Sea turtle research,rescue and rehabiliton centre (DEKAMER) – Dalyan - Turkey

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KURZFASSUNG

Das Sea Turtle Rescue Centre in Dalyan, einem wichtigen türkischen Schildkrötenstrand (Iztuzu), ist das erste seiner Art in der Türkei und befasst sich seit seiner Gründung 2008 mit verschiedenen Forschungsgebieten rund um Meeresschildkröten. Eine der Hauptaufgaben ist das Retten und Pflegen verletzter Meeresschildkröten, mit dem Ziel sie nach der Genesung wieder in die Natur entlassen zu können. Im Sommer 2010 befanden sich 7 Unechte Karettschildkröten im Rescue Centre.

ABSTRACT

The Sea Turtle Rescue Centre at Dalyan- Iztuzu Beach, an important Turkish nesting beach, is the first of its kind in Turkey. Since it was founded in 2008, it has dealt with different research topics about sea turtles. One of the main tasks is to rescue and rehabilitate injured animals, with the aim to release them back into the wild after recovery. In summer 2010 there were 7 sea turtles at the Rescue Centre.

REPORT

Dalyan Beach, one of the fourteen primary nesting beaches in Turkey for the loggerhead sea turtle *Caretta caretta*, was selected as the "best open space in Europe" in 2008 by The Times newspaper (Annual Report, 2009). The Rescue Centre (DEKAMER) at Dalyan Beach was founded in the same year and is the first of its kind in Turkey. Doç. Dr. Yakup Kaska, the founder, first raised the idea of a Rescue Centre in 2000. The underlying thought was that if you save one adult turtle, it is equivalent to saving 1000 hatchlings, because only about 3-5 out of 1000 hatchlings reach the reproductive age (Annual Report, 2009). This report primarily deals with the rescue and rehabilitation of injured sea turtles at the centre, but the centre is also responsible for monitoring the beach (protection of nests), for other research topics and for increasing public awareness. At the Rescue Centre volunteers inform interested visitors about these topics and brochures, like the Annual Report of 2009, are available.

The Rescue Centre works together with Environmental Protection Agency for Special Areas (SEPA), General Directorate of Nature Conservation and National Parks, Municipality of

Dalyan and Pamukkale University. The project is financed by donations from visitors and the Municipality of Dalyan, which funded the building of a roof and a water circulation system. The Pamukkale University supports the centre with equipment and medicine. There is no financial support from the government. The government did, however, grant the permission to build the centre, which now consists of 8 convalescent pools (Figure 1) (a 5-m-deep diving pool is planned), a laboratory, an office, an information tent, a kitchen and, for the volunteers working there, two caravans and several tents. Most of the volunteers come from Pamukkale University, but students from other universities or even foreign students are welcome too. The around 15 volunteers stay there during the summer (the minimum length of stay is one month) and are supported by Dr. Kaska and his postgraduate students. For the treatment of the injured sea turtles, volunteer veterinarians (e.g. veterinary teachers from Pamukkale University) are at the centre's disposal. They are instructed by Dr. Kaska, e.g. he shows them where they have to take the blood sample.

Fig.1: Rescue Centre, interior view; convalescent pools of different sizes (Photo: E. Haeler)
Abb.1: Rescue Centre, Innenansicht; unterschiedlich große „Genesungsbecken“ (Foto: E. Haeler)

When an injured sea turtle is found, the Rescue Centre receives the information from fishermen, boat trip organizers, agencies or the police. Such turtles are then transported in a wooden crate by car to the centre. Most of the sea turtles are found in the surrounding area, for example Dalyan River and Fethiye, but in summer 2010 there was one sea turtle from Mersin, which is further away (about 700 km). After a sea turtle arrives, it is examined by the veterinarians and the appropriate treatment is started. The treatment ranges from the administration of antibiotics to operations, which are carried out in Denizli (about 200 km from Dalyan). During the recovery period the sea turtle stays in one of the convalescent pools (one turtle per pool) (Figure 1). These pools have different sizes and can be filled with sea water to the level required. Sea turtles with deep wounds on the carapace (Figure 2) stay in small pools with little water, so that the carapace stays dry and infections caused by pathogens in the water are reduced (Kaska et al., 2008). When they get healthier, they are moved to bigger pools so that they have more space to swim and to dive. The pools are cleaned and refilled with seawater daily via the pump of the water circulation system. The pools are open

to the public, but to reduce the stress (e.g. shortly after an operation) they can be covered with sheets or separated from the other pools. Taking photographs with flashes is forbidden because it would disturb the animals. The sea turtles are fed once a day early in the morning with dead fishes and dead crabs. This regime is sufficient because they burn less energy in the tanks than in the wild. Often, vitamins are fed to the animals additionally. In some cases, other feeding strategies are required. If problems with independent ingestion develop, for example, then force feeding (the fish is placed near the oesophagus, causing the sea turtle to swallow), tube feeding or intravenous administration of Ringer's solution is necessary (when the animal is very weak). To monitor the progress of rehabilitation, the abilities of the sea turtles (swimming, diving and hunting) are tested from time to time. For this purpose they get live prey. The final step of a successful rehabilitation is the release of the sea turtle back into the wild. This takes place (after the turtles are tagged) near the site where it was found. Normally there are no problems, because the sea turtles do not become accustomed to humans during their stay in the Rescue Centre.

Fig.2: Male *Caretta caretta* with two deep wounds caused by a boat propeller (Photo: E. Haeler)
Abb.2: Männliche *Caretta caretta* mit zwei tiefen Wunden, durch den Propeller eines Motorboots verursacht (Foto: E. Haeler)

But not all the time all convalescence pools are occupied by adult sea turtles. From time to time there are hatchlings in one of the pools. This happens when there have been an excavation in the morning and it was too late to release the hatchlings. In this case the hatchlings stay until about midday in a dry pool with sand at the bottom for strengthening their muscles and then they were put into a pool filled with little water for the rest of the day, where they can swim around. They were released at the same night.

Since 2008 altogether 25 sea turtles have been in the Rescue Centre and 16 of them were female. Furthermore, 18 of the treated sea turtles and belong to the species *Caretta caretta* and the other 7 were green turtles (*Chelonia mydas*). The estimated age of the animals ranges from 10 to 65 years, the average is ~45-50. Until September, 6 of the 25 sea turtles died and 12 could be released. The other 7 were still under rehabilitation and the information about

their sex, species, estimated age etc. can be found at their convalescent pool. Depending on the type and severity of the injury, the stays are of different length. The shortest stay was 12 days and the longest over one year. If a sea turtle cannot be released anymore, it can stay for the rest of its life in the Centre. As shown in Figure 3, the injuries of the 25 treated sea turtles were 7 propeller cuts from boats, 2 speed boat collisions, 7 fishing hook ingestions, 8 fishing line cuts and one gunshot wound. Accordingly, the main problems are motor boats, which often drive too close to the shore, and the fishing industry with its fishing lines and hooks. Unfortunately, it becomes clear that the problems are caused by humans and they could be avoided if people would follow certain rules.

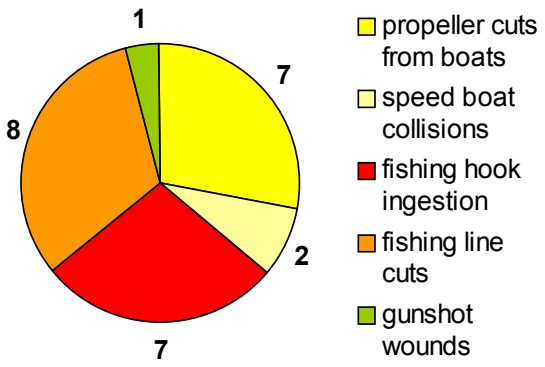

Fig.3: Injuries of the treated sea turtles
Abb.3: Verletzungen der behandelten Schildkröten

To get information about sea turtles everybody can send an email to the Rescue Centre (caretta@pau.edu.tr or dekamer@pau.edu.tr) or visit their homepage (http://caretta.pamukkale.edu.tr/).

The Rescue Centre in Dalyan is not the only Rescue Centre in the Mediterranean Sea. There are ones in other countries too, for example in Greece and Italy. In 1994 ARCHELON, the Sea Turtle Protection Society of Greece, founded in Glyfada Attikis (Greece) one of the first Sea Turtle Rescue Centres in the Mediterranean. It is bigger than the one Dalyan and every year almost 50 turtles are brought there from all over Greece. To support it there are two First Aid Stations in Crete (Pagalohori of Rethymno) and in West Greece (Amvrakikos) which can accommodate turtles for short period of time (http://www.archelon.gr). In Italy there are a few Rescue Centres, for example the WWF Italy Sea Turtle Rescue Centre of Lampedusa and the Fondazione Cetacea in Riccione. Lampedusa is situated in the middle of the Mediterranean Sea and the Rescue Centre annually receives 300-500 loggerhead turtles and does 200-300 surgeries. Fondazione Cetacea in Riccione takes care of loggerhead turtles and other marine vertebrates (http://www.seaturtle.org).

A visit to one of the Rescue Centres is one step in raising awareness for this issue and for initiating a change in thinking.

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Tagged turtles (*Caretta caretta*) (1994 - 2010)

Markierte Schildkröten (*Caretta caretta*) (1994 - 2010)

Sandro Pettermann

KURZFASSUNG

Im Rahmen des Projektpraktikums „Conservation of Sea Turtles“ wurde in der Zeit von 15. Juni bis 10. September 2010 auf den Stränden von Çaliş, Yaniklar und Akgöl nahe Fethiye in der Türkei gearbeitet, wobei die Arbeitsschichten von Strand zu Strand unterschiedlich waren. Dabei wurden im Wesentlichen während den täglichen Früh- und Nachtschichten die Strände abgegangen und für die zum Schutz der Unechten Karettschildkröte (*Caretta caretta*) und zur wissenschaftlichen Datengewinnung relevanten Informationen gesammelt. Bei den Nachtschichten wurde nach weiblichen, nistenden Schildkröten Ausschau gehalten und bei Sichtung die Identifikationsnummer von einem eventuell schon vorhanden Metallmarker notiert. Wenn die Schildkröte jedoch noch nicht markiert war, wurde eine solche Markierung nach Möglichkeit auf der rechten Vorderextremität der Schildkröte angebracht und anschließend Carapaxmessungen vorgenommen. Diese Messungen sollten auch durchgeführt werden, wenn das Tier noch nicht markiert war und auch nicht markiert wurde. Bei den Carapaxmessungen wurden die gerade Carapaxlänge (SCL), die gerade Carapaxbreite (SCW), die gebogene Carapaxlänge (CCL) und die gebogene Carapaxbreite (CCW) berücksichtigt. Beides (Markierung und Vermessung der Meeresschildkröten) wurde nach dem Nistvorgang auf dem Rückweg der Schildkröten zum Meer durchgeführt, um eine Störung des Nistvorgangs zu vermeiden.

In Yaniklar wurde in der Nachtschicht am 29. Juni eine Unechte Karettschildkröte markiert (TRA0968). In Akgöl wurden zwei Schildkröten markiert (TRC2141, TRC2137), wobei eine davon (TRC2141) während zwei Nachtschichten gesichtet wurde. In Çaliş wurden in der Zeit der Nachtschichten zwischen 15. Juni und 12. Juli drei Schildkröten am Strand entdeckt und markiert (TRC2145, TRA0988, TRA0975). Bei keinem Strandabschnitt wurde eine bereits markierte Schildkröte gesichtet. Alle adulten Schildkröten, die während des Beobachtungszeitraumes vorgefunden wurden, erhielten deshalb eine neue Markierung.

ABSTRACT

During the university course “Conservation of Sea Turtles”, the beaches of Çaliş, Yaniklar and Akgöl near Fethiye in Turkey were monitored by the members of this project between the 15 June and 10 September 2010. The work shifts were different from beach to beach. During daily morning and night shifts, data for the conservation of the loggerhead sea turtle (*Caretta caretta*) and for scientific purposes was collected. During the night shifts we watched out for nesting female turtles and, after encountering one, the tag number was recorded if the turtle had already been tagged. If a tag was lacking, the right front flipper was tagged, and after that carapace measurements were made: the straight carapace length (SCL), straight carapace width (SCW), curved carapace length (CCL) and curved carapace width (CCW) were measured. These measurements were also done even if the animal had no tag or wasn’t tagged by us. Both tagging and measurements were accomplished after nesting, when the female turtle was returning to the sea. This helped to avoid disturbing the turtle or endangering the nesting process.

In Yaniklar, one turtle was tagged during the night shift on 29 of June (TRA0968). In Akgöl, two turtles were tagged (TRC2141, TRC2137), one of them (TRC2141) was sighted during two different night shifts. In Çaliş we found and tagged three turtles during the night shifts between 15 June and 12 July (TRC2145, TRA0988, TRA0975). Since no turtle with an already tagged flipper was documented during the observation period, all turtles found on night shifts were supplied with new tags.

INTRODUCTION

“The endangered loggerhead sea turtle *Caretta caretta*, one of the eight surviving sea turtle species, is distributed widely in warm-temperate and subtropical oceans.” (Bentivegna, 2002, cited after Pritchard, 1997). It occurs throughout the Mediterranean and is the most common species here (Bentivegna, 2002, cited after Groombridge, 1990; Pritchard, 1997). In the Mediterranean, two species – *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 “vulnerable”, respectively by the IUCN (International Union for the Conservation of Nature and Natural Resources, the World Conservation Union) (Broderick & Godley, 1996). Since 1996, *Caretta caretta* is classified as “endangered” by the

IUCN. Nesting in the Mediterranean is mainly confined to the eastern basin: Greece, Turkey, Cyprus and Libya (Groombridge, 1990 and Pritchard, 1997, cited in Bentivegna, 2002).
Like other species, the loggerhead sea turtle is migratory. The distance travelled depends on the phase of the life cycle (Bentivegna, 2002, cited after Meylan, 1982; Meylan et al., 1983; Hughes, 1989 & Limpus et al., 1992). Adult females migrate between feeding and nesting areas, which can be hundreds or thousands of kilometers apart. Little is known about the migratory habits of adult males (Bentivegna, 2002).
As the loggerhead sea turtle is endangered in two habitats – sea and beach – it is important to get data on the current population status. Information on migratory patterns can also help to develop effective conservation strategies (Bentivegna, 2002).
There are mainly two methods of obtaining data on migratory patterns: Satellite tags or metal/plastic flipper tags. Satellite tags show the migration routes more precisely, and with this technology it's possible to collect a lot of data (like water temperature, diving patterns, speed of the turtle). Since satellite tags are fully automated and information is sent actively over a GPS-like satellite system, there is no need to follow the turtles anymore and real-time migration patterns can be reconstructed on the computer. On the other hand, satellite tags are very expensive and, compared to flipper tags, not very durable (depending on the battery inside the tag).
In the framework of the sea turtle course on three beaches near Fethiye, we used metal flipper tags because, when an already tagged female comes to the beach again after some years, it can be easily identified by the tag number. This yields important information on the nesting behaviour of *Caretta caretta*, for example the frequency with which they come onto the same or a surrounding beach. This also helps to optimize concepts for conservation. Moreover, carapace measurements provide data about turtle growth and help us to recognize individual animals.
The project, which is a combination of conservation and scientific research, has been conducted every year since 1993 in a cooperation between the University of Vienna and several Turkish universities.
In the sea turtle course of 2010, our observations were made between 15 June and 18 September. The sea turtle project team involved 21 Austrian and 9 Turkish students as well as two Austrian and one Turkish field coordinator.

MATERIAL AND METHODS

In south-western Turkey, adult nesting female loggerhead sea turtles (*Caretta caretta*) were observed this year between 15 June and 10 September 2010 on three beaches near Fethiye. On Çaliş beach, a mostly touristy area, the students went on night shifts every night between 4 July and 4 September in order to collect data and protect the female turtles from the many viewers while laying nests on the beach. Moreover cages were set on each nest to avoid people destroying the egg-chamber underneath by walking over it or putting sunbeds / sunshades near or on the nest. Furthermore, cages with netting wrapped around them prevent the hatchlings from escaping when they emerge on the surface at night. This also makes it easier for us to locate them and escort them safely to the sea.

Yaniklar beach and Akgöl beach adjoin each other, so they are principally two parts of a larger beach. They are both less crowded and touristic than Çaliş beach. More turtles tend to emerge there because it is quieter and less artificial-light pollution occurs. Hence, night shifts in Yaniklar were only conducted until the first nest was hatching due to the risk of stepping on the hatchlings, which were poorly visible at night. In Yaniklar, no cages were used, so the hatchlings had to find their own way to the sea, orientating themselves according to natural light sources.

When we saw a sea turtle on the beach, we examined it, looked for tags and documented the tag number if it was there. If there was no tag, a special plier was used to pierce the tag through the skin of the turtle's right front flipper. During this procedure, one person held the turtle from the side to minimize movements. No person should stand or knee in front of the turtle, as it might bite. For the tagging site, we chose one of the first large scales on the posterior edge of the right front flipper near the axillary and tagged in between the scales (Fig. 1). The tags were provided by the Special Protected Area organisation (ÖCK). Each tag had a unique number to be able to identify each sea turtle individually if and when it was seen on the beach again. The tags which we used had numbers starting with the letters TR (which stands for Turkey), followed by a three- to four-digit-numerical code. Tags with the letters TR at the beginning are all made of Monel, as shown on the homepage of the Archie Carr Center for Sea Turtle Research, University of Florida. We had to be very quiet and careful before we tagged the turtles to avoid disturbing the nest-building process. Therefore we kept a safety distance to the turtle (about 15 to 20 m). The "Florida Fish and Wildlife Conservation Commission" (2007) writes: "When tagging turtles on nesting beaches, wait until the turtle has completed egg-laying before tagging or measuring the turtle."

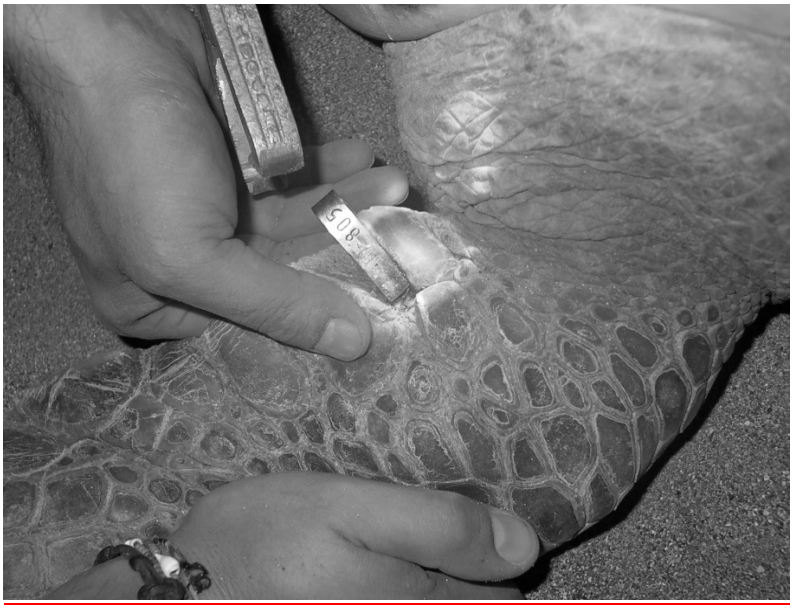

Fig. 1: Adult female *Caretta caretta* being tagged.
Abb. 1: Markieren eines adulten *Caretta caretta* Weibchens.
(Photo: I. Lamaszewska)

After tagging the turtle or identifying it by its unique tag number, we made carapace measurements using both calipers and flexible tape. The "Florida Fish and Wildlife Conservation Commission" (2007) writes: "Using calipers, measure the *straight carapace length notch to tip* (SCLn-t) from the anterior point at midline (nuchal scute) to the posterior tip of the supracaudals. […] In addition to the straight length, curved carapace length should also be measured with a flexible tape. Measure the c*urved carapace length notch to tip* (CCLn-t) from the anterior point at midline (nuchal scute) to the posterior tip of the supracaudals."
In addition to measuring straight carapace length (SCL) and curved carapace length (CCL), we also measured straight carapace width (SCW) and curved carapace width (CCW) using the same technique.

RESULTS

Emergence and nesting of newly and already tagged adult female *Caretta caretta* in Akgöl, Çaliş and Yaniklar in monitoring season 2010

Akgöl

On Akgöl beach we encountered two turtles within two following night shifts, which were newly tagged (Tab. 1). The turtle with tag number TRC2141 emerged on 4 July. After digging an egg-chamber the turtle stopped and returned to the sea without finishing the nest-building

process. The same turtle emerged a second time just one night shift later after it was tagged, on the 5 July at 01:30 a.m. This time the whole nesting was completed (Tab. 2). The nest was built 22.4 m away from the waterline, with a total track length of 54 m. One body pit was found next to the nest. In the same night shift the turtle with the tag number TRC2137 emerged at 11:43 p.m. and was newly tagged too. One body pit was found; the corresponding nest had a distance of 21.9 m to the sea, the total track length was 53 m.

Çaliş

On Çaliş beach we observed a total of 3 turtles. None had a tag. The first one was seen on the 26 June by members of the Turkish turtle team. After digging one body pit and one nest right next to each other, the turtle was tagged with tag number TRC 2145 (Tab. 4; Tab. 3). The nest distance to the sea was 14.3 m. The second turtle emerged on the 5 July. It dug two body pits and one egg-chamber, but discontinued just after the turtle team arrived. No eggs were laid. Before returning to the sea, the turtle was tagged with number TRA 0988 (Tab. 3). The incomplete egg-chamber was 29.7 m away from the waterline and the track had a total length of 74.4 m. The last turtle observed on Çaliş beach appeared in the night shift of 12 July. Again, the turtle returned to the sea after the team arrived but, this time even without starting to dig a body pit or nest. The turtle was given a tag (TRA 0975) 3.9 m away from the waterline.

Yaniklar

On Yaniklar beach only one adult female appeared during a night shift on 29 June and dug one nest (Tab. 6.) 18.1 m away from the sea. This turtle was tagged with tag number TRA0968 (Tab. 5.). No further data on number of body pits or emergence time is available.

This season no previously tagged turtles were documented.

Tab. 1: Emergence of tagged adult female *Caretta caretta* at Akgöl beach (1994-2010)
Tab. 1: Auftreten der markierten *Caretta caretta* Weibchen am Strand von Akgöl (1994-2010)

Tag number	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 (1994-2010)
Tab. 2: Anzahl der Nester der markierten *Caretta caretta* Weibchen am Strand von Akgöl (1994-2010)

Tag number	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
467														1			
471																	1
472																	1
474																	1
475														1			1
476																	1
478																1	
480																	1
481																	2
482																	1

Tab. 2: Number of nests of tagged adult female *Caretta caretta* at Akgöl beach (1994-2010)
Tab. 2: Anzahl der Nester der markierten *Caretta caretta* Weibchen am Strand von Akgöl (1994-2010)

Tag number	2010	09	08	07	06	05	04	03	02	01	00	99	98	97	96	95	94
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 (1994-2010)
Tab. 3: Auftreten der markierten *Caretta caretta* Weibchen am Strand von Çaliş (1994-2010)

Tag number	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					
268												1					
276														1			

Tab. 3: Emergence of tagged adult female *Caretta caretta* at Çaliş beach (1994-2010)
Tab. 3: Auftreten der markierten *Caretta caretta* Weibchen am Strand von Çaliş (1994-2010)

Tag number	2010	09	08	07	06	05	04	03	02	01	00	99	98	97	96	95	94
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 051										2							
TR 052							2			1							
TR 053										1							
TR 054										2							
TR 055										1							
TR 056										1							
TR 057																	

Tab. 3: Emergence of tagged adult female *Caretta caretta* at Çaliş beach (1994-2010)
Tab. 3: Auftreten der markierten *Caretta caretta* Weibchen am Strand von Çaliş (1994-2010)

Tag number	2010	09	08	07	06	05	04	03	02	01	00	99	98	97	96	95	94
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 (1994-2010)
Tab. 4: Anzahl der Nester der markierten *Caretta caretta* Weibchen am Strand von Çaliş (1994-2010)

Tag number	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						
27											1						
169								1									

Tab. 4: Number of nests of tagged adult female *Caretta caretta* at Çaliş beach (1994-2010)
Tab. 4: Anzahl der Nester der markierten *Caretta caretta* Weibchen am Strand von Çaliş (1994-2010)

Tag number	2010	09	08	07	06	05	04	03	02	01	00	99	98	97	96	95	94
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																	
TR 066																	
TR 076							1										
TR 077							1										
TR 078							1										
TR079							2										
TR 080							1										
TR 081							2										
TR 082							1										
TR 731					1												

Tab. 4: Number of nests of tagged adult female *Caretta caretta* at Çaliş beach (1994-2010)
Tab. 4: Anzahl der Nester der markierten *Caretta caretta* Weibchen am Strand von Çaliş (1994-2010)

Tag number	2010	09	08	07	06	05	04	03	02	01	00	99	98	97	96	95	94
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																	

Tab. 5: Emergence of tagged adult female *Caretta caretta* at Yaniklar beach (1994-2010)
Tab. 5: Auftreten der markierten *Caretta caretta* Weibchen am Strand von Yaniklar (1994-2010)

Tag number	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					
364												1					
366												1					
370												1					
372												1					

Tab. 5: Emergence of tagged adult female *Caretta caretta* at Yaniklar beach (1994-2010)
Tab. 5: Auftreten der markierten *Caretta caretta* Weibchen am Strand von Yaniklar (1994-2010)

Tag number	2010	09	08	07	06	05	04	03	02	01	00	99	98	97	96	95	94
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 ECO 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 (1994-2010)
Tab. 6: Nestanzahl der markierten *Caretta caretta* Weibchen am Strand von Yaniklar (1994-2010)

Tag number	2010	09	08	07	06	05	04	03	02	01	00	99	98	97	96	95	94
180								1									
181								1									
375												1	1				
401																2	
403																3	
405														1		1	
406																5	
408																4	

Tab. 6: Number of nests of tagged adult female *Caretta caretta* at Yaniklar beach (1994-2010)
Tab. 6: Nestanzahl der markierten *Caretta caretta* Weibchen am Strand von Yaniklar (1994-2010)

Tag number	2010	09	08	07	06	05	04	03	02	01	00	99	98	97	96	95	94
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	
751															1		
752															3		
753															1		
754															3		
755															2		
756															1		

Tab. 6: Number of nests of tagged adult female *Caretta caretta* at Yaniklar beach (1994-2010)
Tab. 6: Nestanzahl der markierten *Caretta caretta* Weibchen am Strand von Yaniklar (1994-2010)

Tag number	2010	09	08	07	06	05	04	03	02	01	00	99	98	97	96	95	94
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													
TRC 2202		1		1													
TRC 2204				1													
12.004												1					
Bodrum 55									2								
Bodrum 069										1							
Bodrum 280										1							

Tab. 6: Number of nests of tagged adult female *Caretta caretta* at Yaniklar beach (1994-2010)
Tab. 6: Nestanzahl der markierten *Caretta caretta* Weibchen am Strand von Yaniklar (1994-2010)

Tag number	2010	09	08	07	06	05	04	03	02	01	00	99	98	97	96	95	94
Bodrum 360										1							
Bodrum 366										1							
Bodrum ECO 440						1											
538 Monaco										1							
M 522																	1
TRA 0968	1																

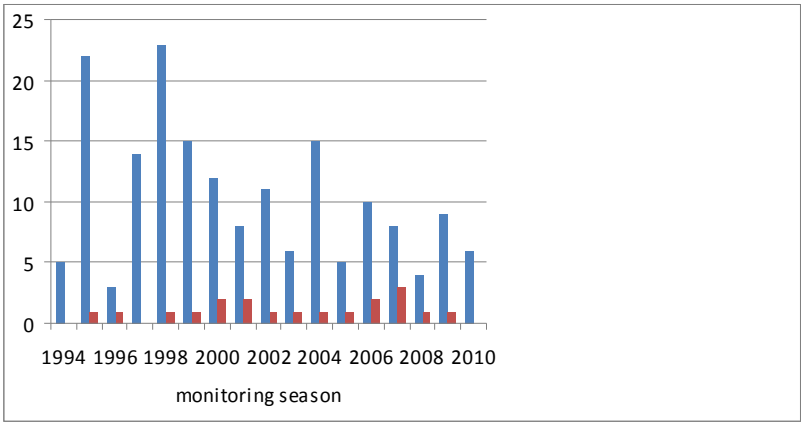

Fig. 2: Number of previously and newly tagged turtles (blue column) and number of returned tagged turtles (red column) compared between years
Abb. 2: Anzahl der bereits markierten bzw. neu markierten Schildkröten (blauer Balken) und Anzahl der zurückgekehrten markierten Schildkröten (roter Balken) im Jahresvergleich

Carapace measurements

All tagged turtles were measured both with a calliper and with a flexible tape.

The newly tagged turtle TRA 0968, which appeared on Yaniklar beach on 29th of July, was the largest turtle measured in 2010. It had a straight carapace length (SCL) of 78cm and a straight carapace width (SCW) of 57.5cm. The curved carapace length (CCL) was 81cm and the curved carapace width (CCW) 74.5cm (Tab. 7).

The turtle which emerged on the 12th of July on Çaliş beach was the smallest one measured this season. Its carapace had a straight length of 65cm, a straight width of 46 cm, a curved length of 70cm and a curved carapace width of 60cm (Tab. 7).

Tab. 7: Carapace lengths and widths of female *Caretta caretta* newly tagged in 2010
Tab. 7: Carapaxlängen und -breiten der 2010 neu markierten *Caretta caretta* Weibchen

Tag number	SCL (cm)	SCW (cm)	CCL (cm)	CCW (cm)
TRC 2141	76	59	80	74
TRC 2137	68	46	72	66
TRA 0968	78	57,5	81	74,5
TRC 2145	73	52	74	70
TRA 0988	73	58	74	76
TRA 0975	65	46	70	60

SCL … Straight carapace length, measured with calliper.
SCW … Straight carapace width, measured with calliper.
CCL … Curved carapace length, measured with flexible tape.
CCW … Curved carapace width, measured with flexible tape.

DISCUSSION

The number of adult female turtles emerging on the beaches, including the number of nests being laid by tagged turtles, is a minimum estimate because some adult females may not be seen by the sea turtle team during the night shifts. Moreover, it is likely that some tagged females emerged earlier in the season, before our project team started working.

Compared with 2009, fewer sea turtles were seen and tagged on the beaches. In 2009, seven turtles were supplied with new tags, while this year six were newly tagged. Interestingly we didn't find any already tagged turtles and, according to our observations, nearly all tagged female turtles only emerged once (except the turtle with tag number TRC2141, it was seen twice within two following night shifts on Akgöl beach) . This is also a big difference compared to the 2009 season, when three tagged turtles appeared several times on different beaches. Note also, that three turtles were seen and newly tagged in Çaliş this year, in 2009 only one, and in 2008 no tagged turtle emerged during the observation period.

Furthermore, two females were seen on Akgöl beach this year, which laid one nest each. This is interesting too because the last turtle observed on this beach goes back to 2003.

There were two turtles on Çaliş beach this season which aborted the nest-building process directly after the project team arrived. The reason for this might be the behaviour of the team, e.g. getting to close to the animal, making too much noise or fast movements next to the turtle, disturbing it.

Clearly, no conclusions can be drawn about the *Caretta caretta* population based solely on 6 newly tagged turtles. The only way to draw more firm conclusions about individual sea turtles and the population around the project area would be if all turtles were consistently tagged

(every turtle seen on the beach over the entire nesting season). Satellite tags would also provide interesting insights.

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The Purpose of Sea Turtle Projects

Magdalena Ritzberger

KURZFASSUNG

Diese Einführung hebt die größten Bedrohungen denen Meeresschildkröten ausgesetzt sind hervor und ergründet den Zweck von Meeresschildkrötenprojekten im Allgemeinen und des Sea Turtle Projects der Universität Wien im Besondern. Aufgrund des komplexen Verhaltens der Tiere und deren damit verbundenes Auftreten in verschiedenen Habitaten (offenes Meer, seichte Küstengewässer und Strände) sind sie unterschiedlichen anthropogenen Bedrohungen ausgesetzt. Demzufolge müssen auch Erhaltungsmaßnahmen dieser Komplexität Rechnung tragen und unter Einbindung aller Akteure geschehen. Meeresschildkrötenprojekte haben die Ziele weiteres Wissen zu gewinnen und diese gefährdeten Tiere zu schützen. Weiters gilt es die Öffentlichkeit zu sensibilisieren um den Fortbestand der Meeresschildkröten zu sichern.

ABSTRACT

This introduction highlights the main threats which sea turtles are confronted with and discusses the purpose of sea turtle projects in general and of the University of Vienna sea turtle project in particular. Due to the very complex behaviour of the animals, they occupy different habitats such as beaches, the neritic zone and the open ocean. In all, they face numerous anthropogenic threats. Accordingly, conservation measures have to be multidimensional and should involve all stakeholders. Sea turtle projects have the objective to gain further knowledge and to protect the endangered species. Furthermore, raising public awareness is an important aspect to ensure the survival of sea turtles.

Sea turtles are present in all major ocean basins, particularly in the tropical and temperate zones. In a complex life cycle, females come ashore in order to produce several clutches of eggs. According to Miller (1997, in Broderick et al., 2002), they commonly migrate every two to three years from foraging areas to nesting sites.

In the Mediterranean, two species are known to nest, *Caretta caretta* (loggerhead turtle) and *Chelonia mydas* [green turtle (Türkozan, 2000)]. Annually about 2000 female loggerhead turtles nest, so it is the most abundant species of marine turtles breeding in the Mediterranean (Groombridge, 1990, in Broderick, 2002). Broderick and others (2002) report that each year 2280-2787 loggerhead turtles nest there. Nesting is restricted to the eastern Mediterranean,

and most clutches are encountered in Greece, Turkey, Cyprus, and Libya. *Chelonia mydas* predominantly nests in Turkey and Cyprus (Margaritoulis et al., 2003), and it is estimated that 300-400 females come ashore annually, with a more precise estimate being 339-360 (Broderick et al., 2002).

Ecologically, the animals function as a substrate and transport vehicle for diverse epibionts. They also transfer nutrients and energy from nutrient-rich feeding grounds to nutrient-poor nesting beaches. Additionally, they host parasites and bacteria and are prey for predators (Bjorndal et al., 2003).

Both loggerhead turtles and green turtles are listed on Appendix 1 of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) and they are categorized as endangered species on the 2010 IUCN (International Union for Conservation of Nature) Red List of Threatened Species (IUCN Red List, 2010). Furthermore, there are several conventions which protect sea turtles in the Mediterranean region, including the Barcelona Convention, Bern Convention, and the Convention on Biological Diversity [(CBD) Casale et al., 2010]. That implies that turtles are in grave danger.

Bowen et al. (1993, in Broderick et al., 2002) mentioned the existence of a genetic isolation between populations in the Mediterranean and rookeries in the Atlantic. Accordingly, the gene flow between these populations is reduced significantly. This fact highlights the importance of regional conservation efforts.

What are the main hazards that sea turtles face? The IUCN Marine Turtle Specialist Group (MTSG) describes five major threats.

- Fisheries impacts
- Direct take
- Coastal development
- Pollution and pathogens
- Global warming

Since sea turtles occupy three different ecosystems during their lives – the terrestrial zone, the oceanic zone and the neritic zone (down to 200m) – they face multiple risks. So each stage of their life cycle has to be taken into consideration, as well as the associated habitats. This requires the protection of species as well as the protection of habitats.

The natural factors that cause problems for marine turtles are predators as well as natural habitat changes. Predators are wild canids like red fox and golden jackal, feral or domestic dogs, and ghost crabs (Camiñas, 2004). Türkozan (2000) also mentioned that coleopteran larvae attack eggs. Plant roots, isolation, and bird predation can also kill hatchlings.

Beside natural factors, human-related activities have numerous negative impacts on these animals (Lutcavage et al., 1997), both on the beaches as well as during their aquatic phase. The main problem is environmental degradation.

Many nesting sites in the Mediterranean are threatened by the fast-growing tourist industry. Turtles breed in summer time, in the Mediterranean from early June to early August, with single nesting events in mid-May and early September (Margaritoulis et al., 2003). So the nesting season coincides with the tourist season. The associated structures such as buildings, beach chairs, parasols, fences, picnic tables, boardwalks, and other beach furniture can make the beach unsuitable for turtles.

Sea turtles face additional risks related with tourism. The characteristics of the sand are crucial for the ability of sea turtles to dig their nests. Coastal armouring, beach nourishment and beachfront development have obvious negative impacts: the females are impeded or they must nest elsewhere. Moreover, tourism limits the area of nesting and is responsible for a decline and change in beach vegetation, which in turn influences the incubation time and temperature because the amount of shading changes (Carthy et al., 2003).

Additional human impacts are tire ruts, vehicles, and tourists on the beach. Another major problem is the artificial light that is emitted at night by hotels and beach bars. These confuse the hatchlings in their sea finding behaviour.

The pollution of the oceans, coastal areas and beaches has to be considered too. The volume of marine debris is enormous. Crude oil, tar, various marine litter and heavy metals can impact the respiration, diving patterns, energy metabolism, digestive tract, and blood chemistry. Turtles are also bioaccumulators of heavy metals. Overall, each type of nonbiodegradable waste affects the life of sea turtles. Further aspects are boat and vessel strikes, which can lead to fatal injuries (Lutcavage et al., 1997)

Beside activities related to tourism, the fishing industry creates major additional hazards. The Mediterranean contains important fishing areas; approximately 100 000 fishing boats ply this sea. These areas are also visited by adult turtles as well as juveniles (Camiñas, 2004). It is estimated that over 150 000 incidental captures occur per year (all species, sizes and origin combined), especially by pelagic longlines, trawls, demersal longlines, and set nets (Casale et al., 2010). Note that the mortality via surface longlines is dependent on the size and shape of hooks, number of hooks, length of branch lines, and other factors (Camiñas, 2004).

If trawls are not provided with turtle excluder devices (TEDs), turtles are unable to escape (Lutcavage et al., 1997).

Intentional killing and exploitation are also widespread in the Mediterranean, particularly in Greece and Egypt; beyond that, dynamite fishing is common in Greece, Lebanon, Libya, and Syria (Casale et al., 2010).

Related to these various threats, the small populations in the Mediterranean are assumed to be in decline (Witherington, 2003). This underlines the importance of conservation measures. Even if a single element in the life cycle is affected, it has an influence on the complex behaviour of the animals. Conservation efforts should focus an all stages of the life cycle and the relevant habitats. Most important seems a coordinated cooperation between governments, NGOs, research institutes and individuals (Casale et al., 2010). Efforts on the regional scale, as appreciated in international conventions like the CBD, strengthen public awareness and should engage people to conserve biodiversity (Hesselink et al., 2010).

The main goals of sea turtle projects are the protection of species, conservation of nature and scientific research. Those gaps in the knowledge concerning population dynamics, life histories and so on must be closed. Turtles are difficult to count in the water and the migratory routes are often unknown (Witherington, 2003). Even more intensive monitoring programs are necessary, and suitable management plans have to be adopted involving national and international levels. Moreover, all stakeholders have to be brought together. Beyond that, raising public awareness, capacity building, and education are relevant aims (Margaritoulis et al., 2003).

For this purpose, interested people need to be informed and the public must become sensitized. Importantly, currently neither tourists, fisherman, nor scientists know enough. If everyone is well informed, it will be easier to implement the measures. Finally we must not forget the non-consumptive value of sea turtles and of biodiversity in general. The protection of such goods has more relevance than at first sight. This aspect could lead to a more sophisticated treatment of nature.

As much as possible under the above-mentioned circumstances has to be done to avoid the extinction of marine turtles.

As the Mediterranean coasts of Turkey are very important nesting grounds for *Caretta caretta* and *Chelonia mydas*, it is of great interest to implement protective measures there. The sea turtle project in Fethiye of the University Vienna and several Turkish universities represents a long-term project with the effort to make a contribution to the conservation of sea turtles and their habitats. Türkozan et al. (2003, in Casale et al, 2010) reported 20 loggerhead turtle nesting grounds in Turkey, including Fethiye. Turkey is also member of several conventions, including the Barcelona Convention, the Convention on Biological Diversity (CBD), CITES,

and Bern Convention. Fethiye is designated as “Specially Protected Area” in the framework of the Barcelona Convention. Main threats on Fethiye beach are tourism development and sand extraction (Casale et al., 2010). Fethiye beach is naturally divided into three sections, Çaliş, Yaniklar and Akgöl. In Çaliş the area behind the beach is heavily developed. Many tourists use the beach, especially in front of the hotels and beach bars. Also water sports and fishing occur there. Tourists also visit the beach at night, some local tourists camp on the beach. In Yaniklar, people use the beach as a picnic site. Particularly on weekends, visitors enter the beach with cars.

Even though not all aspects can be generalized, the project is a great example of how conservation measures should be organized.

“If we don't act now to change the way we treat marine turtles and their habitat, we may lose some populations forever” (Marine Conservation Society, 2009).

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Bachelor Thesis

Caretta caretta nest and air temperature measurements at Yaniklar / Akgöl beaches, Fethiye

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Caretta caretta nest and air temperature measurements at Yaniklar / Akgöl beaches, Fethiye

Magdalena Bauer

Table of contents

KURZFASSUNG

Die Unechte Karettschildkröte (*Caretta caretta*) nistet im Mittelmeer unter anderem an der Küste der Türkei in Fethiye. Nachts schwimmen die Weibchen an den Strand, wandern diesen hoch und graben an einem für sie geeignet vorkommenden Platz eine Eikammer. Diese füllt es mit seinen Eiern, verschließt das Nest und kriecht zurück ins Meer.

2010 wurden 5 Tiny Tags im Rahmen des Schildkrötenprojektpraktikums der Universität Wien zur Messung von Nesttemperaturen eingesetzt, je eines pro Nest. Sie wurden in Yaniklar und Akgöl, zwei Stränden in Fethiye, Türkei in Nester eingegraben und blieben dort, bis die Nester nach dem Verlassen der Juvenilen geöffnet wurden. Tiny Tags sind batteriebetriebene Computerchips, die unter anderem zur Temperaturmessungen genutzt werden können. Diese Sensoren wurden so programmiert, dass sie in einem Intervall von 1 Stunde und 12 Minuten die Temperaturen im Nest aufgenommen.

Als Vergleich, und um die Pufferwirkung des Sandes aufzuzeigen, wurden die Lufttemperaturen von Yaniklar und Çalis per Thermometer gemessen und notiert, 3mal täglich, jeweils um 6:00, 12:00 und 22:00. Der Sand, bzw. auch der Schotter, der das jeweilige Nest umgibt, puffert die außen herrschenden Temperaturen ab. Trotzdem zeigen sich deutliche Korrelationen zwischen Nesttemperaturen und Außentemperatur.

Die Inkubation wird von mindestens 3 Faktoren beeinflusst: der Charakteristik des umgebenden Substrats, Wassercharakteristik des Neststandortes und der Dimensionen der Eikammer.

Die hier aufgeführten Daten zeigen die Zusammenhänge zwischen verschiedenen Faktoren auf. Die niedrigste Außentemperatur in Yaniklar wurde am 4. September mit 17,1°C bestimmt, das Maximum wurde am 22. Juli mit 50,4°C erreicht. Die Fluktuation der Nesttemperaturen, die mit den Tiny Tags gemessen wurden, variierte zwischen 0,5°C-1°C. Der Temperaturmedian der verschiedenen Nester liegt zwischen 30,5°C-33,7°C und die Inkubationszeit zwischen 47-52 Tage.

ABSTRACT

Loggerhead sea turtles (*Caretta caretta*) use beaches of the Mediterranean Sea for their nests, for example the beaches of the Turkish coast in Fethiye. The female turtles arrive at the beach, emerge from the water, climb up and start digging the egg chamber at a place they find suitable for laying eggs. After the chamber is filled with the eggs, the sea turtle closes the nest with sand and returns to the sea.

This year, 5 Tiny Tags, which are small computer-chips that can be used for temperature measurements, were deployed within the “Sea turtle Project” of the University of Vienna to determine the temperatures inside the turtle nests.
They were buried in 5 different nests at Yaniklar and Akgöl, two beaches in Fethiye, Turkey. In order to acquire the needed data, the sensors were programmed to measure the temperature every 1 hour and 12 minutes.
At Yaniklar and Çalis the air temperature was measured daily at 6 am, 12 am and 22 pm and compared with the temperatures in the nests. The surrounding substrate, i.e. sand or gravel, buffers the air temperature, but there is still a clear correlation between the temperatures outside and inside the nest.

The incubation environment is determined by a combination of at least three factors (Carthy et al. 2003): the characteristics of the sand substrate, water characteristics of the nesting site, and the dimensions of the nesting cavity.

These correlations between different factors are shown by the data in this report.
The minimum air-temperature at Yaniklar was recorded on 4 September (17.1°C). The maximum was reached on 22 July (50.4°C). The nest temperature, recorded with the Tiny Tags, fluctuated by between 0.5°C and 1°C. The median temperature of the different nests ranged between 30.5°C and 33.7°C and the incubation time from 47-52 days.

INTRODUCTION

Loggerhead sea turtles (*Caretta caretta*) are, like all other sea turtles, reptiles: their eggs are incubated by the surrounding temperature after the female has buried them in sand or gravel.
Temperature-dependent sex determination (TSD, also called environmental sex determination) among sea turtles produces females at warm temperatures and males at cooler temperatures.
The sensitive period for sex determination occurs around the middle third of incubation. (Ackerman, 1997).
The constant pivotal temperature (the constant incubation temperature that produces equal numbers of male and female hatchling sea turtles) of 28.6 °C – 29.7 °C leads to a 50% male to female ratio of hatchlings (Kaska et al., 1998). Even a change of 1 to 2 °C can make a considerable difference to the sex ratio of the hatchlings. (Mrosovsky et al., 1980).

The substrate surrounding the nest, regardless whether it is sand or gravel, dampens the air temperature and thus protects the hatchlings from strong diurnal temperature changes, ensuring their development.
If the buffering does not function properly, the hatchlings may suffer from malformation of their limbs and bodies or die before they even have a chance to leave the nest.

Not only the outside conditions have an impact on the temperature inside the nests, but there is also a variation of temperature inside, caused by so-called metabolic heat. Eggs at the top of the nest experience generally warmer (up to 1.4 °C) conditions than eggs at the bottom of the same nest.
This caused variation in sex ratio within nests (Kaska et al., 1998).

Incubation time for loggerhead turtle nests ranges from 50 to 61 days, for green turtle nests from 54 to 63 days (Kaska et al., 1998), although shorter periods are possible.

The influence of temperature on sea turtles is a key research topic, one that will only gain in importance as climate change becomes an issue.

MATERIAL AND METHODS

Air temperature

The air temperature at Yaniklar was recorded daily from 26 June until 11 September at 6 am, 12 am and 10 pm. The thermometer was placed on a wooden sun-bed at the beach, where it was exposed to the sun, at least at the noon measurements.

At the camp in Çalis, the temperature was measured in the shade from 4 July until 14 July; from this date on the measurements were taken in the sun, until 11 September, also at around 6:00, 12:00 and 22:00.
At both camps, data on wind conditions and the moon (e.g. visible or not) were noted.

Nest temperature

This research took place at the beach of Yaniklar and the beach of Akgöl in Fethiye.
Five different Tiny Tags were used in order to acquire the information about the temperature.

Tiny Tags are small battery-operated electronic devices, used to measure environmental parameters in given time intervals. They were programmed in Vienna by Christine Fellhofer to collect data every 72 minutes and to stop after 1800 measurements.
The sensor chips were placed into film capsules to protectethem against damage through hatchling movements and sand humidity. Small desiccant bags were placed inside of the capsules to protect the sensitive Tiny Tags against condensation (Fig. 1).

Figure 1: Tiny Tag (V), capsule opened
Abbildung 1: Tiny Tag (V), Filmkapsel geöffnet (photo: M. Bauer)

Data collection

Before the Tiny Tags were buried, they were briefly put into the refrigerator. This step was taken to clearly show when the measurements started.

The temperature sensor chips were buried during the morning shift, almost always into a newly laid clutch, to obtain a full dataset. In two cases, though, it wasn't possible to bury the Tiny Tag into a freshly dug nest. These two nests were: Y7 and A9.
Nest Y7 was laid by the green sea turtle *Chelonia mydas* on 08-07-2010, and the Tiny Tag was put in on 12-07-2010. The long time between nest laying and burying the Tiny Tag was caused by difficulties finding the clutch. The body pit was enormous and the eggs laid deeper than usual for *Caretta caretta*. When it was finally discovered, the Tiny Tag was buried.

The second nest, A9, was chosen because for two days no other nests had been laid. This prompted the decision to use an “old” nest.

All nest were then opened (Fig. 2), some eggs were briefly removed (Fig. 3) and the marked Tiny Tag (with number and date), was placed on top of the eggs (Fig. 4). The removed eggs were put into the nest again (Fig. 6). The depth of the Tiny Tag was recorded (Fig. 5). This helped to determine whether there are depth-specific temperature differences between the nests.

Figure 2: Opening the *Chelonia mydas* nest (Y7) to place the Tiny Tag

Abbildung 2: Öffnen des *Chelonia mydas*-Nestes (Y7) um den Tiny Tag zu platzieren (E. Rameder)

Figure 3: Removing some eggs from the nest Y7

Abbildung 3: Entnahme einiger Eier des Nests Y7 (E. Rameder)

Figure 4: Positioning of the Tiny Tag in the nest Y7

Abbildung 4: Positionierung des Tiny Tags im Nest Y7 (E. Rameder)

Figure 5: Measuring the depth of the position of the Tiny Tag

Abbildung 5: Abmessen der Tiefe, in der sich der Tiny Tag befindet (L. Sommer)

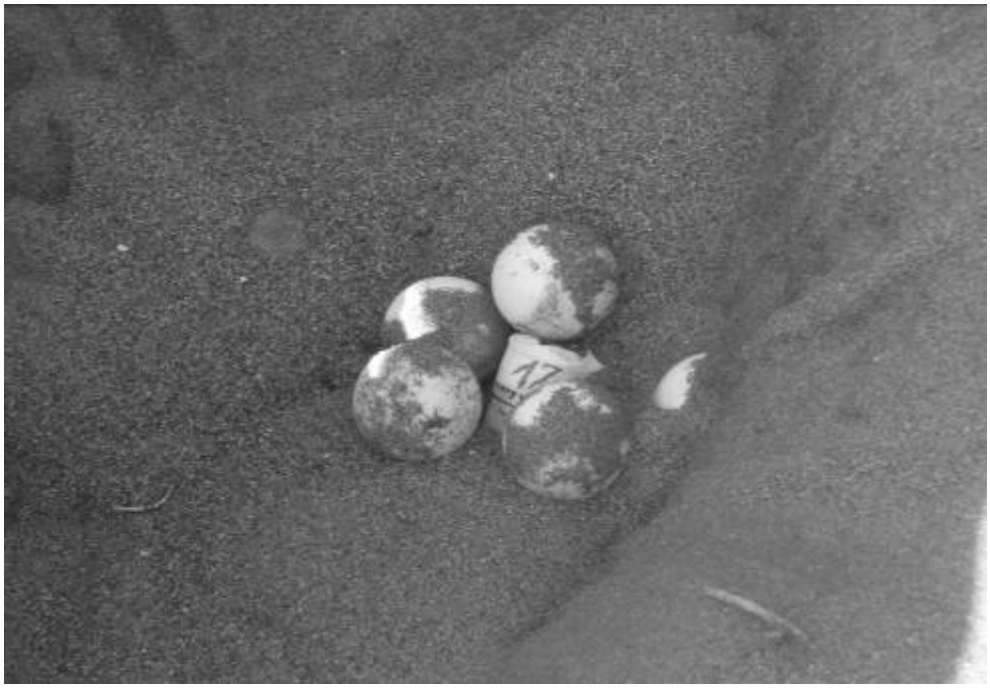

Figure 6: Removed eggs are placed in the nest again

Abbildung 6: Die herausgenommenen Eier werden zurück ins Nest gelegt (M. Bauer)

Figure 7: Closing the nest

Abbildung 7: Das Nest wird wieder verschlossen (L. Sommer)

The Tiny Tags were taken out after about 4 days after the last hatchling had left the nest. Table 1 shows the Tiny Tag specific information, indicating when the different Tiny Tags were buried in which nest, with nesting and hatching date.

Table 1: Overview of Tiny Tag information and nest data

Tabelle 1: Überblick über Tiny Tag spezifische Informationen und Nestdaten

Logger					
	Tiny Tag I	Tiny Tag II	Tiny Tag IV	Tiny Tag V	Tiny Tag VI
type	Orion Tinytalk 1	TinytalkII -40/75 (125)℃	TK-4014	TK-4014	TK-4014
property	temperature	temperature	temperature	temperature	temperature
serial number	30915	45920	382882	382879	382968
capacity	1800	1600	1800	1800	1800
title	2010TT1	2010TT2	2010TT4	2010TT5	2010TT6
interval	1 hour 12 min	1 hour 12 min	1 hour 12 min	1 hour 12 min	1 hour 12 min
total measurements in nest	1003	1201	1141	1099	978
first measurement	30.06.10	30.06.10	07.07.10	12.07.10	17.07.10
last measurement	19.08.10	29.08.10	24.08.10	05.09.10	24.09.10
temperature in nest [℃]					
minimum	29,2	27,7	28,6	29,5	28,7
maximum	35,2	33,7	32,6	32,7	32,9
average	33,7	30,9	30,5	31,5	31,2
range	6,0	6,0	4,0	3,2	4,2
nest information					
nest number	A 4	Y 10	Y 5	Y 7	A 9
nest date	29.06.10	29.06.10	06.07.10	08.07.10	15.07.10
hatch date	12.08.10	17.08.10	24.08.10	25.08.10	31.08.10
incubation time	45 days	49 days	48 days	48 days	47 days
depth of top eggs	0.32 m	0.39 m	0.32 m	0.55 m	0.26 m
total depth	0.49 m	0.58 m	0.53 m	0.66 m	0.42 m
diameter of chamber	0.19 m	0.23 m	0.22 m	0.28 m	0.20 m
distance to the sea	36.3 m	14.5 m	14.7 m	21.5 m	13.2 m
hatchling information					
total number of eggs	71	90	63	98	72
unfertilized	/	3	8 *	47 *	7
early embryo	1	3 *	5	3 + 8*	/
mid embryo	/	/	1	3	/
late embryo	18	/	/	1	2
predated eggs	/	/	/	/	/
empty egg shells	52	84	49	36	63
dead hatchlings	30	/	/	3	3
hatchlings reaching the sea	22	84	49	33	60
* insect eggs and worms					

Data evaluation

Air temperature

The data on air temperature was collected by team members, and noted on form sheets. In Vienna, the information was transferred into Excel tables.

Nest temperature - Tiny Tags

In Vienna, the data were uploaded from the Tiny Tags with Tiny Tag Explorer 4.6; the information from Tiny Tag 1 was uploaded with OTLM. Afterwards, the OTLM data were imported to Microsoft Excel, and the chart was created by Excel too.

RESULTS

Nest Temperature

Each chart (Fig. 8 – Fig. 12) shows the temperature profile measured by the respective Tiny Tag. Every chart shows a diurnal temperature change, but the temperatures are buffered by the sand, so the fluctuation between night and day never increased above 1°C. Overall, the temperature kept rising slowly, until the hatchlings leave the nest.
The minimum temperatures in the beginning of the temperature profiles are caused by putting the Tiny Tags into the refrigerator to mark the start of the measurement.

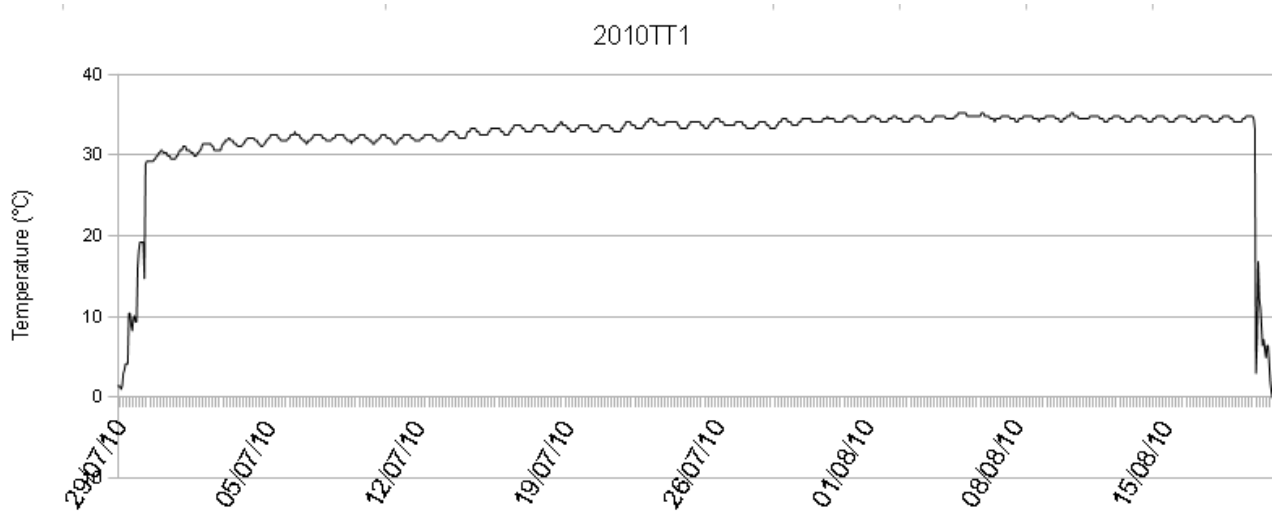

Fig. 8 : Temperature profile measured by Tiny Tag I in nest A4

Abb. 8 : Temperaturverlauf gemessen von Tiny Tag I in Nest A4

Figure 8 shows the temperature course of nest A4 / Tiny Tag I.

The Tiny Tag was in the nest from 30 June until 19 August. The temperature fluctuated between night and day by about 0.5°C - 1°C.

The minimum of temperature was reached on 30 June with 29.2°C at 12.34 pm., and the maximum (35.2°C) was reached in the morning on 5 , 7 and 11 August.

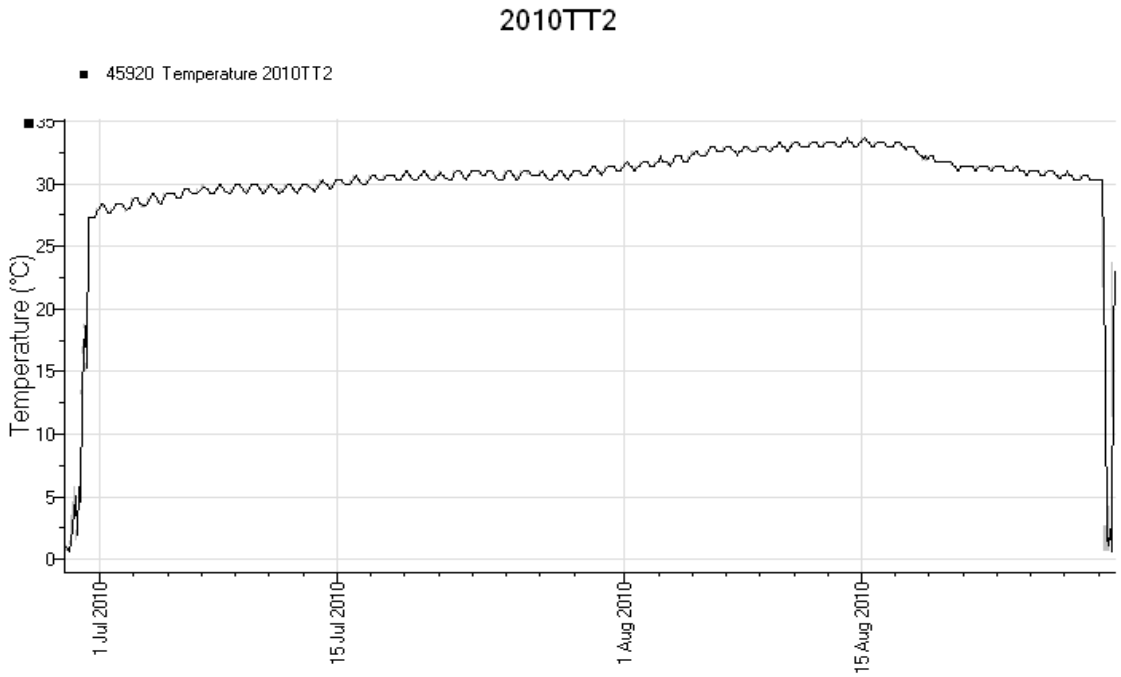

Figure 9: Temperature profile measured by Tiny Tag II in nest Y 10

Abbildung 9: Temperaturverlauf gemessen von Tiny Tag II im Nest Y 10

Figure 9 shows the temperature profile, measured by Tiny Tag II in nest Y10. The Tiny Tag was in the nest between 30 June and 29 August. The night and day fluctuation never exceeded 1°C.
The minimum temperature (27.7 °C) was reached on 1 June and 2 June, and the maximum (33.7°C) was reached on 14, 15 August, and on 5 September.

The figure shows a remarkable drop in the temperature profile between 17 and 18 August.

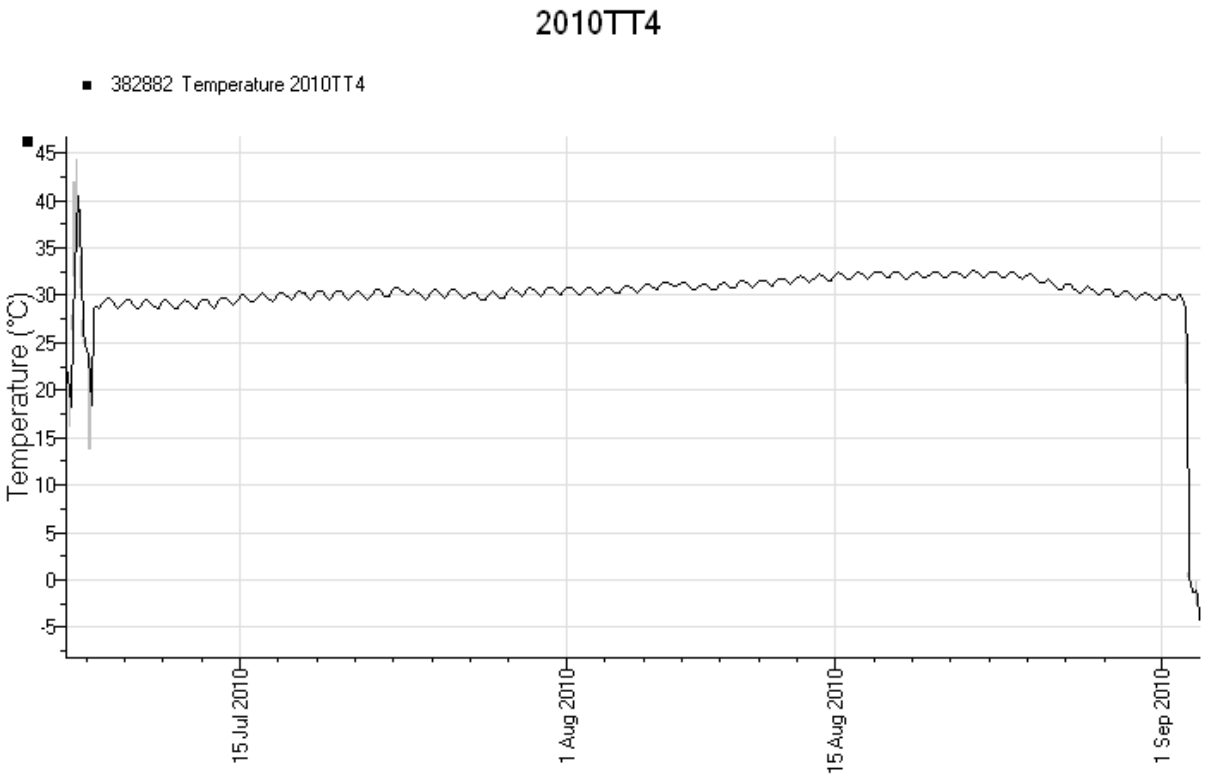

Figure 10: Temperature profile measured by Tiny Tag IV in nest Y5
Abbildung 10: Temperaturverlauf gemessen von Tiny Tag IV im Nest Y5

Figure 10 shows the temperature profile of nest Y 5 / Tiny Tag IV. This Tiny Tag was in the nest from 7 July until 2 September. The fluctuation between night and day was about 1°C.
The minimum was 28.6°C on 11 July at 3.46 pm, the maximum was reached, with 32.6°C, on 22 August at 3:46 am.

This temperature profile shows a remarkable bend between 24 and 25 August.

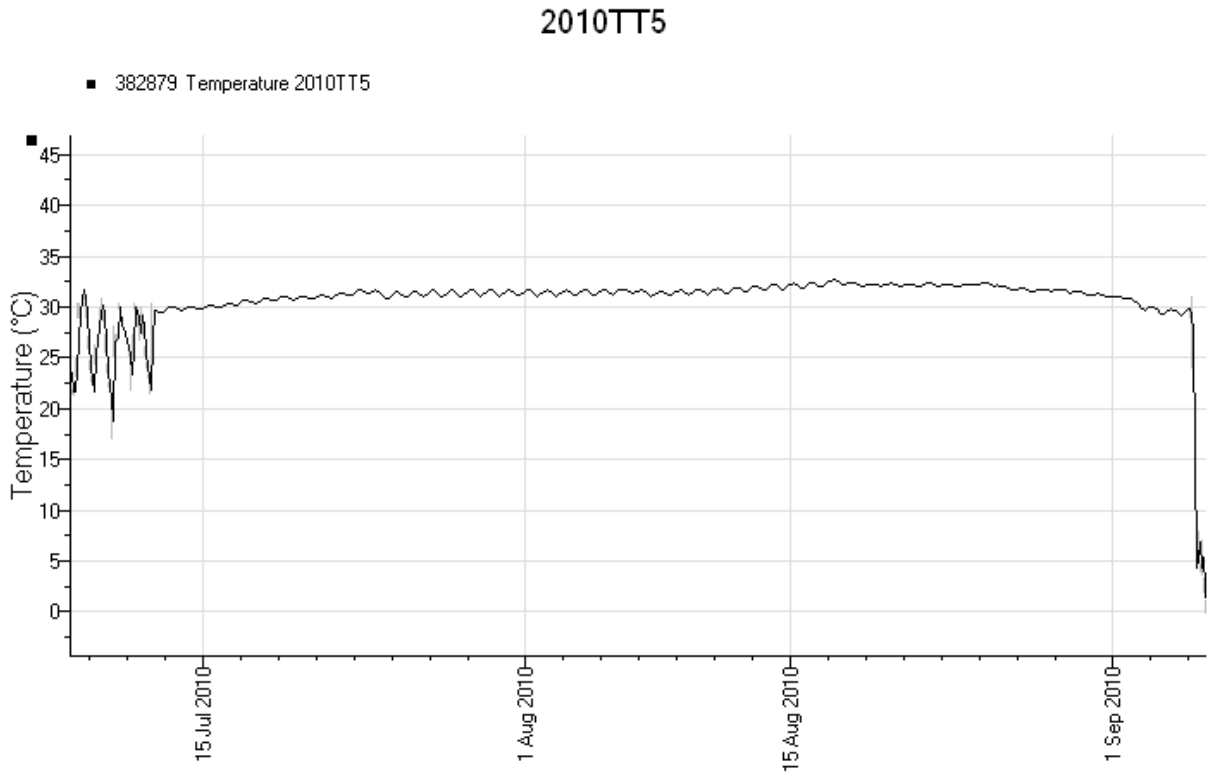

Figure 11: Temperature profile measured by Tiny Tag V in nest Y 7 [*Chelonia mydas*]

Abbildung 11: Temperaturverlauf gemessen von Tiny Tag V im Nest Y 7 [*Chelonia mydas*]

The temperature curve in Figure 11 was measured by Tiny Tag V in nest number Y 7. This Tiny Tag was in the nest from 12 July until 5 September.

The minimum was measured on the first day of measuring, at 3:48 pm. with 29.5°C. The maximum (32.7°C) was reached on 17 August at 6:12 am. The fluctuation between night and day was about 0.5°C. The fluctuation is dampened by the nest depth of 0.55 m.

This temperature profile shows a drop between 25 and 26 August.

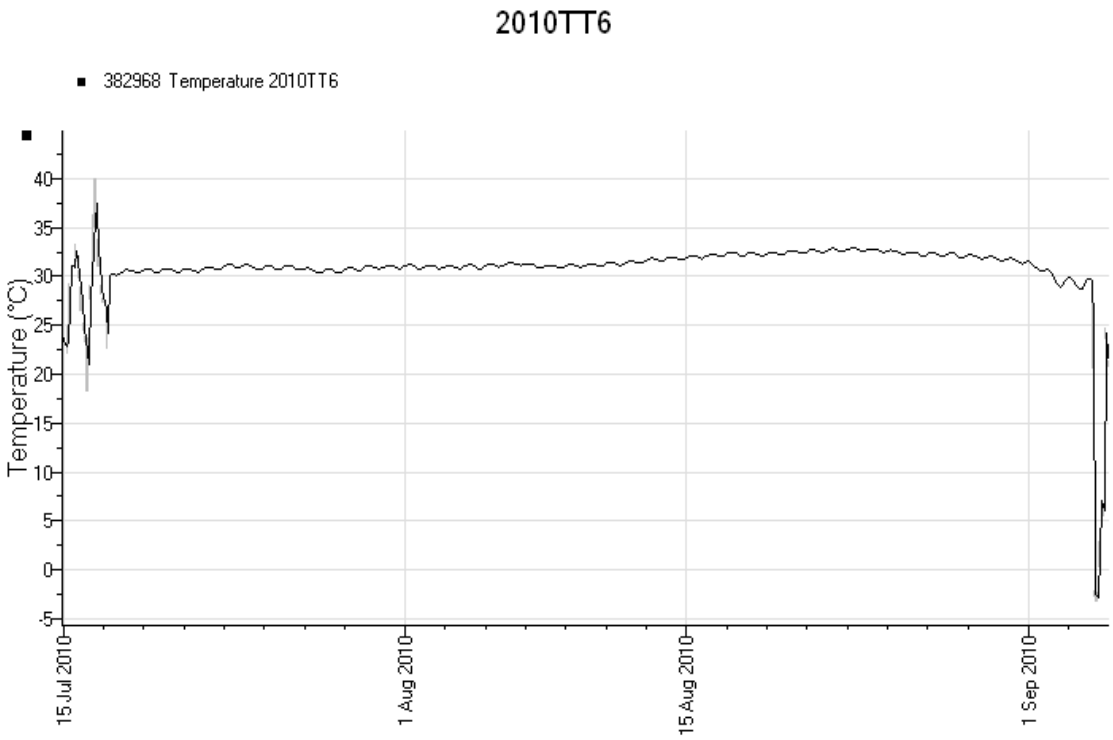

Figure 12 : Temperature profile measured by Tiny Tag VI in nest A9

Abbildung 12: Temperaturverlauf gemessen von Tiny Tag VI im Nest A9

Figure 12 shows the temperature course of Tiny Tag VI in nest A9. The nest temperature was measured between 17 July and 4 September. The night and day fluctuation was never more than 1°C.

The minimum was 28.7°C on 3 September at 1:33 pm, the maximum (32.9°C) on 23 August at 5:09 am.

Air Temperature

The temperature was measured in °C.

The wind was recorded in the categories “calm”, “light”, “heavy” and “stormy”.

Regarding the moon, the differentiation was between whether it was visible or not visible. If visible, a distinction was made between ¼, ½ , ¾, full or new moon.

Table 2 and Fig. 13 show the air temperature data of Yaniklar, Table 3 and Fig. 14 the air temperature data of Çalis.

Table 2: Air temperature of Yaniklar (n.d.: not determined)

Tabelle 2: Lufttemperatur von Yaniklar

Date	Time	Temp. [°C]	Wind	Moon
28.06.10	06:00	18,1	heavy	
28.06.10	12:00	n.d.	n.d.	
28.06.10	22:00	23,3	heavy	full
29.06.10	06:00	19,7	heavy	
29.06.10	12:00	44,2	heavy	
29.06.10	22:00	22,8	heavy	full
30.06.10	06:00	19,1	heavy	
30.06.10	12:00	38,7	light	
30.06.10	22:00	22,7	light	¾
01.07.10	06:00	18,5	calm	
01.07.10	12:00	40,0	light	
01.07.10	22:00	24,5	light	not visible
02.07.10	06:00	20,9	calm	
02.07.10	12:00	44,1	light	
02.07.10	22:00	27,1	calm	not visible
03.07.10	06:00	20,1	calm	
03.07.10	12:00	43,0	light	
03.07.10	22:00	26,6	calm	not visible
04.07.10	06:00	23,0	light	
04.07.10	12:00	45,8	light	
04.07.10	22:00	25,5	calm	not visible
05.07.10	06:00	22,3	calm	
05.07.10	12:00	47,0	light	
05.07.10	22:00	26,3	calm	not visible
06.07.10	06:00	21,2	light	
06.07.10	12:00	n.d.	n.d.	
06.07.10	22:00	26,3	calm	not visible
07.07.10	06:00	22,3	calm	
07.07.10	12:00	43,6	light	
07.07.10	22:00	25,2	calm	not visible
08.07.10	06:00	20,9	calm	
08.07.10	12:00	43,2	heavy	
08.07.10	22:00	24,3	calm	not visible
09.07.10	06:00	20,1	calm	
09.07.10	12:00	38,6	light	
09.07.10	22:00	23,6	calm	not visible
10.07.10	06:00	20,8	calm	
10.07.10	12:00	44,0	calm	
10.07.10	22:00	25,3	calm	not visible

Date	Time	Temp. [°C]	Wind	Moon
11.07.10	06:00	21,7	calm	
11.07.10	12:00	38,7	light	
11.07.10	22:00	25,1	calm	not visible
12.07.10	06:00	21,0	light	
12.07.10	12:00	43,7	calm	
12.07.10	22:00	23,9	calm	not visible
13.07.10	06:00	21,6	calm	
13.07.10	12:00	48,2	light	
13.07.10	22:00	26,6	light	not visible
14.07.10	06:00	20,9	calm	
14.07.10	12:00	46,9	light	
14.07.10	22:00	25,7	light	not visible
15.07.10	06:00	26,0	light	
15.07.10	12:00	46,7	heavy	
15.07.10	22:00	25,3	light	½
16.07.10	06:00	21,9	calm	
16.07.10	12:00	n.d.	n.d.	
16.07.10	22:00	26,9	calm	not visible
17.07.10	06:00	22,1	light	
17.07.10	12:00	45,3	light	
17.07.10	22:00	26,3	light	¼
18.07.10	06:00	21,3	calm	
18.07.10	12:00	n.d.	n.d.	
18.07.10	22:00	n.d.	n.d.	
19.07.10	06:00	21,7	calm	
19.07.10	12:00	46,9	heavy	
19.07.10	22:00	25,8	calm	½
20.07.10	06:00	20,9	calm	
20.07.10	12:00	45,7	light	
20.07.10	22:00	27,6	light	½
21.07.10	06:00	21,0	calm	
21.07.10	12:00	42,4	light	
21.07.10	22:00	27,6	calm	¾
22.07.10	06:00	21,8	calm	
22.07.10	12:00	50,4	light	
22.07.10	22:00	28,0	calm	¾
23.07.10	06:00	21,9	calm	
23.07.10	12:00	43,2	light	
23.07.10	22:00	25,6	light	¾

Table 2: Air temperature of Yaniklar (n.d.: not determined)

Tabelle 2: Lufttemperatur von Yaniklar

Date	Time	Temp. [°C]	Wind	Moon
24.07.10	06:00	20,4	calm	
24.07.10	12:00	49,3	light	
24.07.10	22:00	28,4	light	full
25.07.10	06:00	21,1	n.d.	
25.07.10	12:00	48,8	n.d.	
25.07.10	22:00	25,0	n.d.	not visible
26.07.10	06:00	n.d.	n.d.	
26.07.10	12:00	39,5	stormy	
26.07.10	22:00	n.d.	n.d.	not visible
27.07.10	06:00	21,4	heavy	
27.07.10	12:00	n.d.	n.d.	
27.07.10	22:00	27,5	light	full
28.07.10	06:00	21,9	light	
28.07.10	12:00	45,5	n.d.	
28.07.10	22:00	n.d.	n.d.	n.d.
29.07.10	06:00	21,2	calm	
29.07.10	12:00	45,5	n.d.	
29.07.10	22:00	n.d.	n.d.	n.d.
30.07.10	06:00	23,0	calm	
30.07.10	12:00	45,2	light	
30.07.10	22:00	25,6	calm	n.d.
31.07.10	06:00	23,6	light	
31.07.10	12:00	n.d.	n.d.	
31.07.10	22:00	25,4	calm	not visible
01.08.10	06:00	20,7	calm	
01.08.10	12:00	49,5	light	
01.08.10	22:00	26,5	light	not visible
02.08.10	06:00	20,9	light	
02.08.10	12:00	n.d.	n.d.	
02.08.10	22:00	26,6	calm	n.d.
03.08.10	06:00	22,1	calm	
03.08.10	12:00	47,4	light	
03.08.10	22:00	25,9	n.d.	n.d.
04.08.10	06:00	n.d.	n.d.	
04.08.10	12:00	47,6	light	
04.08.10	22:00	26,0	calm	not visible
05.08.10	06:00	23,2	light	
05.08.10	12:00	42,6	light	
05.08.10	22:00	26,5	calm	n.d.

Date	Time	Temp. [°C]	Wind	Moon
06.08.10	06:00	26,0	light	
06.08.10	12:00	37,9	heavy	
06.08.10	22:00	n.d.	n.d.	n.d.
07.08.10	06:00	22,6	calm	
07.08.10	12:00	48,7	light	
07.08.10	22:00	27,4	calm	not visible
08.08.10	06:00	23,8	calm	
08.08.10	12:00	n.d.	n.d.	
08.08.10	22:00	27,3	calm	not visible
09.08.10	06:00	23,3	light	
09.08.10	12:00	47,1	light	
09.08.10	22:00	27,0	calm	not visible
10.08.10	06:00	21,8	calm	
10.08.10	12:00	47,9	calm	
10.08.10	22:00	n.d.	n.d.	n.d.
11.08.10	06:00	21,3	calm	
11.08.10	12:00	45,7	light	
11.08.10	22:00	26,9	calm	not visible
12.08.10	06:00	22,6	calm	
12.08.10	12:00	46,3	light	
12.08.10	22:00	26,4	calm	not visible
13.08.10	06:00	22,8	calm	
13.08.10	12:00	47,8	light	
13.08.10	22:00	26,7	calm	not visible
14.08.10	06:00	21,3	calm	
14.08.10	12:00	46,5	light	
14.08.10	22:00	25,6	calm	¼
15.08.10	06:00	20,3	calm	
15.08.10	12:00	46,9	light	
15.08.10	22:00	27,7	calm	½
16.08.10	06:00	23,9	calm	
16.08.10	12:00			
16.08.10	22:00	27,2	calm	½
17.08.10	06:00	19,9	calm	
17.08.10	12:00	47,8	light	
17.08.10	22:00	25,1	calm	½
18.08.10	06:00	21,2	calm	
18.08.10	12:00	51,3	light	
18.08.10	22:00	28,8	calm	¾

Table 2: Air temperature of Yaniklar (n.d.: not determined)

Tabelle 2: Lufttemperatur von Yaniklar

Date	Time	Temp. [°C]	Wind	Moon
19.08.10	06:00	23,0	calm	
19.08.10	12:00	43,7	light	
19.08.10	22:00	26,2	calm	¾
20.08.10	06:00	21,7	calm	
20.08.10	12:00	43,9	light	
20.08.10	22:00	n.d.	n.d.	n.d.
21.08.10	06:00	23,6	calm	
21.08.10	12:00	45,1	light	
21.08.10	22:00	27,4	calm	¾
22.08.10	06:00	22,6	calm	
22.08.10	12:00	45,4	light	
22.08.10	22:00	26,6	calm	full
23.08.10	06:00	21,2	calm	
23.08.10	12:00	45,9	light	
23.08.10	22:00	27,1	calm	full
24.08.10	06:00	21,8	calm	
24.08.10	12:00	42,3	heavy	
24.08.10	22:00	25,2	calm	full
25.08.10	06:00	21,4	calm	
25.08.10	12:00	47,1	light	
25.08.10	22:00	26,9	light	full
26.08.10	06:00	19,6	calm	
26.08.10	12:00	48,8	light	
26.08.10	22:00	25,1	calm	full
27.08.10	06:00	18,2	calm	
27.08.10	12:00	48,1	light	
27.08.10	22:00	n.d.	calm	full
28.08.10	06:00	18,6	calm	
28.08.10	12:00	41,1	light	
28.08.10	22:00	24,8	calm	¾
29.08.10	06:00	18,4	calm	
29.08.10	12:00	38,4	light	
29.08.10	22:00	23,5	calm	¾
30.08.10	06:00	18,4	calm	
30.08.10	12:00	43,6	light	
30.08.10	22:00	24,3	calm	¾
31.08.10	06:00	19,6	calm	
31.08.10	12:00	45,4	light	
31.08.10	22:00	23,1	calm	not visible

Date	Time	Temp. [°C]	Wind	Moon
01.09.10	06:00	22,1	calm	
01.09.10	12:00	46,3	light	
01.09.10	22:00	21,5	calm	not visible
02.09.10	06:00	16,9	calm	
02.09.10	12:00	43,7	light	
02.09.10	22:00	21,5	calm	not visible
03.09.10	06:00	17,3	calm	
03.09.10	12:00	46,1	light	
03.09.10	22:00	22,1	calm	¼
04.09.10	06:00	17,1	calm	
04.09.10	12:00	43,5	light	
04.09.10	22:00	21,9	calm	not visible
05.09.10	06:00	18,1	calm	
05.09.10	12:00	47,1	heavy	
05.09.10	22:00	27,8	calm	not visible
06.09.10	06:00	20,0	calm	
06.09.10	12:00	45,6	light	
06.09.10	22:00	23,6	calm	new
07.09.10	06:00	24,1	calm	
07.09.10	12:00	40,8	heavy	
07.09.10	22:00	22,6	calm	new
08.09.10	06:00	17,4	calm	
08.09.10	12:00	43,6	light	
08.09.10	22:00	24,7	calm	new
09.09.10	06:00	20,4	calm	
09.09.10	12:00	43,9	light	
09.09.10	22:00	23,2	calm	not visible
10.09.10	06:00	18,5	calm	
10.09.10	12:00	43,7	light	
10.09.10	22:00	n.d.	n.d.	n.d.
11.09.10	06:00	23,7	calm	not visible

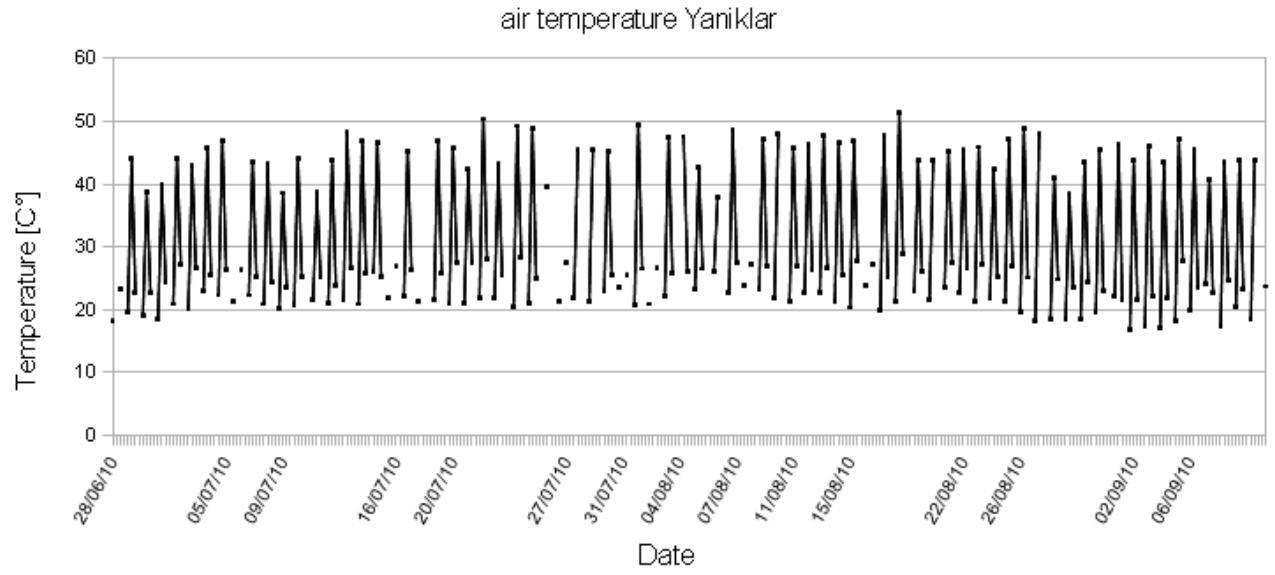

Figure 13: Air temperature at Yaniklar

Abbildung 13: Lufttemperatur von Yaniklar

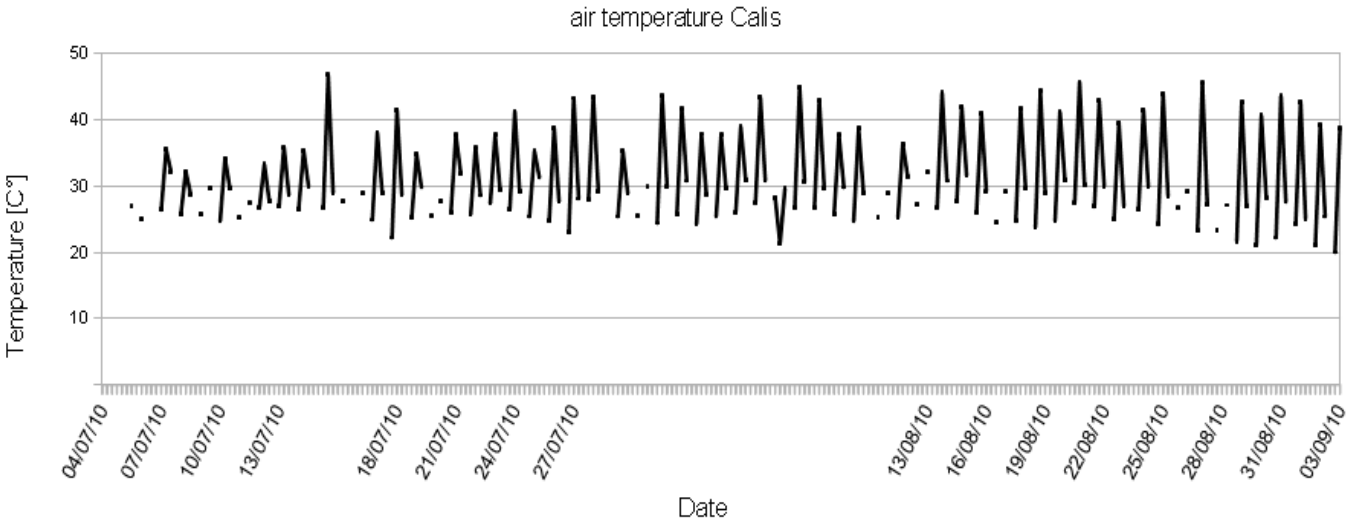

Figure 14: Air temperature at Çalis

Abbildung 14: Lufttemperatur von Çalis

Table 3: Air temperature at Çalis (n.d.: not determined)

Tabelle 3: Lufttemperatur von Çalis

Date	Time	Temp. [°C]	Wind	Moon
Shadow Measurements				
04.07.10	06:10	25 – 27	n.d.	
04.07.10	12:00	n.d.	n.d.	
04.07.10	22:00	n.d.	n.d.	n.d.
05.07.10	06:00	n.d.	n.d.	
05.07.10	12:00	n.d.	n.d.	
05.07.10	22:09	27,0	n.d.	not visible
06.07.10	06:19	25,0	n.d.	
06.07.10	12:00	n.d.	n.d.	
06.07.10	22:00	n.d.	n.d.	n.d.
07.07.10	06:15	26,4	calm	
07.07.10	12:30	35,5	slightly windy	
07.07.10	22:00	32,2	soft breeze	not visible
08.07.10	06:12	25,8	calm	
08.07.10	12:00	32,2	WINDY	
08.07.10	22:13	28,8	calm	not visible
09.07.10	06:16	25,8	soft breeze	
09.07.10	12:00	n.d.	n.d.	
09.07.10	22:11	29,7	calm	not visible
10.07.10	06:02	24,7	calm	
10.07.10	12:40	34,2	soft breeze	
10.07.10	22:10	29,6	calm	not visible
11.07.10	06:15	25,2	calm	
11.07.10	12:00	n.d.	n.d.	
11.07.10	22:10	27,5	calm	not visible
12.07.10	06:08	26,8	calm	
12.07.10	12:00	33,3	light	
12.07.10	22:15	27,8	light	not visible
13.07.10	06:10	27,0	calm	
13.07.10	12:05	35,9	calm	
13.07.10	22:12	28,7	light	not visible
14.07.10	06:09	26,6	calm	
14.07.10	12:00	35,4	light	
14.07.10	22:15	30,0	calm	not visible
Sun Measurements				
15.07.10	06:15	26,7	light	
15.07.10	12:10	46,8	light	
15.07.10	21:55	29,0	calm	< ¼
16.07.10	06:00	27,7	calm	

Date	Time	Temp. [°C]	Wind	Moon
16.07.10	12:00	n.d.	n.d.	
16.07.10	22:06	28,9	light	¼
17.07.10	06:51	24,9	calm	
17.07.10	12:16	38,1	light	
17.07.10	22:10	29,0	calm	> ¼
18.07.10	06:10	22,2	calm	
18.07.10	11:50	41,5	light	
18.07.10	22:15	28,7	calm	½
19.07.10	06:15	25,2	calm	
19.07.10	12:05	34,8	light	
19.07.10	22:11	29,8	calm	½
20.07.10	06:05	25,6	calm	
20.07.10	12:00	n.d.	n.d.	
20.07.10	21:58	27,8	calm	> ½
21.07.10	06:05	26,1	calm	
21.07.10	12:00	37,7	light	
21.07.10	n.d	31,9	light	¾
22.07.10	06:06	25,7	calm	
22.07.10	12:10	35,8	calm	
22.07.10	22:23	28,6	calm	¾
23.07.10	06:10	27,4	calm	
23.07.10	12:10	37,7	light	
23.07.10	22:04	29,5	calm	¾
24.07.10	06:00	26,5	calm	
24.07.10	12:15	41,3	light	
24.07.10	22:05	29,1	calm	~full
25.07.10	06:15	25,4	calm	
25.07.10	12:20	35,3	light	
25.07.10	22:25	31,3	calm	full
26.07.10	06:10	24,8	calm	
26.07.10	12:30	38,8	light	
26.07.10	22:20	27,7	light	½
27.07.10	06:10	23,0	calm	
27.07.10	12:00	43,3	light	
27.07.10	22:15	28,1	calm	full
28.07.10	07:40	28,0	calm	
28.07.10	12:45	43,5	calm	
28.07.10	22:30	29,3	calm	¾

Table 3: Air temperature at Çalis (n.d.: not determined)

Tabelle 3: Lufttemperatur von Çalis

Date	Time	Temp. [°C]	Wind	Moon
29.07.10	06:14	25,4	calm	
29.07.10	12:00	35,3	n.d.	
29.07.10	22:10	28,9	calm	¾
30.07.10	06:07	25,5	calm	
30.07.10	12:00	n.d.	n.d.	
30.07.10	22:12	29,9	calm	not visible
31.07.10	06:10	24,4	calm	
31.07.10	12:23	43,6	light	
31.07.10	22:10	30,0	calm	not visible
01.08.10	06:25	25,8	calm	
01.08.10	12:10	41,7	light	
01.08.10	22:10	30,8	calm	not visible
02.08.10	06:13	24,3	calm	
02.08.10	12:15	37,9	light	
02.08.10	22:31	28,8	calm	not visible
03.08.10	06:15	25,4	calm	
03.08.10	12:30	37,7	light	
03.08.10	22:10	29,7	calm	not visible
04.08.10	06:10	26,1	calm	
04.08.10	12:02	39,0	light	
04.08.10	22:10	31,0	calm	not visible
05.08.10	06:28	27,4	calm	
05.08.10	12:35	43,4	light	
05.08.10	22:40	30,8	calm	not visible
06.08.10	06:25	28,3	light	
06.08.10	12:30	21,4	light	
06.08.10	22:10	29,6	calm	not visible
07.08.10	06:14	26,8	calm	
07.08.10	12:48	45,0	light	
07.08.10	22:10	30,7	calm	not visible
08.08.10	06:40	26,7	calm	
08.08.10	11:30	43,0	light	
08.08.10	22:17	29,6	calm	not visible
09.08.10	06:13	25,7	calm	
09.08.10	12:00	37,7	light	
09.08.10	22:11	29,8	calm	not visible
10.08.10	06:25	24,7	calm	
10.08.10	13:00	38,7	light	
10.08.10	22:15	28,9	calm	not visible

Date	Time	Temp. [°C]	Wind	Moon
11.08.10	06:15	25,3	calm	
11.08.10	12:00	n.d.	n.d.	
11.08.10	22:35	28,9	light	not visible
12.08.10	06:18	25,3	calm	
12.08.10	12:00	36,4	light	
12.08.10	22:10	31,4	calm	not visible
13.08.10	06:25	27,3	calm	
13.08.10	12:00	n.d.	n.d.	
13.08.10	22:18	32,1	calm	not visible
14.08.10	06:26	26,8	calm	
14.08.10	12:35	44,1	calm	
14.08.10	22:20	30,8	calm	not visible
15.08.10	06:15	27,8	calm	
15.08.10	12:05	42,0	calm	
15.08.10	22:26	31,6	calm	visible
16.08.10	06:23	26,0	calm	
16.08.10	12:00	41,0	light	
16.08.10	21:55	29,3	calm	½
17.08.10	07:13	24,5	calm	
17.08.10	12:00	n.d.	n.d.	
17.08.10	22:15	29,1	calm	½
18.08.10	06:27	24,7	calm	
18.08.10	12:50	41,8	light	
18.08.10	22:13	29,7	light	½
19.08.10	06:15	23,8	calm	
19.08.10	12:00	44,4	light	
19.08.10	22:26	29,0	calm	¾
20.08.10	06:26	24,8	calm	
20.08.10	13:30	41,2	light	
20.08.10	22:25	30,9	calm	¾
21.08.10	07:30	27,5	calm	
21.08.10	12:31	45,7	light	
21.08.10	04:48	30,2	calm	¾
22.08.10	06:35	26,9	calm	
22.08.10	11:45	42,9	calm	
22.08.10	22:28	30,0	calm	10 Elftel
23.08.10	07:00	25,0	calm	
23.08.10	12:45	39,6	light	
23.08.10	07:12	27,0	calm	11 Zwölftel

Table 3: Air temperature at Çalis (n.d.: not determined)

Tabelle 3: Lufttemperatur von Çalis

Date	Time	Temp. [℃]	Wind	Moon
24.08.10	06:30	26,5	calm	
24.08.10	13:00	41,5	light	
24.08.10	23:30	29,9	calm	full
25.08.10	07:35	24,2	calm	
25.08.10	12:40	44,0	light – heavy	
25.08.10	23:00	28,5	calm	full
26.08.10	06:25	26,7	calm	
26.08.10	excursion			
26.08.10	22:00	29,3	calm	~full
27.08.10	06:24	23,4	calm	
27.08.10	12:15	45,6	calm	
27.08.10	22:31	27,2	calm	full - ¾
28.08.10	06:15	23,4	calm	¾
28.08.10	12:00	n.d.	n.d.	
28.08.10	22:30	27,1	calm	¾
29.08.10	06:19	21,7	calm	
29.08.10	12:17	42,6	light	
29.08.10	22:45	27,0	calm	not visible
30.08.10	06:21	21,1	calm	
30.08.10	12:30	40,7	calm	
30.08.10	21:34	28,3	calm	not visible
31.08.10	06:25	22,2	calm	
31.08.10	12:15	43,6	calm – light	
31.08.10	22:00	27,6	calm	
01.09.10	06:22	24,3	calm	
01.09.10	12:16	42,7	light – heavy	visible
01.09.10	22:00	25,1	calm	not visible
02.09.10	06:30	21,1	calm	
02.09.10	13:30	39,2	calm	
02.09.10	22:41	25,4	calm	not visible
03.09.10	06:24	20,0	calm	
03.09.10	13:00	38,7	light	
03.09.10	22:00	n.d.	n.d.	n.d.

DISCUSSION

Nest temperature

Sea turtle nests have their own micro-climate. Although the air temperature changes considerably over the course of the day, the temperature inside the nest stays almost the same.
Temperature differences within and between nests can be explained by nest depth, the amount of sand between the surface and the nest, the distance to the sea (because of the water and its cooling effect) the number of eggs in the nest (metabolic heat) and the substrate type.
Rainfall did not play an important role in the data of this year because it only drizzled twice.
Tiny Tags 2, 4 and 5 recorded clear drops in the temperature curve (Tiny Tag 2/Y10- 17.-18.8, Tiny Tag 4/Y5- 24.-25.8., Tiny Tag 5/Y7- 25.-26.8.). These changes result from the hatchlings that left the nest and disturbed its micro-climate. The hatch dates correlate with the dates of the drops.

Even if outside the nest the air temperature changed by up to 20°C, inside the nest the temperature changed over the whole incubation time by about only 3 degrees.
In the nests, the maximum is reached in the morning and the evening,
Figure 15 shows the comparison between air temperature in Yaniklar and nest temperatures.

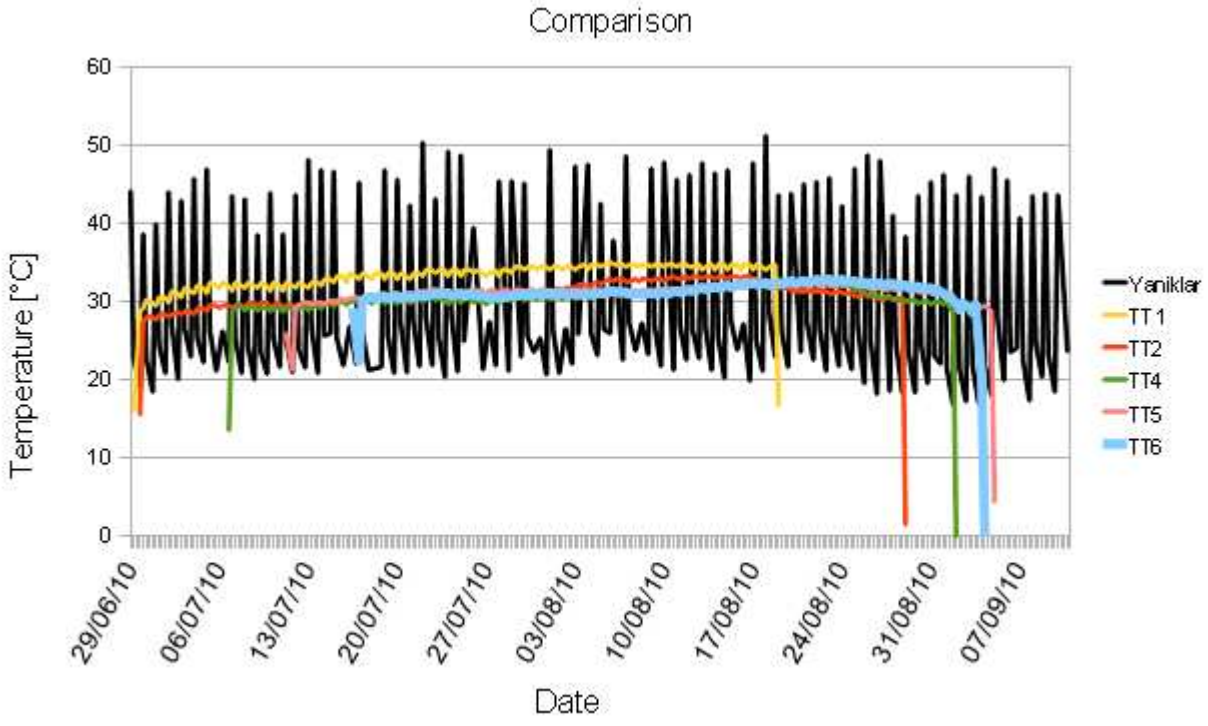

Figure 15: Comparison between Yaniklar air temperature and nest temperatures
Abbildung 15: Vergleich der Yaniklar Lufttemperaturen und der Nesttemperaturen

No clear correlation between the incubation time and the incubation temperature is visible in Fig. 15. The depth of the egg chamber and the substrate have an impact on the incubation time.

Typically, incubation period (I, days) decreases as incubation temperatures (T, °C) increases. (Ackerman, 1997). As shown in Fig. 16 below, this also held true for the data collected this year. Table 4 shows the data related to the chart.

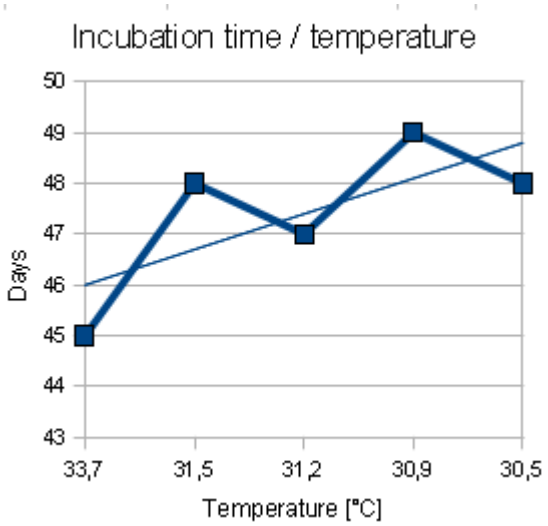

Table 4: Incubation days and temperature median
Tabelle 4: Inkubationstage und Temperaturmedian

logger	temp. median [℃]	days
TT1	33,7	45
TT5	31,5	48
TT6	31,2	47
TT2	30,9	49
TT4	30,5	48

Figure 16: Incubation temperature influence on incubation time
Abbildung 16: Inkubationstemperatur – Einfluss auf Inkubationsdauer

Air temperature

The data from Çalis are problematic because the data collection was not standardized.

The first problem was that there was no standardized place where the measurements were taken. It was unclear whether the thermometer was to be placed in the sun or in the shade.
The second problem was that the surface on which the thermometer was placed differed from measurement to measurement, ranging from grass, sand, to asphalt.
The sensor of the thermometer was positioned on one side of the thermometer. The third problem therefore was that the direction in which the temperature sensor pointed wasn't standardized and the temperature changed when the direction was changed.

Comparing the data of Çalis and Yaniklar (Fig. 17) revealed that the temperatures between sites differ per day by about 5°C. The maximum temperature difference of 16.5°C between Yaniklar and Çalis was reached on 6 August (Yaniklar 37.9°C; Çalis 21.4°C)

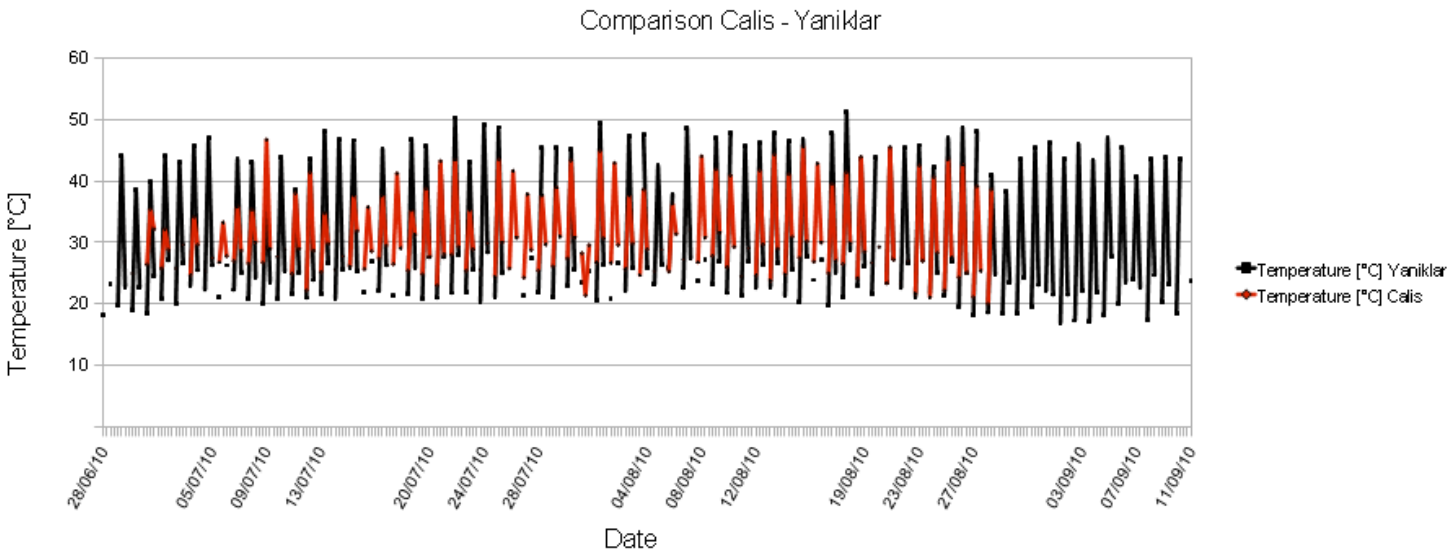

Figure 17: Air temperature comparison Yaniklar -Çalis

Abbildung 17: Lufttemperatur - Vergleich Yaniklar-Çalis

The data show that the air temperature at Çalis fluctuated less than in Yaniklar. Çalis is warmer in the morning and the evening than Yaniklar, and changes less during the day time (about 10-20°C); Yaniklar is considerably hotter (by about 20-30°C) at midday than at 6 am and 10 pm.

Impact of Tiny Tags on breeding success

Table 5 shows the incubation time, the different egg numbers, empty egg shells and the hatchlings reaching the sea. It also shows the depth of the nest and the distance to the sea.

Many factors determine the breeding success of each nest, but there are no recognisable differences between the nests with or without Tiny Tag. This leads to the conclusion that the use of Tiny Tags in sea turtle nests do not endanger the hatchlings.

Table 5: Nest information

Tabelle 5: Nest Informationen

TinyTag	Nest	Incubation time	Total number of eggs	Empty shells	Hatchlings reaching the sea	Distance to sea	Nest depth	sediment type
I	A 4	52 days	71	52	22	35,30 m	0,32 m	sand
II	Y 10	49 days	90	84	84	18,10 m	0,39 m	gravel
IV	Y 5	48 days	63	49	49	17,40 m	0,4 m	gravel
V	Y 7	48 days	98	36	33	23,20 m	0,6 m	sand
VI	A 9	47 days	72	63	60	15,50 m	0,45 m	sand

Chelonia mydas

According to the collected data, the temperature in the *Chelonia mydas* nest, Y 7, was the most stable measured in the year 2010. The reasons for this might be the depth of the nest. At 0.60 m it was the deepest of the “Tiny Tag nests”. It was 0.15 m deeper than the deepest *Caretta caretta* nest. As shown in the chapter “Results”, the temperature difference during the incubation was always around 0.5°C, whereas the nest temperature in the *Caretta caretta* nests varied by about 1°C.
The breeding success was not very high: only 33 hatchlings reached the sea (from a total of 98 eggs layed in this nest).

These data are recorded to better understand the different factors influencing the eggs and the hatching success of *Caretta caretta*. The results here show that the temperature has a direct effect on the breeding success. The depth of the nests also plays an important role.

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……..2010 Observer:……..

ADULT/NEST/TRACK

Date:……. Time:……..	Nest Nr.:……..	Track Nr.: ……..

Tag Nr.: L R

Straight measurements:

SCL ……. SCW …….

Curved measurements:

CCL ……. CCW …….

Number of carapace scutes:

N: V: SP: .

C_L: C_R: .

M_L: $M_{R:}$.

Epibionts ……..

Deformations……..

Shape of track

dry zone(1)

moist zone(2)

wet zone(3)

Total track length:……..

Track width:……

Nr. of body pits: …….

Nest Dist. to sea: ……..

Beach zones

1:……m (dry)

2:...……....m (moist)

3:……m (wet)

Hatchery

Yes No

Exact position of the nest:

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

.....2010
HATCHING-DATA

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

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

Other observations and remarks:

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

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

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

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

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

Insects ets. in nest:

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Andreas Schmidt once again designed, produced and sponsored our set of sea turtle postcards.

In Fethiye, a series of hotels and restaurants in Calis/Fethiye provided us with dinners every evening: Rebin Beach, Letoon Otel, Golden Moon Otel, Mutlu Otel, Delta Otel, Pelin Otel, Calis Beach, Hotel Remer, Aymes Otel, Area Otel, Cenk Bey, Merhaba Restaurant & Orient Restaurant. Thank you for the delicious meals!

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