potential explanations for this are, that right after the hatch, they crawl hyperactively straight to the sea. In this frenzy a change in crawling direction is not part of their natural behavior. More importantly, they are unable to crawl backwards (Salmon and Wyneken, 1987, 1992, 1994). Two different objects, made of plastic strings, were collected and may pose a threat to hatchlings, comparable with the danger of fishing nets. The above-

mentioned experiment showed that over 80 % of the tested hatchlings were unable to overcome the heaped fishing nets (Trießnig, 2006).

The third most litter type measured by weight was the category “others” (11.3 %), which is in line with Trießnig’s data. Note, however, that there are differences between the data in view of recreational waste (left clothes, food remains or the like), which is mostly caused by day picnickers and bathers: With a value of 15.7 % of the total debris mass, Trießnig collected twice as much cloth than in this study. Additionally, Trießnig found 11.7 % organic waste, contrary to this study (7.8 %). Trießnig argues this with the high number of day visitors for recreational purposes. Particularly during the summer months, many people spend their time on the beach, picnicking, cooking barbeques or having parties, and most leave the garbage behind.

Usually, litter items like plastic bottles and bottle cups (Figure 11) appear to be recreational waste, but the huge amount of these objects found on the beach potentially also point to illegal dumping. A case in point is the car tires or the concrete item (Figure 8) which were found this year. The data on the other material categories largely confirm Trießnig’s work.

The intertransect comparison showed that debris weight in Transect 3 (29.1 g/m²) was 5.5 times higher than the average value of the other three transects (5.3 g/m²). Equally, the number of items found in Transect 3 was many times higher than that of the other transects. The original assumption was that the biggest amount of litter would be found in Transect 4, because a street makes it easy for people to reach the beach, and because there is a beach bar there. The most litter items on Transect 3 were bottle caps, perhaps pointing also to litter dumping.

In general, all litter items, regardless of their composition, can cause problems for hatchlings because they can reduce crawling speeds and decrease mobility. This causes longer time periods on land and can negatively impact baby turtles` lives (Rötzer, 2007). This, for example, increases the chance of being caught by predators (Stancyk, 1982). Secondly, immobilized hatchlings are more exposed to the sun and the heat, which can lead to hyperthermia and desiccation (Bustard, 2005). Thirdly, hatchlings that must overcome barriers probably expend energy needed to migrate offshore. Finally, retained newborns, during this life period, may disrupt the imprinting mechanisms that are necessary to guide the females back to the beach for nesting when they mature (Owns et al., 1982). Longer disruptions can apparently also cause offshore orientation problems (Lohmann et al., 1990).

Organic (6.6 % of all items, 7.8 % in terms of weight), metal (2 % items, 3.5 % weight) or glass (6.4 % items, 4.6 % weight) litter items are also problematic. The last two categories can

cause lacerations, while organic debris, especially food remains such as fruits, seeds and meat, can attract many predators, like birds or dogs (pers. observation).

Overall, the beach debris survey yielded litter density of 11.1 g/m² and 0.9 items/m² (Trießnig: 12.4 g/m², 1.0 items/m²). Although these values are lower than those from research along other coastlines (along the coast of Mexico with 1.5 items/m², Silva-Iniguez, 2003, or of Japan with 3.41 items/m², Kusui, 2003, or of Panama with 3.6 items/m², Garrity, 1993), the study area in Yaniklar is a loggerhead nesting beach and calls for greater attention to enable a barrier- and litter-free start for freshly hatched loggerheads and to reduce the blow-off of litter from the beach into the sea.

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APPENDIX: Photos of beach debris found in the survey (all photos by Lisa Strebinger, except Figure 11)

Figure 4: Litter collected on Transect 1, including two big and heavy plastic items (remains of a large basin and a plastic plank).
Abb. 4: Der gesammelte Müll von Transekt 1, inklusive zwei große und schwere Plastikgegenstände (Reste eines Plastiktrogs und einer Plastiklatte).

Figure 5: The beach debris was collected by students with big bin bags and plastic gloves.
Abb. 5: Strandmüll wurde von Studenten, ausgestattet mit großen Müllsäcken und Plastikhandschuhen, eingesammelt.

Figure 6: Litter collected on Transect 2, including two big and heavy plastic items (remains of a table and a plastic pipe), as well as a big piece of foam.
Abb. 6: Der gesammelte Müll von Transekt 2, inklusive zwei große Plastikgegenstände (Reste eines Tisches und ein Rohr), sowie ein großes Stück Schaumstoff.

Figure 7: Two pairs of rubber boots found on Transect 2, such debris is difficult to explain.
Abb. 7: Zwei paar Gummistiefel wurden auf Transekt 2 gefunden, warum solcher Müll am Strand zu finden ist, ist schwer zu erklären.

Figure 8: Transect 2, a 1.5 m long and 7.2 kg heavy concrete element, probably dumped on the beach by local residents.
Abb. 8: Transekt 2, ein 1.5 m langes und 7.2 kg schweres Betongebilde, möglicherweise von Einheimischen am Strand abgelagert.

Figure 9: Litter collected on Transect 3. This was the transect with the 58.2 kg and 4997 different items.
Abb. 9: Der gesammelte Müll von Transekt 3. Hier wurde der meiste Müll gesammelt: 58,2 kg und 4997 verschiedene Objekte.

Figure 10: Transect 3, a huge plastic sheet which was entangled in a bush.
Abb. 10: Transekt 3, eine große Plastikplane, welche sich in einem Busch verfangen hatte.

Figure 11: The most commonly found litter items were loose bottle caps. These are either the remnants of plastic bottles left on the beach by visitor or washed ashore. (Photo: M. Stachowitsch)
Abb. 11: Die meist gefundenen Müllgegenstände waren lose Plastikstöpsel. Diese Reste von Plastikflaschen wurden entweder von Besuchern zurückgelassen oder angespült.

Figure 12: Observed outside the examined transects: a car tire and a plastic canister, directly next to a sea turtle nest (market with a stone semi-circle).
Abb. 12: Wurde außerhalb der untersuchten Transekte beobachtet: ein Autoreifen und ein Plastikkanister, gleich angrenzend an ein Schildkrötennest (markiert mittels Stein-Halbkreis).


Figure 13: A broken sun umbrella stand, possibly left by day visitors, observed outside the examined transects.
Abb. 13: kaputter Schirmständer, möglicherweise von Badegästen zurück gelassen, außerhalb der untersuchten Transekte wurde gefunden.