Bachelor Thesis

Vehicles on a Turkish nesting beach for loggerhead sea turtles

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KURZFASSUNG

Fethiye ist einer von 17 Niststränden für die bedrohte Unechte Karettschildkröte (*Caretta caretta*) in der Türkei. Der Strand ist unterteilt in drei Bereiche: Calis, Yaniklar und Akgöl. Akgöl ist ein wichtiger Strandabschnitt auf dem jedes Jahr viele Nester gelegt werden. Auch wenn Tourismus hier nicht dieselben Probleme verursacht wie in Calis, gibt es einen negativen anthropogenen Einfluss. Akgöl wird vor allem von Türken besucht die mit ihrem Auto anreisen. Fahrzeuge werden jedoch nicht nur als Transportmittel benutzt sondern oft fahren die Leute mit ihrem Auto, trotz Parkplätze vor dem Strand, auf den Strand und stellen ihr Auto dort ab was eine Bedrohung für die Unechte Karettschildkröte darstellt. Das Überfahren von nistenden Schildkröten und Jungtieren, das Abbrechen des Nistvorgangs und das zerstören von Nestern sind nur einige wenige Beispiele für die Auswirkungen von Autos an Niststränden. In unserer Studie versuchten wir herauszufinden wie groß der menschliche Einfluss auf die Meeresschildkröten von Akgöl ist. Wir stellten fest, dass sich in einer Woche vor Beginn Ramadans 196 Fahrzeuge, während sich in einer Woche während Ramadan 169 Fahrzeuge unmittelbar vor bzw. am Strand aufhielten. Wir schätzen die Zahl der Menschen die sich in einer Woche am Strand aufhielten auf 498 vor Beginn Ramadans und 284 während Ramadan. Des Weiteren versuchten wir festzustellen ob ein Zusammenhang besteht zwischen den Gebieten in denen sich die Nester befanden und den Gebieten in denen viele Autos sich aufhielten. Es schien, dass die adulten Tiere viel befahrene Gebiete mieden und die Nester in Gebiete legten in denen kaum oder gar keine Autos gesichtet wurden. Um zu verhindern dass die Fahrzeuge den Jungtieren am Strand schaden wurden Barrieren errichtet und untersucht wie wirksam sie sind.

ABSTRACT

Fethiye beach is one of 17 nesting beaches of the endangered loggerhead sea turtle (*Caretta caretta*) in Turkey. The nesting beaches are divided in three parts called Calis, Yaniklar and Akgöl. Akgöl is a very important part with a large number of nests each year. Although tourism does not play the same crucial role as it does in Calis, there is still an anthropogenic impact. Akgöl is visited mostly by Turkish people who arrive by car. Although there are parking areas in front of the beach, people drive on the beach and park their cars there. This can cause many problems for sea turtles. Running over nesting females, hatchlings, aborting nesting attempts, disorientating hatchlings, altering the development of the unborn embryos

and crushing nests are only a few examples. We attempted to determine the impact of human activity on the loggerhead sea turtles on Akgöl. We counted 196 vehicles in one week before Ramadan and 169 vehicles in one week during Ramadan. The number of people using the beach was estimated to be 498 people in one week before Ramadan and 284 people in one week during Ramadan. We tried to determine if vehicles on the beach have an influence on the choice of the nesting site of adult sea turtles. Adult see turtles seem to avoid frequented areas and were nesting in areas where we did not document any vehicles. To reduce the impact of cars on the hatchlings, we built barriers to prevent cars from driving on the beach and tested if they work efficiently.

INTRODUCTION

Of the seven existing sea turtle species, three are known to occur in the Mediterranean: the loggerhead sea turtle (*Caretta caretta*), the Green turtle (*Chelonia mydas*) and the leatherback sea turtle (*Dermochelys coriacea*). Of these three species the loggerhead sea turtle is the most common in the Mediterranean (Margaritoulis et al., 2003). Nonetheless, the loggerhead sea turtle is listed as an endangered species on the Red List of the IUCN.

Loggerhead sea turtles face several anthropogenic threats in the Mediterranean, which can be classified into two main threats: fishery and threats on the nesting beaches. Examples for the second category would be beach armouring, tourism, artificial lights and vehicles on the beach.

Our study focuses on threats caused by vehicles and people on the beach. There are many threats caused by cars including running over nesting females, hatchlings, stranded turtles that have washed ashore, disturbing nesting females, aborting nesting attempts, and disorientating hatchlings (National Marine Fisheries Service and U.S. Fish and Wildlife Service, 2008).

Driving vehicles on the beach compact the sand, which can decrease hatchling success and kill hatchlings within the nests (Mann, 1977). The severity of the impacts depends on the weight of the vehicle and the phase of the incubation during which this disturbance occurs (Arianoutsou, 1988).

Vehicle tracks on the beach can hinder hatchlings from reaching the sea. Studies showed that hatchlings were unable to crawl out of tracks deeper than 10 cm. If the tracks were less deep it took hatchlings longer than normal to reach the sea. This causes increased energy expenditure, more time on the beach and therefore a higher probability to fall victim to predation,

desiccation or get crushed by cars driving on the beach. Tracks 10-15 cm deep are common on beaches with loose, coarse-grained sand (Lamont, 2002).

Another problem is lights of cars and flashlights of people on the beach. Adult sea turtles avoid lighted areas, which can result in lower nesting activity on the beach (Witherington, 1992). False crawls, which mean a nest was started but no eggs were laid, are more likely to occur on beaches used by vehicles (Nester, 2006). In addition, those lights can lead to disorientation and misdirection of sea turtle hatchlings. Sea turtle hatchlings orient themselves to the brightest point on the horizon. Artificial lightning, for example car lights, can misdirect them, which can lead to the death of sea turtle hatchlings due to exhaustion, predation or desiccation (Witherington & Martin, 2003).

In our study we tried determine the effects of cars on loggerhead sea turtles on a nesting beach in Turkey. We therefore measured the number and position of parking cars, car tracks and sea turtle nests. We tried to determine if cars on the beach may influence the choice of the nesting site of adult sea turtles. It was also documented what kind of people were on the beach and what effects they may have on sea turtles and sea turtle nests. A barrier was built to prevent cars from driving on the beach. We noted if people accepted the barrier by recording if people passed the barrier and how often the barrier was destroyed.

MATERIAL AND METHODS

Fethiye beach is one of 17 nesting beaches of the endangered loggerhead sea turtle in Turkey (Canbolat, 2003). The nesting beaches of Fethiye are divided in three parts. Akgöl, Calis and Yaniklar. Our study was done in Akgöl, which is the western part and is about 1.5 km long. The substrate changes in often distinct parallel sectors to the sea. Based on the vegetation we distinguished four zones to determine if there is a connection between the zones the cars were parking in and the zones sea turtles used to lay their eggs. The four zones were rock zone, chamaeophyte zone, bush zone and reed bulrush zone (Appendix I Figure 1, Appendix II Figure 1). Nearest to the sea was the rock zone with large coarse stones as substrate. No plants settle there. The rock zone is followed by the chameophyte zone. Chamaeophytes are plants whose buds are very close to the ground. The substrate consists of smaller, but still coarse stones. Behind the chamaeophyte zone is the bush zone with fine gravel or sand as substrate, which allows bigger plants to settle. The last zone, separating the beach from the street and parking areas, is the reed bulrush zone with a sandy substrate. This zoning counts for the whole beach with one exception. The western part of the beach, called “Sandy beach”, shows no zonation. Sandy beach is a very small area with only 50 m length. The whole area consists

of fine sand, which can be found on only a few small parts on the rest of the beach (Appendix I Figure 2).

One street leads to the parking areas and a picnic area at the beach. Before you can park your car there, you have to pay five lira at an old control house (36.693705, 29.041065, Appendix I Figure 2). The street can be closed, but this was never observed during our investigation period between 20 July 2011 and 10 August 2011. This year Ramadan was between 1 August 2011 and 28 August 2011. Ramadan is the ninth month in the Islamic calendar and is the Islamic month of fasting in which participating Muslims relinquish eating, drinking and smoking during daylight hours. Before Ramadan there were four access points from the street to the beach. Access point one (AP 1) (36.697288, 29.035628) was at the end of the street. The ÖCK, a part of the Department of the Environment in Turkey, built a small parking area and established wooden posts which functioned together with a small river bed as a barrier to prevent cars from leaving the parking area and driving on the beach (Appendix II, Figures 3 & 4). The average distance between those posts is 1.42 m, which means if one post is missing; a car will be able to pass through the resulting gap. Parallel to the street was a reed belt which functioned as barrier for cars and motorcycles; only three spots allowed cars to pass through and enter the beach. Access point two (AP 2) (36.697096, 29.036339) and AP 3 (36.695688, 29.038724) were two broad paths to the beach (Appendix I, Figure 2, Appendix II, Figures 5 & 6). After the first week of investigation an excavator came and bulldozed a new parking area between access point one and access point two. Therefore the whole reed belt between those entries was destroyed and, with it, the natural barrier preventing vehicles from entering the beach. I spoke to a person responsible for the excavator and made a deal. To prevent cars from driving on the beach through the new parking area, a wall of sand was built in front of the beach (Appendix II Figure 11). Access point four (36.695255, 29.039053) is a very narrow path (3.15 m) but broad enough for a car to drive through (Appendix II, Figure 7).

The preparations for the investigation started on Wednesday, 20 July 2011. At 15:00 we smoothed over all existing tracks. Two hours later, at 17:00, the access points were controlled to determine whether new tracks were made. The investigation period lasted two weeks. For the photo documentation a Canon S95 camera was used.

In the first week, we observed the number of cars and car tracks entering the beach through the access points and where they were parking if there were no barriers, except at access point one. The position of the parking cars were marked on a Google satellite map (Appendix I,

Figures 3 & 4). We examined what kind of people were on the beach. We distinguished four categories: Singles, Couples, Groups and Families. We tried to determine if those people were tourists or local Turkish residents by noting their license plates. The access points were observed three times a day: 07:00, 12:00 and 17:00.

On 27 July, after the last patrol at 17:00, we started to dig four ditches, one at each access point. We were equipped with three shovels and a pickaxe. Although at access point one a barrier was already there, we dug a ditch behind the row of wooden posts where two posts were missing (Appendix II, Figure 13). The next day the above-mentioned excavator came and built the new parking area. We therefore interrupted our data recording until the wall at the new parking area was built. We had to build two more ditches between access point one and two because the wall was not long enough (Appendix II, Figure 11). The ditches were around 30 cm deep and 50 cm wide; the wall was about 50 cm high and had a length of 40.5 m (Table 1).

Tab.1: Maße und Lage der fünf Gräben und des Walls.
Tab.1: Measurements and position of the five ditches and the wall.

Ditch number	Access point	Length	Average Width	Average depth	Deepest point
1.	1	1.38 m	0.55 m	0.35 m	0.37 m
2.	1	3.30 m	0.57 m	0.37 m	0.44 m
3.	2	1.22 m	0.68 m	0.36 m	0.42 m
WALL	2	40.5 m	-	0.53 m	0.65 m
4.	3	3.39 m	0.45 m	0.37 m	0.44 m
5.	4	2.36 m	0.46 m	0.38 m	0.41 m

The second week, between 4.August and 10.August, we recorded the same data as we did in the first week, but this time with barriers at the access points. Additionally, we examined how often the barriers were damaged and had to be repaired.

All photographs were taken by myself except photos 34 and 35 (M. Stachowitsch). The maps were taken from Google Satellite (22.7.2011 18:40) and Google Earth (24.10.2011 17:11).

RESULTS

During the investigation period a total number of 249 parking cars, 116 car tracks, 33 motorcycles and 18 motorcycle tracks were counted either on or near the beach around one of the four access points. Almost 70% of the parked cars were documented before Ramadan, but only 21% of the car tracks. During Ramadan (1-28 August) the total number of cars (parked cars and car tracks) decreased by 13.8%. The number of motorcycles during Ramadan nearly

doubled in comparison to their number before Ramadan. The number of motorcycle tracks during Ramadan was equal to the number counted before Ramadan (Table 2, Figure 1).

Tab.2: Gesamtzahl der gezählten Autos vor und während Ramadan und deren Verteilung zwischen den vier Zufahrten (AP 1-4).
Tab.2: Total number of parked cars, car tracks, motorcycles, motorcycle tracks before and during Ramadan and their distribution among the access points (AP 1-4)

	AP1	AP 2	AP 3	AP 4	Total Number
Parked cars before Ramadan	143	4	18	6	171
Parked cars during Ramadan	65	11	2	0	78
Car tracks before Ramadan	2	1	22	0	25
Car tracks during Ramadan	1	84	6	0	91
Motorcycles before Ramadan	10	1	1	0	12
Motorcycles during Ramadan	19	0	2	0	21
Motorcycle tracks before Ramadan	4	0	5	0	9
Motorcycle tracks during Ramadan	2	0	3	4	9

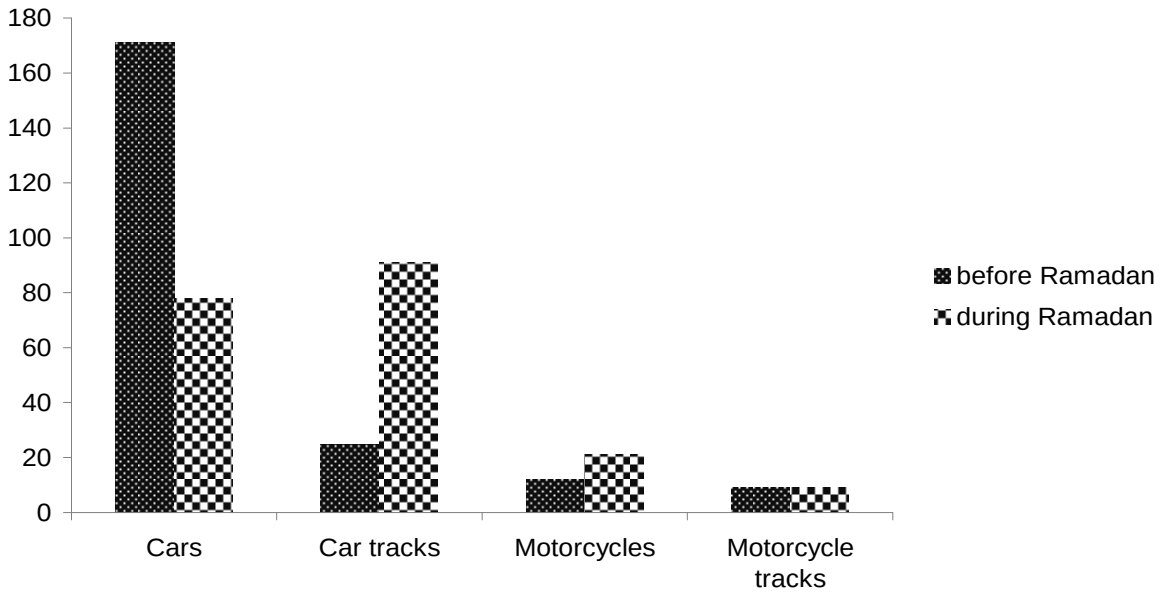

Fig. 1: Gesamtzahl der Autos, Autospuren, Motorrädern und der Motorradspuren vor und während Ramadan in Akgöl.
Fig. 1: Total number of cars, car tracks, motorcycles and motorcycle tracks in Akgöl before and during Ramadan.

The four access points were not used equally. Before Ramadan most cars were documented around access point 1 (AP 1). A total of 145 parking cars and car tracks were determined around AP 1. That's nearly 75% of all cars observed before Ramadan. During Ramadan the newly built parking area was the most visited access point. More than a half of all cars were parked there. Nearly 40% of the cars during Ramadan parked at access point one. There were no cars at AP 4 during Ramadan (Table 2, Figure 2).

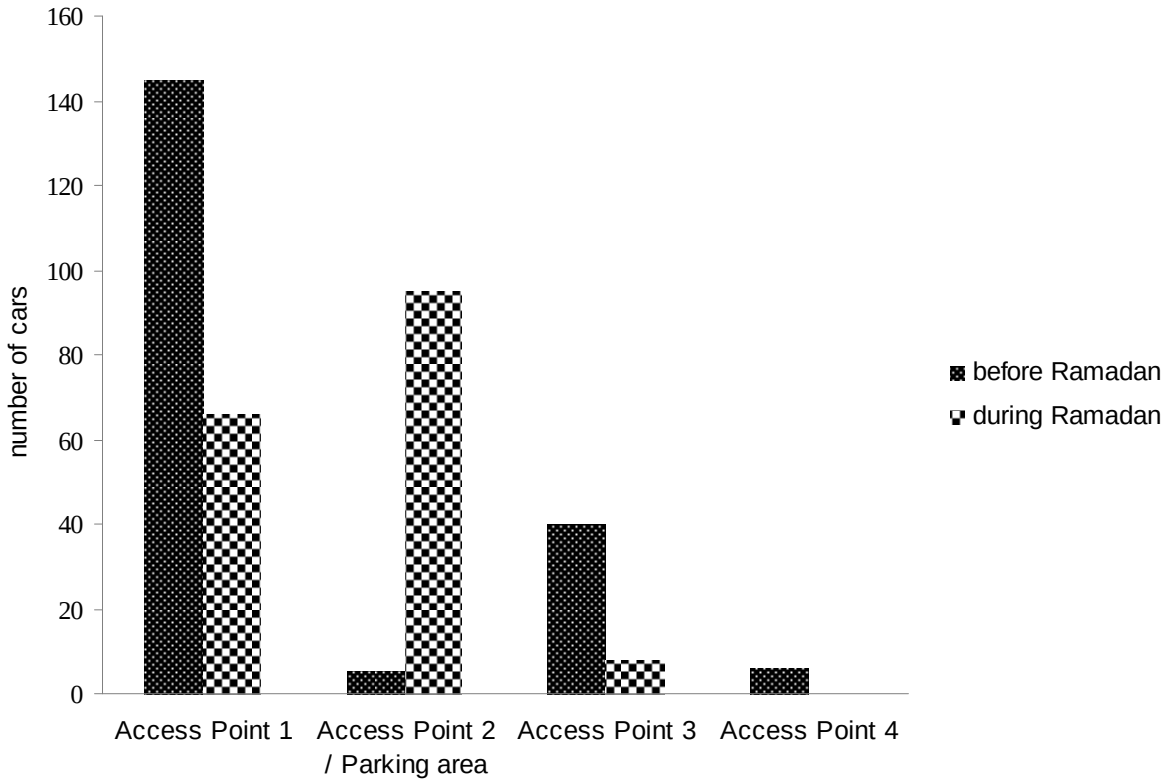

Fig. 2: Anzahl der Autos (sowohl parkender Autos als auch Autospuren) bei den 4 Zufahrten zum Strand.
Fig. 2: Number of cars (both parked cars and car tracks) at the 4 access points to Akgöl beach.

Most motorcycles were documented at access point one. Before Ramadan about 60% of all motorcycles were around there. AP 4 was not used by motorcycles before Ramadan. During Ramadan the number of motorcycles in general and the percentage of motorcycles at access point one increased. During Ramadan the number of motorcycles increased by about 40%. 70% of all motorcycles documented during Ramadan were around AP 1. AP 2 became a parking area, no more motorcycles were seen there (Figure 3).

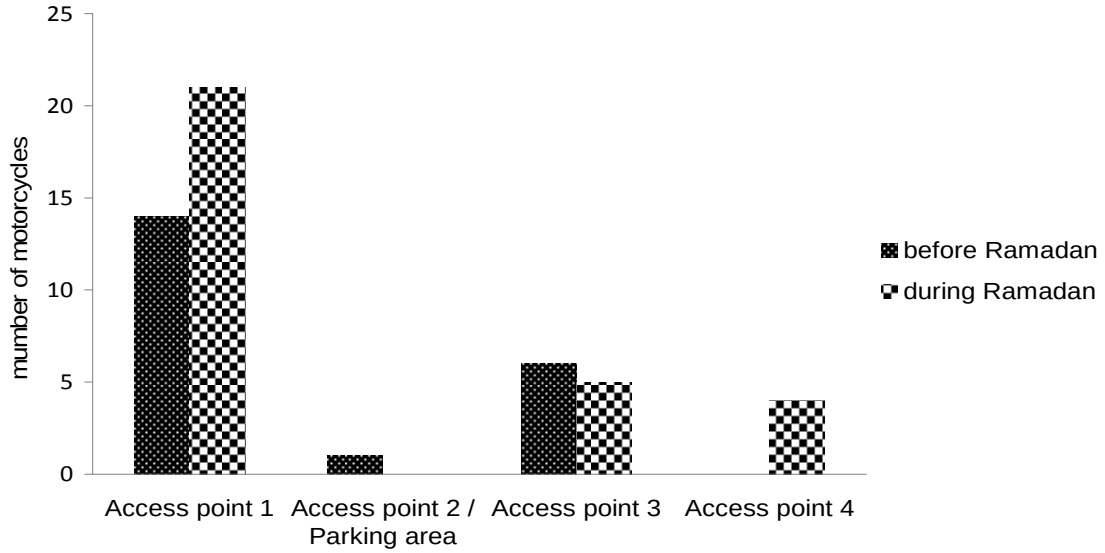

Fig. 3: Anzahl der Motorräder (sowohl abgestellter als auch Spuren) und deren Verteilung auf die vier Zufahrten zum Strand.
Fig. 3: Number of motorcycles (parked motorcycles and tracks as well) and their distribution among the four access points to Akgöl beach.

The highest density of parking cars was at 17:00. Around 60% of the documented cars were parking there at this time both before and during Ramadan. The number of cars increased during the day. More than 50% of the car tracks were noted at 07:00, both before and during Ramadan (Figure 4).

Fig. 4: Anzahl der Autos und die Zeiten zu denen sie gesichtet wurden.

Fig. 4: Number of cars and the time they were recorded.

Before Ramadan, 77% of all car tracks recorded at 07:00 were at access point three. During Ramadan the total number of tracks at 07:00 increased and the number at access point three decreased. During Ramadan, 93% of the car tracks recorded at seven o´clock in the morning were noted at access point two (Figure 5).

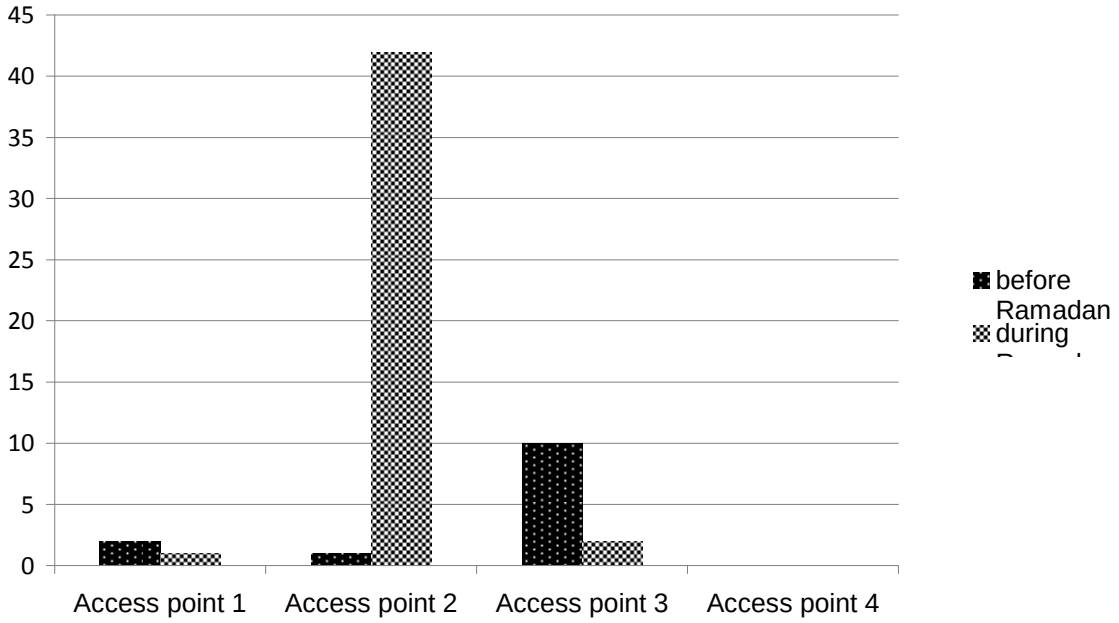

Fig. 5 : Anzahl der Autospuren bei den Zufahrten die um sieben Uhr morgens aufgenommen wurden.

Fig. 5: Number of car tracks at the access points recorded at 07:00.

The situation of parking motorcycles was similar. 58% of the motorcycles were noted at 17:00 before Ramadan, 57% during Ramadan. Before Ramadan no motorcycles were seen at 07:00, but most of the tracks were noted at this time. 55% of the motorcycle tracks before Ramadan and 78% of the motorcycle tracks during Ramadan were documented at 07:00. Before Ramadan there were no motorcycle tracks at 17:00 (Figure 6).

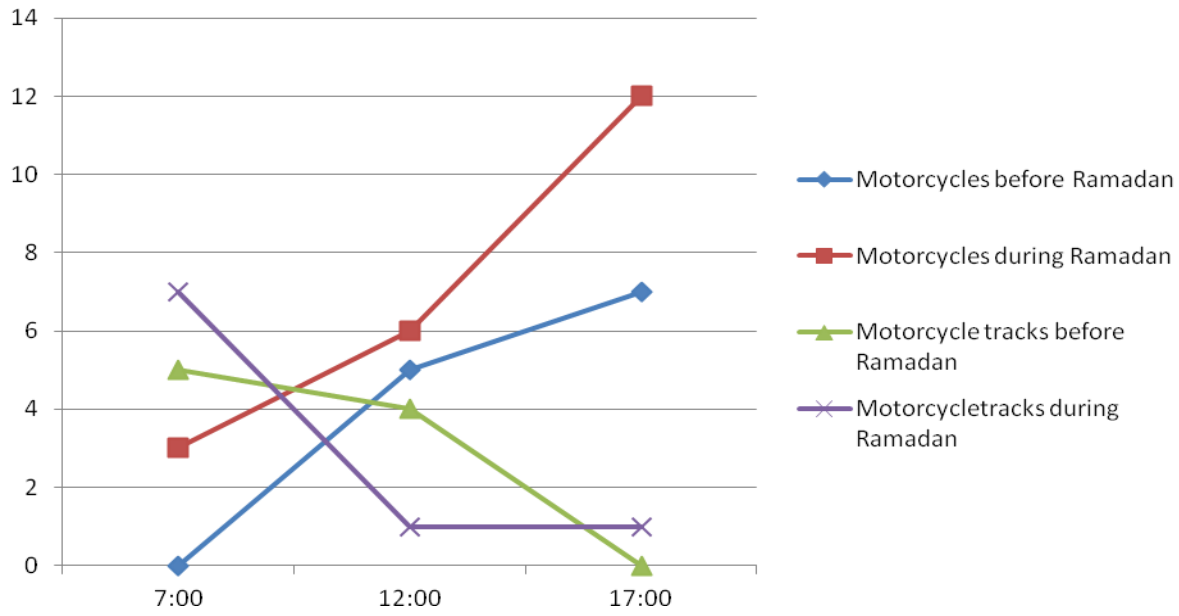

Fig. 6: Anzahl der Motorräder und die Zeiten zu denen sie dokumentiert wurden.
Fig. 6: Number of motorcycles and the time they were documented.

Before Ramadan, Sunday was the most frequented day. The number of cars was twice as high as on the other days. The number of motorcycles increased too. During Ramadan the number of cars was distributed homogeneously throughout the week. The number of motorcycles increased at the end of the week (Figure 7).

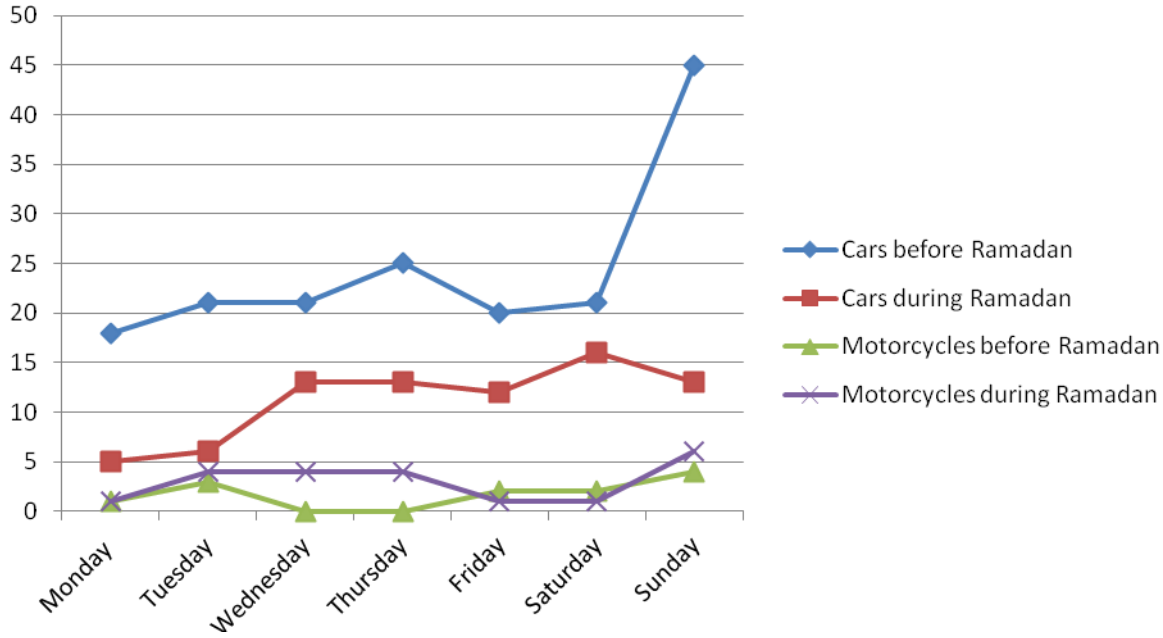

Fig. 7: Anzahl der Autos und Motorräder an den jeweiligen Wochentagen.
Fig. 7: Number of cars and their distribution during the week.

Most of the people visiting the beach were there with their families. During Ramadan, the number of families dropped by more than half. Nonetheless, there were more families during Ramadan than groups, Singles or Couples. Before Ramadan the second largest cluster was couples. During Ramadan the three clusters singles, couples and groups were nearly even. The number of Singles and couples during Ramadan decreased, the number of groups was doubled (Figure 8).

Based on an average of four persons per “group”/”family”, the numbers of singles, couples, groups, and families is equivalent to approximate 498 before and 284 persons after Ramadan in the respective one-week period.

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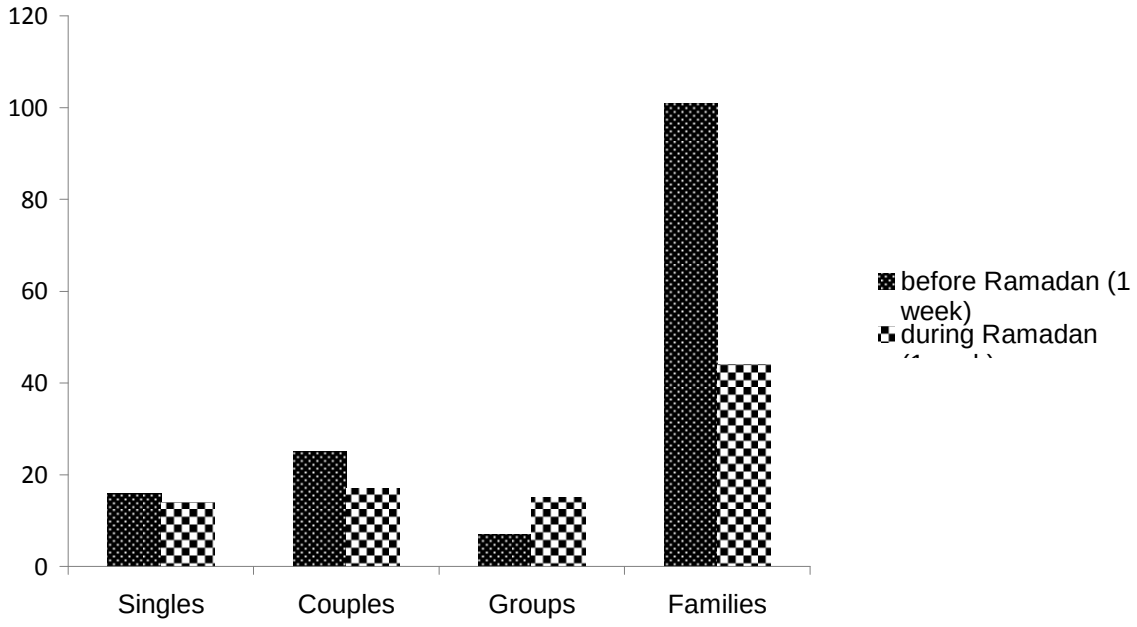

Fig. 8: Anzahl der Einzelpersonen, Paare, Gruppen und Familien auf Akgöl.

Fig. 8: Number of Singles, couples, groups and families on Akgöl beach.

In the first week, before the ditches were dug, 60% of the cars at the access point two entered the beach. At access point three, even 92.5% of the cars entered the beach. At access point one, only two cars (1.4%) entered the beach. No cars entered the beach at access point four (Figure 9, Table 3).

After building the ditch and the wall, two cars entered the beach in the whole week. They did so at AP 1. At APs 2, 3 and 4, no more cars were entering the beach (Figure 9, Table 4). During the investigation period the walls remained undamaged.

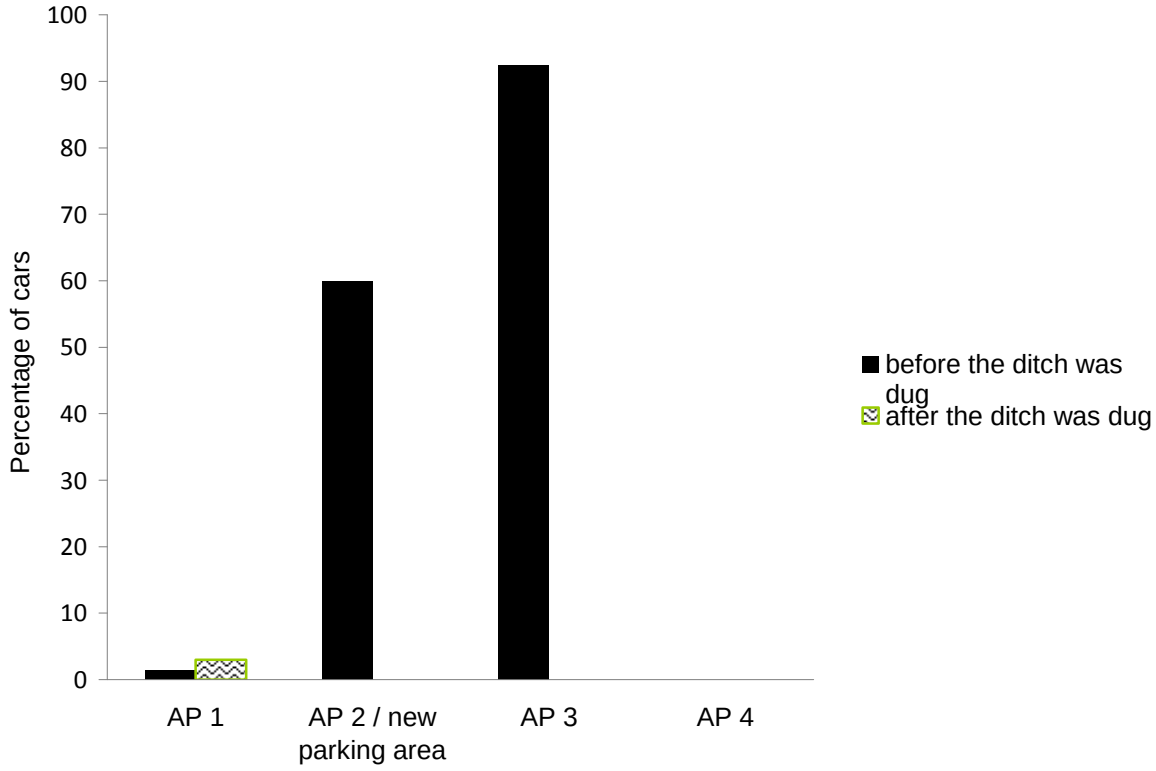

Fig. 9: Anteil der Autos (in Prozent) welche durch eine der vier Zufahrten den Strand befuhren.

Fig. 9: Percentage of cars entering the beach at the access points before and after the barriers were dug.

In the first week, 35.7% of the motorcycles at AP 1 entered the beach. All motorcycles at access point three entered the beach. At AP 2, the only motorcycle documented did not enter the beach and at AP 4 there were no motorcycles at all (Figure 10, Table 2).

After the barriers were built, the number of entering motorcycles at AP 1 and 3 decreased to 4.8 (28.6%). At AP 2 there were no motorcycles. The 4 motorcycles at AP 4 did not enter the beach (Figure 10, Table 4).

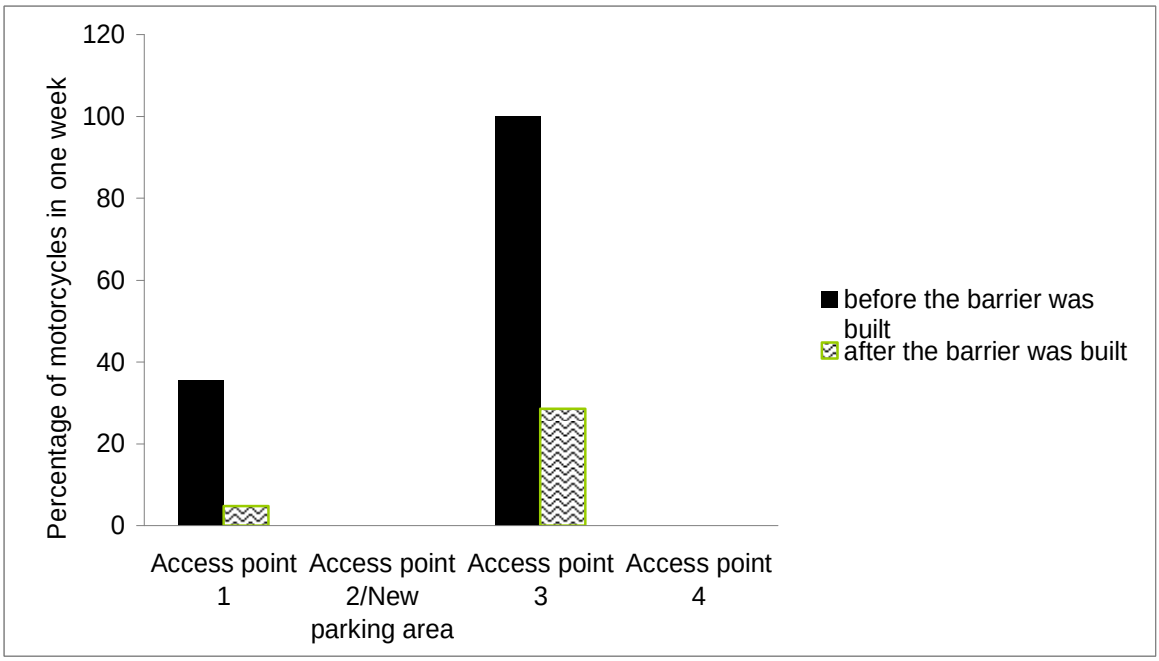

Fig. 10: Anteil der Motorräder (in Prozent) welche durch eine der 4 Zufahrten zum Strand gelangten.

Fig. 10: Percentage of motorcycles which entered the beach at one of the four access points.

Tab. 3: Anzahl der Autos und Motorräder die vor bzw. am Strand waren bevor der Graben gemacht wurde. Die Daten wurden in einer Woche aufgenommen.
Tab. 3: The total number of cars and motorcycles ("bikes") before Ramadan, which were either on the beach or behind it. Data were collected during a one-week period.

	Access point 1		**Access point 2**		**Access point 3**		**Access point 4**	
	Cars	**Bikes**	**Cars**	**Bikes**	**Cars**	**Bikes**	**Cars**	**Bikes**
In front of the beach	141	9	2	1	3	0	6	0
On the beach	2	5	3	0	37	6	0	0
% on the beach	1.4	35.7	60	0	92.5	100	0	0

Tab.4: Anzahl der Autos und Motorräder die während Ramadan vor der Barriere hielten oder durchfuhren. Die Daten wurden in einer Woche aufgenommen.
Tab.4: Number of cars and motorcycles ("bikes") during Ramadan which either stopped before the barrier or passed it. Data were collected during a one-week period.

	Access point 1		**Access point 2**		**Access point 3**		**Access point 4**	
	Cars	**Bikes**	**Cars**	**Bikes**	**Cars**	**Bikes**	**Cars**	**Bikes**
In front of the beach	64	20	95	0	8	5	0	4
On the beach	2	1	0	0	0	2	0	0
% on the beach	3	4,8	0	0	0	28,6	0	0

Before Ramadan the highest concentration of cars was at access point one behind the barrier. Two cars used the gap in one of the post rows to enter the beach and parked in the bush zone.

Half of all cars entering the beach parked in the reed zone, most of them at access point three (Appendix I Figure 3, Table 5).

During Ramadan, 95% of all cars were distributed between access point one and the new parking area (Figure 2, Appendix I Figure 4). Eight of the 169 cars were parked at access point three. No cars were around access point four. Two cars passed the barrier at access point one and parked on Sandy beach (Appendix I Figure 4, Appendix II Figure 17).

Tab. 5: Anzahl der Autos in den jeweiligen Zonen am Strand in denen sie parkten. Daten wurden jeweils in einem einwöchigen Intervall aufgenommen.
Tab. 5: Number of cars and the zones in which they were parked during a respective one-week period.

	Reed zone	Bush zone	Chamaeophyte z.	Rock zone	Small beach
Before Ramadan	21	14	7	0	0
During Ramadan	0	0	0	0	2

We determined a total number of 18 nests on Akgöl. 65% of the sea turtle nests of Akgöl were on Sandy beach. Four nests were situated in front of access point one and the new parking area. The remaining two nests were not near one of the four access points. Three of the four nests at AP 1 and 2 were located near the sea in the rock zone. The other nest was next to the parking area at access point one, situated in the reed zone. The two nests in the east were both located in the chamaeophyte zone (Appendix I Figure 5, Figure 11).

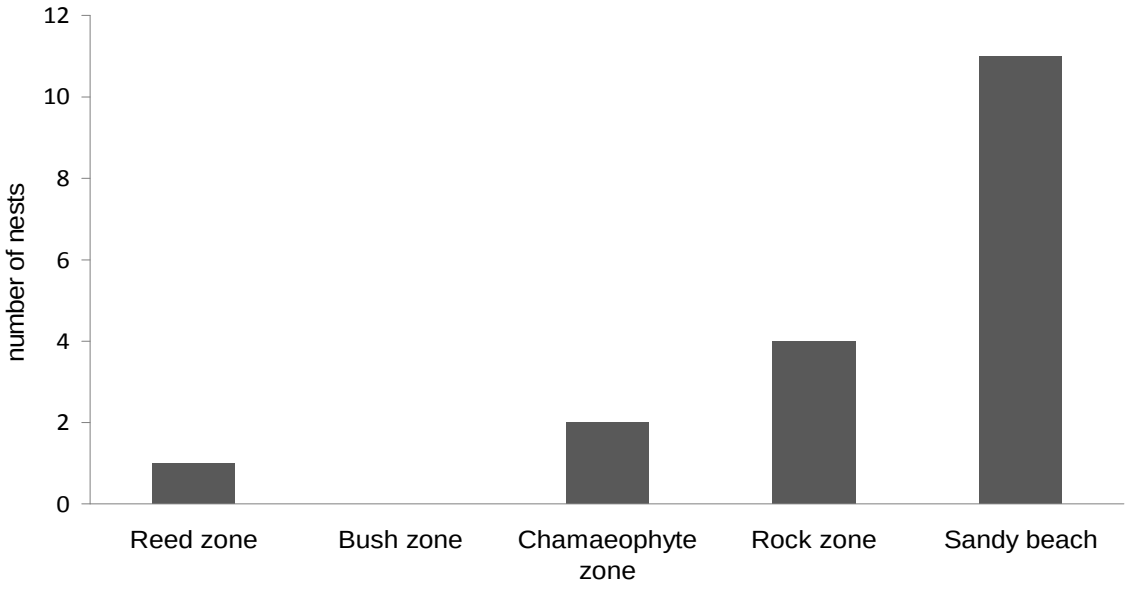

Fig. 11: Position der Nester auf Akgöl.
Fig. 11: Position of the nests on Akgöl beach.

DISCUSSION

Most people on the beach were there with their families. Before Ramadan we counted 101 families on the beach in one week. The number decreased in one week during Ramadan to 44 families. There were only Turkish people; tourists did not seem to know the place. The small sandy part of the beach had the highest concentration of people**.** This is a potential conflict between sea turtle conservation efforts and local residents, because this small area was one of the most important spots for nesting: it had the highest concentration of nests of all Fethiye beaches. For sea turtles it is optimal because it is dark (longer distance to the parking area where the cars were) and the substrate is very fine sand, which is rare on any other part of the beach. Precisely these fine sand features explain why the people prefer this part of the beach. A big problem was the lack of information for the visitors there. Many people told us they didn`t know that the beaches of Fethiye were sea turtle nesting grounds (but see below). Others did not even know that sea turtles came out of the water to lay their eggs. On all three parts, Akgöl, Calis and Yaniklar, there were new shields explaining that this was a nesting beach for sea turtles (Appendix II, Figure 18), but the locations of the shields were suboptimal. On Akgöl, one such shield was situated somewhere in the middle of the beach, where hardly any people came by (Appendix I, Figure 2). Even if the shield was seen, it´s not as informative as it could be about how to behave on a nesting beach: it merely stated “Follow official warnings”, but there was no shield about official warnings. What is needed is a shield at the parking areas, which tells the people what they are allowed to do and what they are not allowed to do on a nesting beach. An additional shield showing the life cycle of a female sea turtle with pictures would be a good idea, especially for kids. One such shield was installed in Calis, but also in a poor location.

Shields alone will not solve the problem. We marked some of the nests with shields, which told the people in three different languages (Turkish, English and German) that this is a sea turtle nest (Appendix II, Figure 19). All nests (both with and without shields) were marked with stones, which were arranged in a semicircle. Many people ignored the shields. Worse, they were often used as towel holders (Appendix II, Figure 20) or were converted to umbrellas (Appendix II, Figure 21). A local resident told us that a group of youngsters took the shields and made football goal posts out of them. We recorded motorcycle tracks passing very close to sea turtles´ nests (Appendix II, Figure 22). During Ramadan, one of the two cars

passing the barrier drove on the sandy part of Akgöl and nearly drove over a nest (Appendix II, Figure 17). Often the stones of the semicircles were taken away and we had to find the nest again by triangulating.

Another problem was umbrellas. Most had no umbrella stands and were just stuck into the sand (Appendix II, Figure 23). If there´s a sea turtle nest below, the eggs can be destroyed or hatchlings killed. Even if an umbrella is not driven through a nest, it can influence the development of the embryos within it. The shade made by umbrellas alters the nest temperature, which can affect the development of the sea turtle embryos and the sex ratio (Mrosovsky & Yntema, 1980). The same effects can be caused by shade made by cars, tent-like sunshades (Appendix II, Figure 24) and other beach items.

Even though it is forbidden because of the fire hazard, we saw people making bonfires or barbecuing outside the picnic area (Appendix II, Figure 25). This can cause big problems for sea turtle nests if people mistake our nest markings for fireplaces. Therefore we should think about other ways to mark the nests, like putting signs on every nest (despite the problems with our current shields).

One more problem is garbage on the beach. The Greek NGO MEDASSET filed a complaint in the framework of the Bern Convention against the Turkish government for not properly maintaining the beaches of Fethiye, which are special protected areas. Before Ramadan, no dustbins were on the beach. The garbage was piled up at the parking area (access point 1/ AP 1) or was left on the beach (Appendix II, Figures 26 and 27). After Ramadan, three dustbins were deployed: one at “Sandy beach”, one at access point 1 and one at the picnic area, but the deployment of the dustbins was more symbolic than useful, because the garbage in the dustbins was not taken away (Appendix II, Figure 28).

The problem we concentrated on were cars on the beach, the problems they caused and how to prevent them from driving on the beach. Although most cars were noted at 17:00, half of the car tracks before Ramadan were counted at 07:00. This indicates that many people visit the beach in the evening after 17:00 or in the night. During our night shifts we always saw a few cars on the beach, mostly families. The lights of the cars and other lamps used on the beach may have disoriented the hatchlings which emerged at the same time. We had a nest directly next to AP 1. It was a secret nest found based on hatchling tracks in the morning. These hatchlings did not reach the sea. They were disorientated, probably because of the lights of the visitors and their cars (Witherington & Martin, 2003) and ran to the access point

or into the vegetation and were lost. To save the remaining hatchlings in the nest, we put a cage upon the nest and controlled for emerging hatchlings every two hours. Despite our efforts the nest was not very successful. With the first emerging of the disorientated hatchlings, we lost 24 hatchlings, i.e. about 48% of the hatched eggs.

During a data recording break on 28.July 2011, an excavator came and dug up the whole area between access point one and access point two for a new parking area. The whole vegetation between these two access points was destroyed and with it the natural barrier preventing cars from driving on the beach (Appendix II, Figures 9 and 10). The excavator took that opportunity to bury all the garbage collected on the beach before – directly in the adjoining wetland. Besides the negative effects of destroying the vegetation and burying the rubbish, the excavator caused another big problem. While digging the rubbish and building the new parking area, the excavator drove on the beach. Our secret nest with the disorientated hatchlings was in the area dug up by the excavator. This and any other possible nest were crushed by the excavator (Mann, 1977). It would be better if measures like this were taken before or after the nesting season and not while it is still in progress.

Contrary to our expectations the number of cars only decreased a bit during Ramadan. During Ramadan, which coincided with the high season of hatchling emergence, the number of car tracks increased. Nearly 100 car tracks were noted in one week, of which 44 were seen at 07:00. This is equivalent to an average of six cars per night. The reason for the rapid increase of car tracks during Ramadan is the newly built parking area mentioned above. Because of this big new area, the cars were more evenly distributed between the small parking area of AP 1 and the new parking area. We did not quantify the car tracks at AP 1: the number of cars during the daytime made it impossible to document them. This indicates that, especially before Ramadan, more cars were on the beach at night than quantified. For further studies it would be interesting to concentrate on the tracks in the morning and the events at night.

Before Ramadan, only one barrier (wooden posts) prevented cars from driving on the beach at AP 1. In the first week, only two cars entered the beach. Although the wooden barrier worked very well, problems remained. One was the durability of the posts. When I started my investigation on 21 July 2011, two posts were missing in the middle row (Appendix II, Figure 12). The resulting gap was broad enough for cars to pass. Interestingly, this gap was only used twice in a single night during the whole week. It seemed to be enough if people knew that they were not allowed to drive further on the beach. Another interesting observation was that the people who removed the posts did not use the resulting gap to enter the beach with their

cars i.e. no car tracks. Therefore, the motivation to damage the barrier must be another one. Perhaps the wooden posts were used for a bonfire at the picnic area. Another problem was that these wooden posts did not prevent motorcycles from entering the beach. Nonetheless many people accepted the barrier and parked their motorcycle at the parking area, although more than one third of the motorcycles still drove on the beach.

In contrast, the access points without barriers were used as entries to the beach by cars. APs 2, 3 and 4 lacked barriers before Ramadan. At AP 2, more than one half of all cars entered the beach at access point three, nearly every car entered. In some cases the cars came very close to the waterline; driving in circles was also documented once (Appendix II, Figure 29). Access point four was not used as an entry. It was used only as a parking place by one and the same person. Perhaps it was not recognized as an entry because it was a very narrow way. Even motorcycles avoided this access point. The vegetation there functioned as a natural barrier for both cars and motorcycles (Appendix II, Figure 7).

Most of the cars on the beach were around AP 3. Ten of 13 car tracks were here at 07:00 before Ramadan, which indicates that most cars were around there at night. Note that no nest was near AP 3. The nests at AP 1 and 2 were very near to the sea, far away from the parking area. Most of the nests were on Sandy beach, where no cars were documented before Ramadan. One explanation is that the adult sea turtles avoided the positions where cars and people were present at night. Only one nest was near one of the access points. Moreover only one nest was in the reed zone, although the substrate there was fine sand. This was also the zone where most of the cars parked. Even if the substrate there seemed optimal for sea turtle nests, they avoided that zone, again suggesting that cars on the beach at night, especially the lights, play a role in the choice of nesting sites (Witherington, 1992).

After the ditches were dug and the wall was built at the access points, no cars entered the beach through AP 2-4. Only at AP 1, two cars passed the barrier. Characteristically for the Mediterranean climate, it was a very hot and dry summer and the riverbed at AP 1 dried out (Appendix II, Figure 17). This provided a new gap in the barrier and was used by those two cars, although most people stayed at the parking area. The ditches and the wall as barriers worked very well, but they share the same problems as the wooden posts. They are not very durable: it was easy to destroy a ditch or a wall. Although the ditches were not destroyed during the investigation period, they were during the data recording break (between 28 July 2011 and 3 August 2011) and after the investigation period (which ended on 10 August 2011). Both happened at AP 3, which was the most popular entry to the beach before the ditches

were made. In the first case an elderly man cut off the bushes next to the ditch and threw the thorny branches into the ditch. The second time, someone put sand into the ditch to pass it. However, even if the barriers are not destroyed by directed actions, they are unstable: In a few months the ditches and walls will be gone. The other problem (motorcycles) cannot be solved with ditches either. A gap for the people to pass the ditch is needed, but this gap also allows motorcycles to pass. Nonetheless the ditches reduced the number of motorcycles driving on the beach, but not to zero.

Our barriers were a good idea to prevent cars from driving on the beach, but more can and must be done to save the last nests on the beach. A better idea would be a fence with a gate allowing people to enter the beach. This would be a more stable, long-term solution.

Another idea would be to control the beach, especially at night. During Ramadan, two men controlled if the cars had paid for the parking area: the visitors had to pay five Turkish lira to be allowed to drive to the picnic or parking area. No further controls of the activity of the people on the beach were made. Before Ramadan there were no controls. Inspectors like this could be used not only for selling tickets but also to watch over the beach and to ensure that visitors adhered to the rules.

In addition the beach has to be controlled at night. Although it is forbidden to go on the beach after 20:00, car tracks noted in the early morning suggest that some visitors are not aware or do not care about this. Controlling the beach at night without disturbing sea turtles could be done very easily here. Only one street leads to the access points. A small control station with a chain is already there (Appendix II, Figure 2). At night the beach could be closed with this chain and a lock and opened in the early morning hours when the controls start again. Our investigation showed that this control would have to be done the whole week and not only on certain days or the weekend. Even if more people visit the beach at the weekend than during the week, the difference was not that high: there was a continuous visitor flow the whole week.

Controls, nest markings and rangers telling the people about the nests will not save all the nests on Akgöl, especially on “sandy beach”. Not all nests can be detected before the hatchlings emerge. This year we found seven new nests based on hatchling tracks. To fully protect these nests on the part of the beach with the highest concentration of nests would require closing the sandy part of the beach for cars and people during the nesting season. Sandy beach is only a very small part of Akgöl - there would be enough free space along the

rest of the beach, which is less important for sea turtles. This would be a small but efficient step forward. Shields, a ranger and maybe a fence would be needed to protect this small part of the beach.

In summary I can say that there were some good ideas to improve the situation for sea turtles this year, such as the wooden posts and building a new parking area, but the implementation was poor and short-sighted. Building new parking areas or construction measures should be done before and not during the nesting season. Much remains to be done, starting with better controls and including a complete closure of the “sandy beach” section.

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Appendix I

Abb. 1: Die vier Vegetationszonen auf Akgöl. Die Grenzen wurden mit verschiedenen farben markiert.
Fig. 1: The four vegetation zones on Akgöl beach. Borders are marked with different colours.

Abb. 2: Strand von Akgöl mit dem Kontrollhäuschen, den sandigen Teil von Akgöl im Westen, den Picknickplatz, dem Informationsschild und die vier Zufahrten zum Strand.
Fig 2: Akgöl beach with the control house at the street, the sandy part in the west, the picnic area, the information shield and four access points to the beach (AP1– AP4).

Abb. 3: Positionen der parkenden Autos bevor die Barrieren errichtet wurden.
Fig. 3: Position of the parked cars on Akgöl beach before the barriers were built.

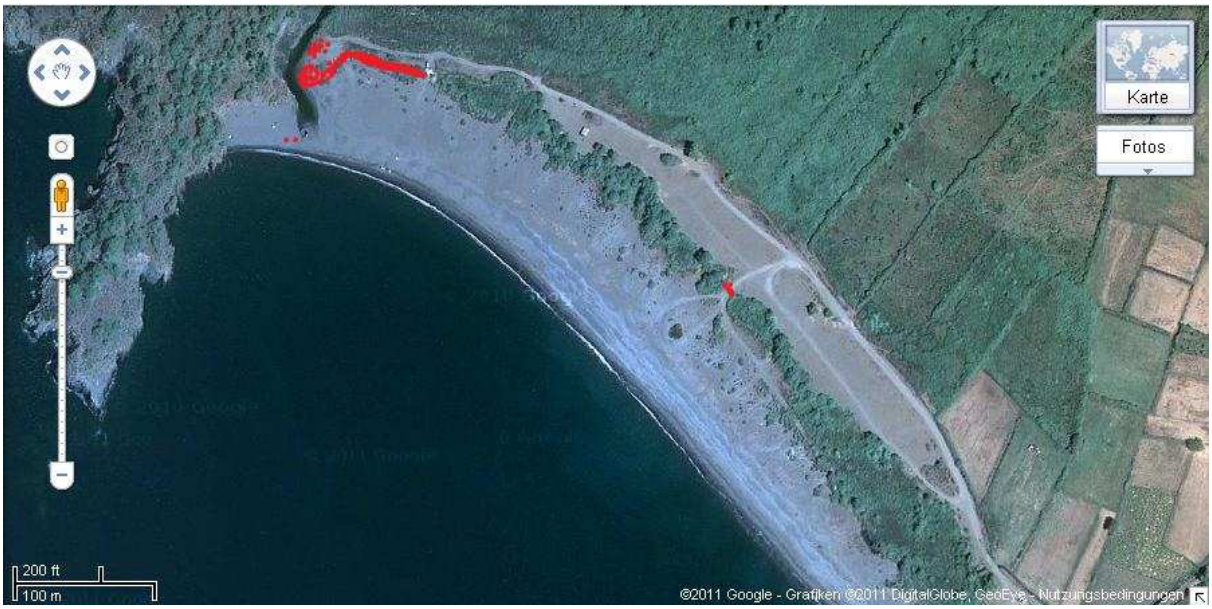

Abb. 4: Positionen der parkenden Autos auf Akgöl nachdem die Barrieren errichtet wurden.
Fig. 4: Position of parking cars on Akgöl beach after the barriers were made.

Abb. 5: Nestpositionen auf Akgöl.
Fig. 5: Location of the nests on Akgöl beach.

Appendix II

Abb. 1: Die vier Vegetationszonen.
Fig. 1: The four vegetation zones.

Abb. 3: Erste Zufahrt von Small Beach aus.
Fig. 3: Riverbed at access point 1 (AP 1).

Abb. 5: Zweite Zufahrt
Fig. 5: Access point 2 (AP 2)

Abb. 2: Kontrollhäuschen vor dem Strand.
Fig. 2: Control house on the beach

Abb. 4: Erste Zufahrt von der anderen Seite

aus.
Fig. 4: Access point 1 (AP 1) photographed from the other side

Abb. 6: Dritte Zufahrt

Fig. 6: Access point 3 (AP 3)

Abb. 7: Vierte Zufahrt
Fig 7: Access point 4 (AP 4)

Abb. 8: Ein Bagger baut eine neue Parkfläche vor dem Strand.
Fig. 8: An excavator bulldozing a new parking area.

Abb. 9: Schilfgürtel zwischen den zwei Zufahrten.
Fig. 9: Reedbelt between the two access points.

Abb. 10: Zerstörter Schilfgürtel
Fig. 10: Destroyed reedbelt.

Abb. 11: Erdwall und Graben vor der neuen Parkfläche.
Fig. 11: Wall and ditch in front of the new parking area.

Abb. 12: Holfpflockreihe bei der ersten Einfahrt mit zwei fehlenden Pflöcken
Fig. 12: Row of wooden posts at access point 1 (AP 1) with two posts missing.

Abb. 13: Graben vor den fehlenden Pflöcken.
Fig 13: Ditch in front of the missing posts.

Abb. 14: Ausheben des Grabens bei der neuen Parkfläche.
Fig. 14: Digging the ditch at the new parking area

Abb. 15: Ausgraben der Barriere bei der dritten Zufahrt.
Fig. 15: Digging the ditch at AP 3.

Abb. 16: Graben bei der vierten Ausfahrt.
Fig. 16: Ditch at AP 4.

Abb. 17: Auto welches an den Pfosten vorbei fuhr.
Fig. 17: Car passing the posts.

Abb. 18: Schild mit ungenauen Informationen über den Niststrand.
Fig. 18: Shield with vague information about the nesting beach.

Abb. 19: Nestmarkierung mit Steinen und Schildern
Fig. 19: Nest marking with a stone semicircles and shields

Abb. 20: Nestmarkierung verwendet als Handtuchhalter.
Fig. 20: Nest marking used as towel holder.

Abb. 21: Alte Frau die die Nestmarkierung als Schirm verwendet.
Fig. 21: Old woman using a nest marking as an umbrella.

Abb. 22: Motorradspur neben einem Meeresschildkrötennest.
Fig. 22: Motorcycle tracks close to a sea turtle nest.

Abb. 23: Schirm der ein Nest beschattet.
Fig. 23: Umbrella shading a nest.

Abb. 24: Sonnenblende am Strand.
Fig. 24: Tent-like sunshade on the beach.

Abb. 25: Grillen am Strand.
Fig. 25: Barbecuing on the beach.

Abb. 26: Müll zusammengetragen bei der ersten zufahrt.
Fig. 26: Garbage accumulated at AP 1.

Abb. 27: Müll am Sandy beach.
Fig. 27: Garbage left on Sandy beach.

Abb. 28: Weiterhin Müll am Strand nachdem die Mülltonnen aufgestellt wurden.
Fig. 28: Garbage still deposited AP 1 after the dustbins were deployed.

Abb. 29: Auto das Kreise am Strand fuhr.
Fig 29: Car driving in circles.

Abb. 30: Autospur direkt über ein Nest.
Fig. 30: Car tracks directly through nest.

Abb. 31: Autos auf Akgöl.
Fig. 31: Cars on Akgöl beach.

Abb. 32: Autos bei der dritten Zufahrt
Fig. 32: Cars at AP 3.

Abb. 33: Meeresschildkrötennest neben dem Parkplatz
Fig. 33: Sea turtle nest next to the parking area at AP 1.

Abb. 34: Autos am Strand vor Sandy beach während der Nistsaison 2010 (Photo M. Stachowitsch).
Fig. 34: Cars on Akgöl beach in front of Sandy beach during the nesting season 2010 (Photo M. Stachowitsch).

Abb. 35: Autos bei der ersten Zufahrt ohne Barrieren in der Nistsaison 2010 (Photo M. Stachowitsch).
Fig. 35; Cars at AP 1 without barrieres during the nesting saison 2010 (Photo M. Stachowitsch).

Bachelor Thesis

Water sports activity near Yaniklar beach, Turkey, and the associated pressure on nesting Loggerhead turtles (*Caretta caretta*)

Wassersportaktivität vor den Stränden von Yaniklar, Türkei und der verbundene Druck auf nistende unechte Karettschildkröten (*Caretta caretta*)

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KURZFASSUNG

Diese Arbeit beschäftigt sich mit Wassersportaktivität vor den Stränden von Yaniklar in Fethiye, ein SEPA (Special Environmental Protection Area) Gebiet der Türkei und wird im Rahmen des Meeresschildkrötenprojektes 2011 (Universität Wien) ausgeführt. Untersucht wird ein Areal, welches direkt zwischen zwei bekannten und wichtigen Niststränden der Unechten Karettschildkröte (*Caretta caretta*) liegt.

Die Unechten Karettschildkröten sind im Mittelmeer von allen Meeresschildkrötenarten am weitesten verbreitet und nisten auf Stränden des östlichen Mittelmeerbeckens. Schildkröten sind während ihres ganzen Lebenszykluses einer Reihe von potenziell schädlichen und anthropogenen Aktivitäten ausgesetzt, die zu einer Abnahme in ihrer Population führen und eine Veränderung in den Ökosystemen, wo sie eine wichtige Rolle spielen, verursachen.

Alle Meeresschildkrötenarten sind als gefährdete Arten im Endangered Species Act (ESA) eingestuft, was einige Institutionen im Mittelmeerraum dazu motiviert, hat Forschung- und Schutzprojekte einzurichten, um diesem Populationsabfall entgegenzuwirken. Viele Todesfälle von Schildkröten werden im Zusammenhang mit Wasserfahrzeugaktivität an den Küsten und am offenen Meer gestellt. Schildkröten sind vor allem in Küstengewässern der Gefahr einer Kollision ausgesetzt. Die Wahrscheinlichkeit, dass eine Schildkröte von einem Schiff oder Motorboot erfasst wird, ist von der Art, vom Verhalten zwischen den Nistversuchen am Strand und von der Dichte des Bootverkehrs abhängig.

Die Aufgabe dieser Arbeit war das Erstellen eines Aktivitätsbudgets der Wassersportfahrzeuge um zu demonstrieren, an welchen Stunden und Tagen die Aktivität am höchsten war. Das beobachtete Areal im Wasser wurde in zwei Zonen aufgeteilt, die „safe zone“ und die „permitted zone“. Dann wurde die Aktivität jeder Wassersportfahrzeugkategorie mittels „instantaneous sampling“ gemessen. Die Resultate zeigen eine hohe Aktivität vor allem am späten Nachmittag. Sie zeigen auch, dass einige Wasserfahrzeuglenker oft durch die „Safe Zone“ oder Schwimmzone fahren, was eigentlich nicht erlaubt ist.

Die Resultate können als Vorlage für zukünftige Forschungen in dieser Richtung genutzt werden und zeigen auch, welche Punkte oder Maßnahmen zukünftig bei den Mitarbeiter und Kunden des Wassersportbetriebes angesprochen werden können.

ABSTRACT

This study deals with water sport activity on Yaniklar beach in Fethiye, a SEPA (Special Environmental Protection Area) region in Turkey. The research was performed within the scope of the sea turtle course 2011, a practical course offered by the University of Vienna. The area where the field work took place lies between two important nesting beaches for the Loggerhead turtle (*Caretta caretta*).

The Loggerhead sea turtles are found in relatively high abundance in the Mediterranean Sea and frequently nest on its beaches. Throughout all stages of their lives, turtles are exposed to potentially harmful anthropogenic activity, which has over the years led to a clear decline in their population and potentially seriously changes the ecosystems they play a vital role in.

All species of sea turtles are listed as endangered according to the Endangered Species Act (ESA), motivating numerous institutions around the Mediterranean to launch research and conservation projects to counter their decline. A frequent source of mortality to sea turtles is vessel traffic both in coastal waters and the high seas. Especially in coastal waters, turtles are increasingly exposed to vessel collisions. The level of risk of a vessel collision depends on the internesting activity of the individuals. This can vary according to species and to the level of boat traffic. The animals are especially at risk when surfacing to breathe after a dive.

The aim of this paper was to create a general activity budget to demonstrate peak times of the day and week of vessel traffic. The observed water area was hereby split into two zones; the so-called safe zone and the permitted zone. The activity of each watersport vessel category was then recorded using instanteous sampling. The results show that the activity reaches its peak in the late afternoon and that many vessel operators drive through the prohibited safe zone.

These results could act as a template for future observations and also point to various points or measures that should be addressed with water sport customers or the facility staff.

INTRODUCTION

The loggerhead turtle and the Green turtle in the Mediterranean

Of the approximately 250 known species of turtles worldwide two families, together containing seven species, are marine. All sea turtle species share certain characteristics including “nonretractile extremities, extensively roofed skulls and limbs converted to paddle like flippers” (National Research Council 1990**)** which represent their morphological adaption to marine life around 140 million years ago and distinguish them from their terrestrial relatives.

The two families *Cheloniidae* (hard-shelled turtles, consisting of six species) and *Dermochelyidae* (consisting of only one species; the Leatherback turtle) have a worldwide distribution, particularly in the tropic and subtropical regions. Many have specialised feeding habits, which leads to distinct distribution patterns. Sea turtles spend most of their lives migrating through the worlds’ oceans (apart from the polar regions) until they reach sexual maturity. At that point they regularly visit shallower areas to mate with females later nesting at very specific beach areas. All species within the two families are enlisted as endangered species according to the Endangered Species Act (ESA).

Two species show regular nesting and migratory activity in the Mediterranean; the Loggerhead turtle (*Caretta caretta*) and the Green turtle (*Chelonia mydas*). Sightings of Leatherback turtles (*Dermochelys coriacaea*), Hawksbill turtles (*Eretmochelys imbricata*) and Kemp’s Riley (*Lepidochelys kempii*) have also been reported.

Throughout the different stages of their life cycle, sea turtles are susceptible to human-induced mortality and morbidity. (National Research Council, 1990). The anthropogenic pressure enacted on sea turtle species in coastal and pelagic areas has led to a decline in nesting activity and sightings. Both species are now protected under the convention on the Conservation of European Wildlife and National Habitats (Bern Convention) and the Convention for the International Trade in Endangered Species (CITES). Respectively, the Loggerhead turtle is classified as “endangered” and “vulnerable” by the IUCN (International Union for the Conservation of Nature and Natural Resources) and vigilance and care is

demanded of the authorities in areas where the species is present.

Water Sports as a threat to sea turtles

Water vessel activity and recreational boat traffic have increased in Mediterranean waters with the development and expansion of the tourism industry over the last 20 years. Vessel collisions are one of the most common human-induced causes of mortality in several marine taxa (Hazel et al. 2007) and pose a clear threat to turtles surfacing to breathe. In the U.S.A, for instance, strandings of sea turtles that were suspected to be from vessel strikes increased from 10% in the 1980s to a record high of 20.5% in 2004 (Sapp 2010).

Diving and internesting behaviour of loggerhead turtles has been assessed to determine the possibility of collisions in certain areas. Female Green and Loggerhead turtles tend to spend the day foraging around the coastal areas where they intend to nest at night, a behaviour which can last for several days and has, as yet, not properly been understood. Observations have been recorded in which the animals swam between the surface and a depth of one metre, increasing the chance of a potential vessel strike (Sapp 2010).

Diving behaviour of loggerhead females was assessed during internesting intervals in Cyprus using time depth recorders (TDrs) (Houghten et al. 2002). The authors state that “behaviour during the internesting interval may be highly adapted to local conditions”, which suggests an invariance in their behaviour. The results of the recorded dives show that the subjects spent considerable time on the seabed. Due to several physiological changes in the turtle's body during these periods, the animals may rest at the seabed to regain energy to complete the streneous task of nesting later at night or use the seabed as a retreat from disturbances at the surface. Turtle also perform benthic dives or float below the surface to rest before and after laying a nest, making them a target for vessel collisions.

Water sports are a form of recreational human activity that has expanded and evolved with the development of the tourism industry and represents a particular threat to turtles around nesting beaches.

Pollution

Water sport vessels that are powered by engines usually run on gasoline, a toxin which is always released into the sea.Moreover, many water sport vessels are loud and can disturb or frighten marine life, including female turtles which intend to nest on a nearby beach at night.

Injuries

Strandings of sea turtles with particular injuries have been associated with vessel strikes. Many papers address the issue of vessels exceeding a certain speed. The recommendations are that a speed limit be imposed that endangers the animals less. As turtles are exceptional swimmers, one question is how slow must a vessel go, so that the turtle will recognise it early enough to maneuvour out of its way.

Caretta caretta has an auditory capacity of 250-1000 Hz (Bartol 1999) and *Chelonia mydas* between 200-700 Hz (Ridgway 1969), which are very low frequencies. Turtles have a good vision underwater but their eyesight above the surface is poor, which means there could be a fatal delay in detecting oncoming danger when floating at the surface or breathing after a dive.

The different injuries suffered by turtles through vessel collisions are numerous. They involve cuts or slits through direct contact with propellers or crushed and dented carapaces and skulls due to strikes from other parts of the vessel.

Although many injuries seen on stranded turtles, particularly those caused by the propellers, show characteristics of a boat injury, it is very difficult to definitely determine whether a collision or contact with the vessel was really the cause. So the association of the injury with a vessel collision often remains an assumption, such as that of the juvenile turtle in Fig.1 and 2. (see appendix 1).

Adam Sapp conducted a number of field experiments to help categorise these injuries in 2010. For the experiments "a synthetic carapace was designed that represented the structural behaviour of the actual biological turtle carapace with material strength properties as defined by Hodges (2008)" (Sapp 2010). Experiments like these could help identify and distinguish vessel collisions injuries from others.

All research conducted in this direction could help reduce the risk of collisions with a turtle. One important step is to localise the areas of particular importance to vulnerable species. This is recognised by various management authorities worldwide who intend to encourage more vigilance in vessel operators or take necessary precautions such as limiting activity to certain obligatory routes or introducing speed limits (Hazel et al. 2007).

Aim of this study

This paper acts as a template for future observations of water sport activity within the frame of the sea turtle course in Fethiye, Turkey, a course which is conducted annually and is initiated by the University of Vienna and various Turkish Universities (Dokuz Eylül University, Adnan Menderes University, Pamukkale University and the association EKAD). The projects intend to contribute to the conservation of sea turtles in the Mediterannean and demonstrate, by gradually building up a scientific database, the nesting activity on the beaches in the area.

Turkey is part of both the Bern and CITES conventions. It is also included in the Barcelona Convention, annexed to which was the SPA Protocol, defining the locations that are to be Special Protected Areas (SPAs). The SPA is now known as SEPA (Special Environmental Protection Area), which is a modification of the protocol.

Fethiye has been specified as an SEPA region due to the dramatic effect mass that tourism has had on the nesting Loggerhead turtles, giving the authorities the responsibility to ensure the safety and protection of this endangered species.

One of the rules set down by the SEPA regarding water vessels, is the prohibition of activity within one sea mile off the shore. This study is designed to determine how high water sport activity is on a small, specified section of the touristic beaches of Fethiye and simultaneously determine whether there is cause for the authorities responsible to better enforce the laws laid down by the SEPA protocol.

The objective is to create an activity budget and determine at what times of the day and what days of the week and which of the three categories of vehicles show the most activity. Moreover, it should reveal whether the operators correctly conduct the recreational activity within the frame of the SEPA laws.

MATERIAL AND METHODS

Pre-observations and research

Before beginning with the observations, it was necessary to collect necessary background information to ensure effective and reliable field work and choose a suitable observation and data recording method.

Choice of the observation site

The point from which the observations were made was on the beach in front of the campground, Onur camp, where the project's participants were acommodated. This location was chosen because on either side of the camp there was a large hotel and a nesting beach. On one side, towards the east, is the Camp Doga, followed closely by the hotel Lykia Botanika and the 4 km stretch of Yaniklar beach that leads to the town of Calis. On the other side, towards the West, is Yonca Lodge followed by the Tuana Majesty Club hotel and the 1.5 km long beach of Akgöl. (see appendix 1 Fig. 11)

The two hotels, Tuana and Botanika, share a single watersport facility. Each hotel has a pier stretching out into the sea, where the recreational vessels can dock to pick up customers (see appendix 1; Fig. 3). Occasionally, larger boats arrive at the piers to pick up tourists for boat tours to Fethiye harbour and the uninhabited islands in the bay. Yellow buoys were positioned about 200 m away from the shore to mark the area that is supposedly prohibited to water sport vessel operators to allow safe swimming for the people residing in the camps and both hotels.

Note that the SEPA actually stipulates one sea mile as being forbidden for water vessel acitivity. This was clearly neglected due to the presence of the two hotels despite the fact that Akgöl and Yaniklar are known nesting grounds for *Caretta caretta*.

Pre-observations that were carried out over the week from the 3rd to the 10th of July 2011 showed that water sports activities were taking place in the waters between the two hotels. This led to the decision to conduct the observations should be conducted on subjects here. The piers of each hotel therefore acted as boundaries that enclosed the observed site. The beach

infront of the Onur campground provided a good overview of the area between the two hotels. The Tuana pier is roughly 75 m long and the Botanika pier is 25 m long (both are marked with red pins in appendix 1; Fig. 11).

An imaginary line was drawn starting from each pier towards the open sea, determining the enclosed observation area further out. The enclosure was further already physically divided into two zones by the yellow buoys beyond the two piers. These marked the borders of a so-called safe zone, which was officially prohibited to water sport practioners to allow safe swimming of camp and hotel guests, and the permitted zone beyond the buoys.

Information on the facility

The facility opened at nine in the morning until five in the evening and was in operation every day of the week.

Information on the different leisure activities it offered which were associated with motor-driven water vessels was attained. The price and ride duration of the various rides were also determined. All the 15 small vessels at the leisure centre were categorised into three groups;

Jet skis The facility owned five of these and their ride duration ranged from 15 to 20 minutes. Jet skis were given a separate category because they were often operated by customers of the facility.(see appendix 1; Fig. 4).

Water sports boats Ride duration ranged, as with the jet skis, between 15 and 20 minutes. The term water sport boat encompasses the motor-driven vessels that were responsible for the various rides; such as banana boat, doughnut and parasailing. Six different boats were present (see appendix 1; Fig. 5).

Rented Boats Ride duration between 30 minutes and 1 hour. The prices were dependent on the vessel's horsepower. Three different boats, each with a different speed, were offered; one with 40Hp, one with 30Hp and one with 60Hp (see appendix 1; Fig. 6). A 30Hp boat was present but never seen in use. The rented boats were rarely used compared with the other two groups of vessels (see results).

Recording Method

The data was recorded using time sampling methods. The pre-observations in the first week led to the conclusion that instantaneous sampling would be the most suitable recording method.

Here, a categorised individual activity within one of the two designated water zones was scored after a specific time interval. The time interval chosen was ten minutes due to the duration of most of the rides.A general activity budget was established by conducting observations during opening hours; from 09:00 to 17:00.

The data was noted in previously prepared data sheets. These were split up into three columns, each one representing a category of water sport vessels. The three columns were further split into two rows showing the two zones; the permitted zone and the safe zone. On the left of the data sheets were the time intervals. Every ten minutes, the observer would look up at the site and record the number of individuals of each of the watersport categories in both zones.

The observations were conducted irregularly and at random for every weekday (Monday-Sunday) over a period of five weeks. For each weekday, a full day from 9:00 till 17:00 had to be observed to enable proper comparison of results.

Equipment

The equipment had to capture certain moments to support the information noted on the prepared data sheets. A camera was used to take photographs and on occasion video footage. A stopwatch was used to time the 10 minute intervals, and binoculars were used to determine whether a vessel belonged to the water sports facility or not.

RESULTS

Total boating activity for each weekday (see Appendix 2)

The activity recorded in the data sheets in the field was combined: the activity within a category in each zone was added up and listed as composite data (Table 1.). The tables attatched in the appendix show the total activity on each weekday, for each zone and category, which are then added up for each time inverval. These results are further displayed in the diagrams below each table, to show the general activity during the course of the day. Table 1 and Figure 1 below represent the overall activity of each weekday separately. The highest activity was recorded on Saturday.

Table 1. Total boating activity throughout each weekday
Tabelle 1. Gesamtaktivität von jedem Wochentag

Weekday	**Total Activity**
Monday	40
Tuesday	37
Wednesday	42
Thursday	33
Friday	42
Saturday	48
Sunday	33

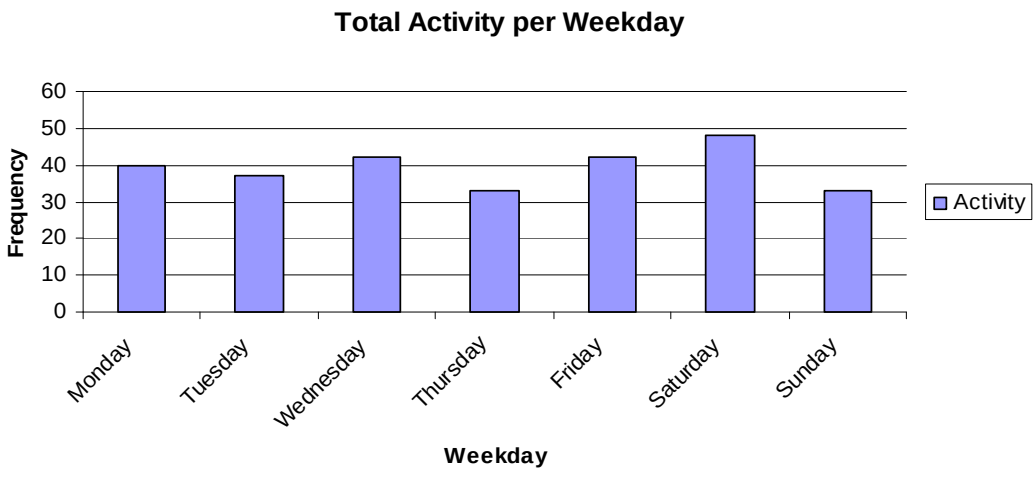

Figure 1. Total activity throughout each week day
Abbildung 1. Gesamtaktivität von jedem Wochentag

General Activity Budget

The general activity budget was then calculated by adding each time interval for all weekdays. Table 2 and Figure 2 display the total activity during the opening hours of the watersport facility.

The general activity budget was calculated to demonstrate at what hour of the day the most vehicles were in use in the specified area over the five weeks of observation.

Table 2. Total activity of all vessels in both zones within given time intervals
Tabelle 2. Gesamtaktivität von allen Wassersportfahrzeuge in beiden Zonen innerhalb des gegebenen Zeitintervalls

Time	**Total activity (both zones)**
09:00-10:00	9
10:00-11:00	35
11:00-12:00	35
12:00-13:00	45
13:00-14:00	32
14:00-15:00	26
15:00-16:00	52
16:00-17:00	41

The highest activity occurred between 15:00 and 16:00. The first time interval, when the facility opens, showed the lowest activity followed by strong increase to a much more active phase an hour later. The active phase remains high with a short drop at 14:00, and then a sudden increase an hour later to the maximum value of 52.

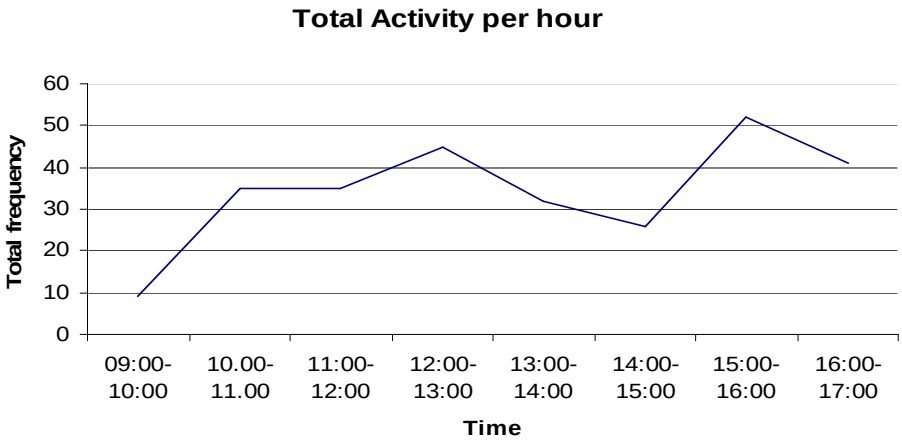

Figure 2. Total activity of all vessels in both zones within given time interval
Abbildung 2. Gesamtaktivität von alle Wassersporfahrzeuge in beiden Zonen innerhalb gegebene Zeitintervalle

Total activity budget for vessels and zones

Table 3 is a more complex presentation of the general activity budget designed to display the difference in activity within the two zones of observation the safe zone (SZ) and the permitted zone (PZ). It also shows how active each of the vessel categories were in that particular zone. This table was created by adding together the activity of each vessel category in each zone for all weekdays for each time interval.

Table 3. Activity diffentiation of each watersport vessel category in each zone
Tabelle 3. Activitätsdifferenzierung von jeder Wassersport Kategorie in den einzelnen Zonen..

Time interval	Zone	Jet ski	Water sports boat	Rented boat	All vehicles
09:00-10:00	SZ	1	4	1	6
	PZ	2	0	1	3
10:00-11:00	SZ	3	6	0	9
	PZ	23	0	3	26
11:00-12:00	SZ	3	11	2	16
	PZ	18	0	1	19
12:00-13:00	SZ	4	19	1	24
	PZ	20	1	0	21
13:00-14.00	SZ	6	10	2	18
	PZ	0	14	0	14
14:00-15:00	SZ	2	10	2	14
	PZ	8	3	1	12
15:00-16:00	SZ	5	19	4	28
	PZ	13	8	3	24
16:00-17:00	SZ	4	16	1	21
	PZ	10	9	1	20
Total activity	SZ	28	95	13	136
	PZ	94	35	10	139
	Both Zones	122	130	23	275

The highest overall activity was shown by the leisure boat category with a total frequency of 130 in both zones.

The most frequently seen vessels crossing the safe zone were the water sport boats, whilst jet skis were the most frequently seen category in the permitted zone. The jet skis are the only category of the three where activity was much higher in the permitted zone versus safe zone. In contrast, the leisure boats show a high activity in the safe zone in Fig. 7. The following diagrams, Figure 3. to 5., are a representation of Table 3. showing the total activity in each zone, displaying the proportion of activity of each vessel category in the zones.

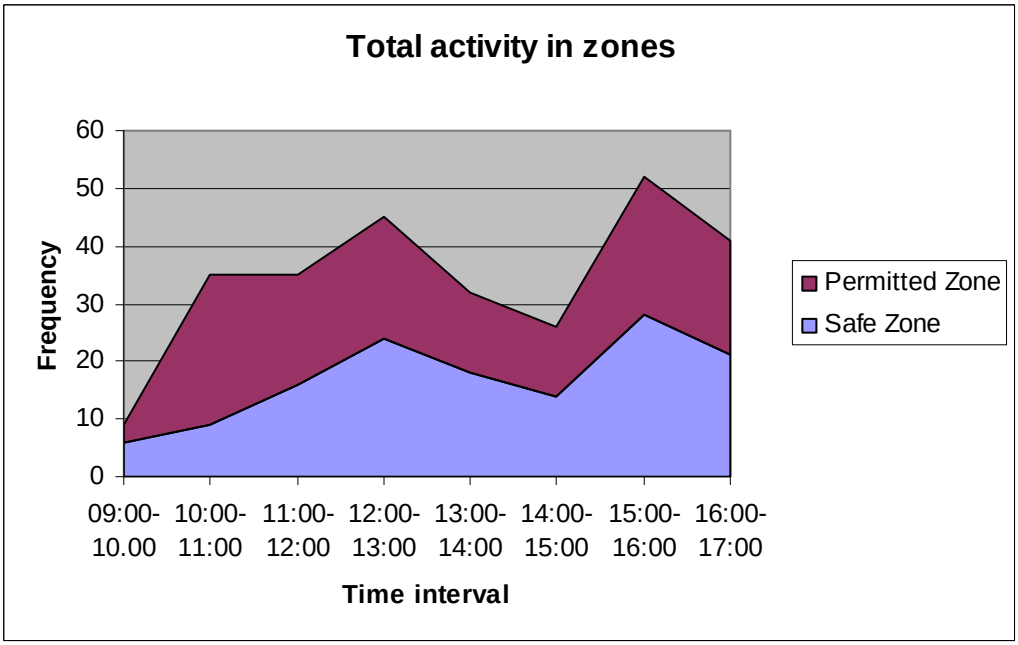

Figure 3. Total activity of all water sport vessels with zone differentiation within given time intervals
Abbildung 3. Gesamtaktivität aller Wassersportfahrzeuge mit Zonenunterteilung in gegebenen Zeitintervallen.

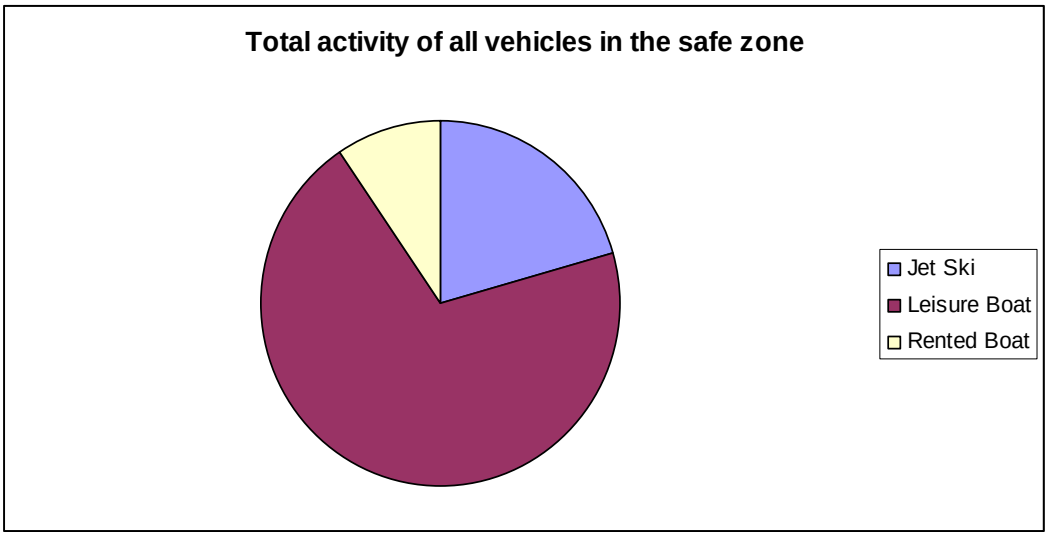

Figure 4. Total activity within the safe zone of each water sport vessel category
Abbildung 4. Gesamtaktivität innerhalb der “safe zone” von jeder Wassersportfahrzeug-Kategorie

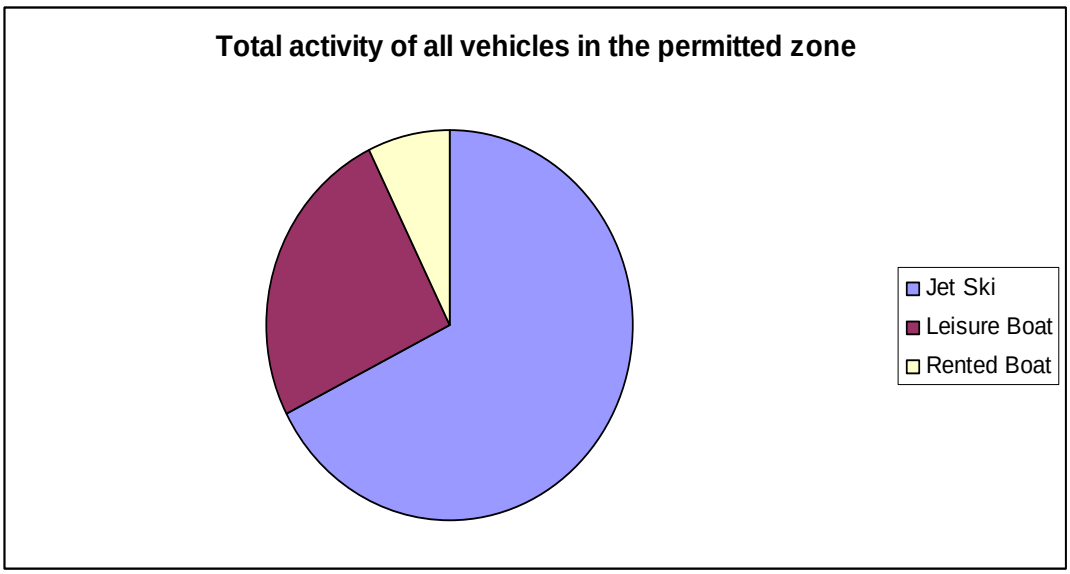

Figure 5. Total activity within the permitted zone of each water sport vessel category

Abbildung 5. Gesamtaktivität innerhalb der “permitted zone” von jeder Wassersportfahrzeugkategorie

DISCUSSION

The total activity on each separate weekday (Appendix 2) and the summary of these results in table 1. shows that Saturday is the day with the highest frequency of observed water sport vessels passing through both zones. All figures for every weekday attached in appendix 2 show a strong increase in vessel activity before noon and a strong decline at a certain hour after 12:00.

The general activity budget (Table 2) shows that the maximum frequency of 52 was between 15:00 and 16:00. The frequencies in this table are all generally high after 10:00 (one hour after the facility opens) with no distinct differences between early and late afternoon. The second highest frequency was recorded between 12:00 and 13:00, followed by a decrease in activity until the maximum at 16:00. The general activity budget proves that water sport vessel activity can be high at any time after the opening hour (9:00- 10:00).

The activity of all vessels combined in the permitted zone is only slightly higher than in the safe zone (Table 3). Moreover, the activity of certain vessel categories shows a higher frequency in the safe zone than in the permitted zone. This is particularly true for the water sport boats, which were in the safe zone three times more often than in the permitted zone. In contrast, the jet skis, which had the second highest observed total activity, showed their maximum in the permitted zone. The number of observed rented boats is very low and their values will not be further discussed here.

This difference in the activity of jet skis and water sport boats within each zone may reveal the general behaviour and attitude of the vessel operators. Jet skis are mostly driven by customers, whilst water sport boats are only operated by facility staff. The safe zone is even marked as prohibited on a sign near the facility for all customers to see. This indicates that customers tend to adhere to the rules but that the water sport staff tends to ignore them. Very often, water sport boats crossed the waters of the safe zone from one pier to pick up guests from the other (Appendix 1, Fig. 9). It is difficult to propose a reasonable alternative to this convenient route, but one turtle-friendly solution would be to impose a strict speed limit within this area.

The results address a general issue in conservation biology. It is often the case that people residing in or having a holiday in an area unaware of turtle nesting activity. This is also the

case for the two nearby beaches Yaniklar and Akgöl. Alternatively, some people are aware and are simply indifferent to it. Nonetheless the results point to carelessness out of convenience, and discussions with the staff of the water sports centre in the upcoming years is one potential strategy to improve the situation.

This, however, does not solve the general problem that these vessels pose a major threat to sea turtles foraging around the area.

Various studies using technical devices such as TDrs (time-depth recorders) show that turtles are most at risk after a false crawl event, within 12h after nesting and the night before returning to the beach to nest (Sobin et al. 2008).

The observations were carried out, as mentioned previously in the introduction, over a period of five weeks during the whole of July till the first week of August. The month July usually still shows nesting activity in the region of Fethiye, and in 2011 a number of turtles were seen laying or attempting to lay a nest on Akgöl beach, the smaller of the two nesting beaches which is also closer to the watersport centre. Alternatively, the smaller vessels as well as the larger boats that left the piers to pick up tourists (Fig. 10) pose a danger to the turtles nesting on both beaches.

The internesting behaviour of turtles is an important aspect and can vary with the region. Research on internesting behaviour of the Loggerheads in Fethiye could promote its conservation there. Assessing the dive behaviour, for example, could help evaluate the risk of boat collisions and allow efficient measures to be taken that protect the turtles without harming the tourist industry. Strategies could include the introduction of obligatory routes or corridors, which in the case of Yaniklar beach, should probably be set up differently to how they currently are.

Direct research on internesting behaviour is difficult to perform and requires technical equipment (for example TDrs and satellite tags). Other methods that can also provide important information on potential collision risk are those that study the vessels themselves. One factor that is relevant for the topic is the boat draft. The boat draft describes the depth of water occupied by a boat in the water at any given time. Its value increases with the length of the vessel (Sobin et al. 2008). Accordingly, the vessels belonging to the facility could be measured and correlated with another important factor not considered in this study, namely the water depth in the area.

Another significant factor in vessel collisions with turtles is boat speed. A slow boat can clearly be more easily evaded by a turtle and would cause less damage to the animal that it strikes.

According to previous field experiments, a vessel at planing speed (40km/h) causes considerable damage, while one at idle speed (7km/h) only does so in four out of ten trials (Sapp 2010). Speed limitations within the obligatory routes are therefore highly recommended.

Regarding injuries due to the vessel propulsion systems, one approach is to install less dangerous systems or cover the propellar with a metallic grid.

Clearly, mitigation strategies are available. Their introduction and enforcement, however, is ultimately dependent on cooperation with the authorities in the area and, of course, the local residents, in this case the water sport centres staff. Unfortunately, even simple protection measures, such as the existing zones that are even there to protect tourist from boat traffic, are not followed for various reasons. This calls for continuing research to provide support for these measures.

This thesis is one step in this direction. It could be used as a template to inspire further activity studies on water sport vessels or other boats to build up a database. This, combined with concrete action, could help protect the sea turtle species in this area.

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Hazel, Lawler, Marsh, Robson 2007: Endangered Species Research Vol. 3: 105-113; Vessel speed increases collision risk for the Green Turtle *Chelonia mydas*

Sobin, Eckert 2008: Diving Behaviour of female Loggerhead Turtles (*Caretta caretta*) during their internesting interval and an evaluation of the risk of boat strikes

Adam Sapp; 2010: Influence of small vessel operation and propulsion system on Loggerhead sea turtle injuries

Appendix 1 - Photographs

Fig.1. Injured juvenile *Caretta caretta* at San Lucjan Rescue Centre, Malta
Fig.1. Verletzte, junge *Caretta caretta* im San Lucjan Rescue Centre, Malta

Fig.2. Injured juvenile *Caretta caretta* at San Lucjan Rescue Centre, Malta
Fig.2. Verletzte, junge *Caretta caretta* im San Lucjan Rescue Centre, Malta

Fig.3. View of the observation area as seen from the Tuana pier
Fig.3. Sicht vom Tuana Steg über die Beobachtungszone

Fig.4. Four of the five jet skis used by the watersport facility at Tuana.
Fig.4. Vier von den fünf Jetskis, die vom Wassersportzentrum verwendet werden

Fig.5. One type of the various water sports boats used by the watersport facility at Tuana.
Fig.5. Beispiel eines der water sports boats, die von dem Wassersportzentrum verwendet werden

Fig.6. The 60 Hp boat for rent offered by the watersport facility at Tuana.
Fig.6. Ein 60 Hp Boot, welches vom Wassersportzentrum zum Vermieten an Touristen verwendet wird

Fig.7. Water sport boat crossing safe zone
Fig.7. Wassersportfahrzeug beim Durchqueren der Schutzzone

Fig.8. Water sports bot pulling Parasail and two jet skis in safe zone
Fig.8. Wassersportfahrzeug mit Parasail und zwei Jetskis in der Schutzzone

Fig.9. Water sports boat without customers crossing the safe zone from Botanika to Tuana pier.
Fig.9. Wassersportfahrzeug ohne Fahrgäste beim Überqueren der Schutzzone vom Botanika zum Tuana-Steg.

Fig.10. Large vessel crossing the safe zone transporting guests to Tuana pier.
Fig.10. Großes Ausflugsboot beim Überqueren der Schutzzone, um Gäste zum Tuana Steg zu transportieren.

All photographs taken by Paula Thake

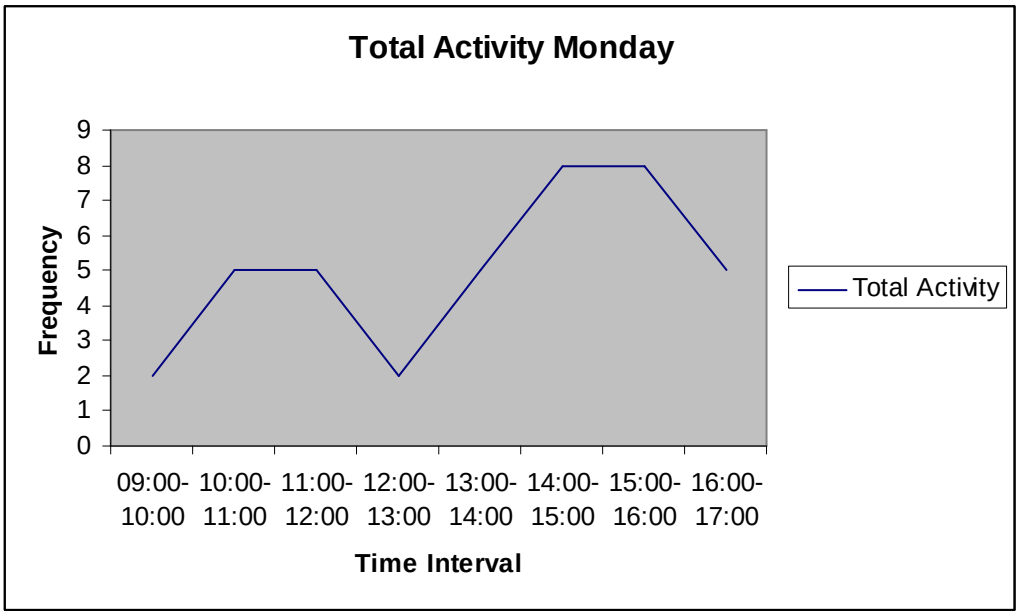
Maps

Fig.11. Google Earth map of observation area showing piers and nesting beaches.
Fig.11. Google Earth Karte von der Beobachtungszone mit Hotelstege und Niststrände.

Appendix 2

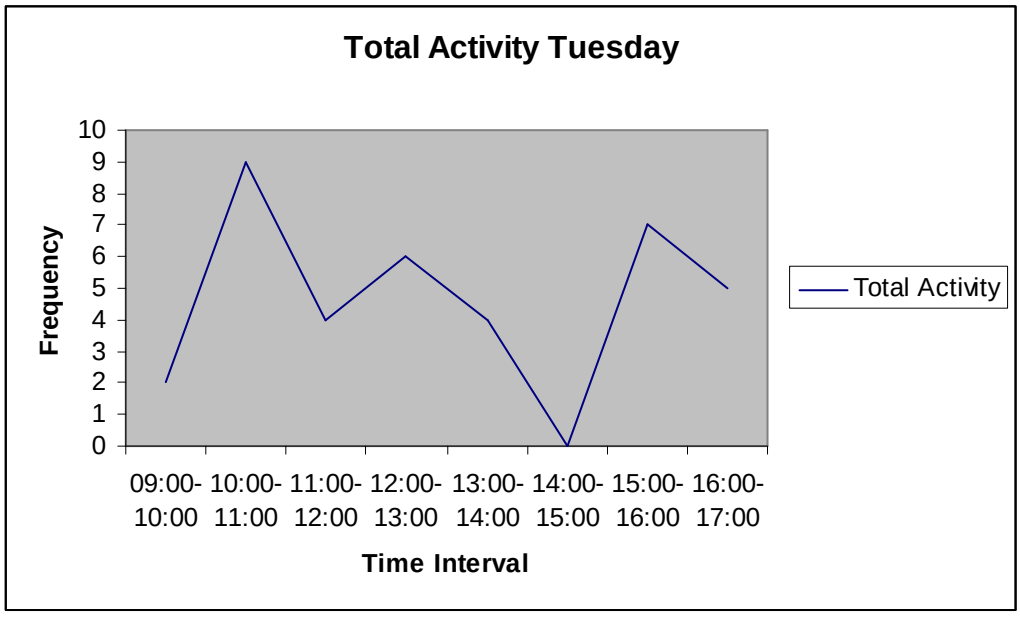
Total Activity Monday

Time interval	Vehicle	Safe zone	Permitted zone	Total activity
09:00-10.00	Jet Ski	0	0	2
	Water sport boat	0	0	
	Rented boat	1	1	
10:00-11:00	Jet Ski	0	3	5
	Water sport boat	0	0	
	Rented boat	0	2	
11:00-12:00	Jet Ski	0	3	5
	Water sport boat	2	0	
	Rented boat	0	0	
12:00-13:00	Jet Ski	0	0	2
	Water sport boat	2	0	
	Rented boat	0	0	
13:00-14:00	Jet Ski	0	0	5
	Water sport boat	3	2	
	Rented boat	0	0	
14:00-15:00	Jet Ski	1	4	8
	Water sport boat	1	1	
	Rented boat	0	1	
15:00-16:00	Jet Ski	0	3	8
	Water sport boat	3	1	
	Rented boat	0	1	
16:00-17:00	Jet Ski	1	2	5
	Water sport boat	1	1	
	Rented boat	0	0	



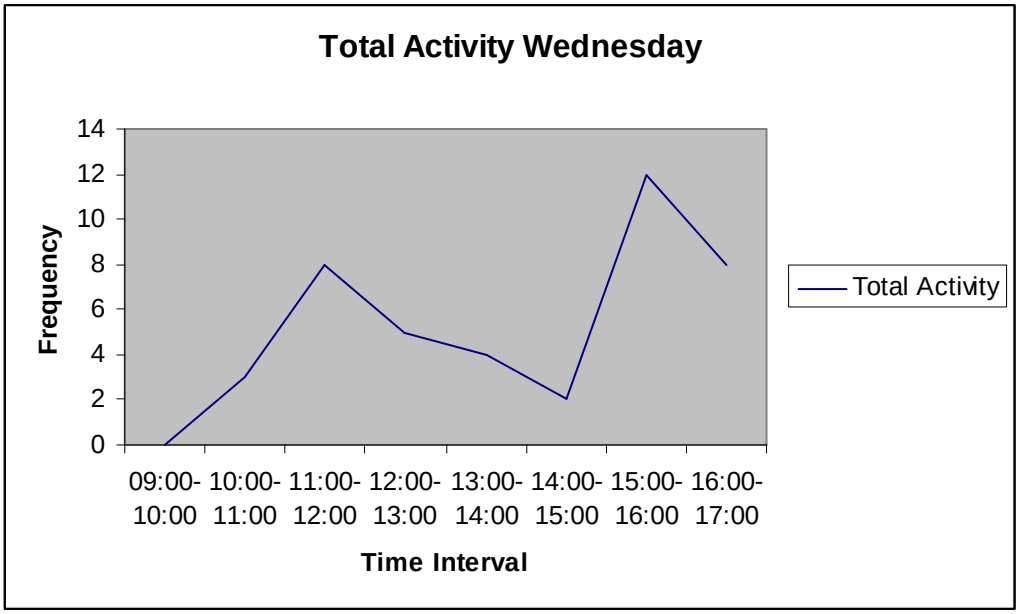
Total Activity Tuesday

Time interval	Vehicle	Safe zone	Permitted zone	Total activity
09:00-10.00	Jet Ski	0	0	2
	Water sport boat	2	0	
	Rented boat	0	0	
10:00-11:00	Jet Ski	0	3	9
	Water sport boat	6	0	
	Rented boat	0	0	
11:00-12:00	Jet Ski	0	2	4
	Water sport boat	2	0	
	Rented boat	0	0	
12:00-13:00	Jet Ski	2	1	6
	Water sport boat	3	0	
	Rented boat	0	0	
13:00-14:00	Jet Ski	0	0	4
	Water sport boat	2	2	
	Rented boat	0	0	
14:00-15:00	Jet Ski	0	0	0
	Water sport boat	0	0	
	Rented boat	0	0	
15:00-16:00	Jet Ski	1	2	7
	Water sport boat	3	1	
	Rented boat	0	0	
16:00-17:00	Jet Ski	0	0	5
	Water sport boat	3	1	
	Rented boat	1	0	



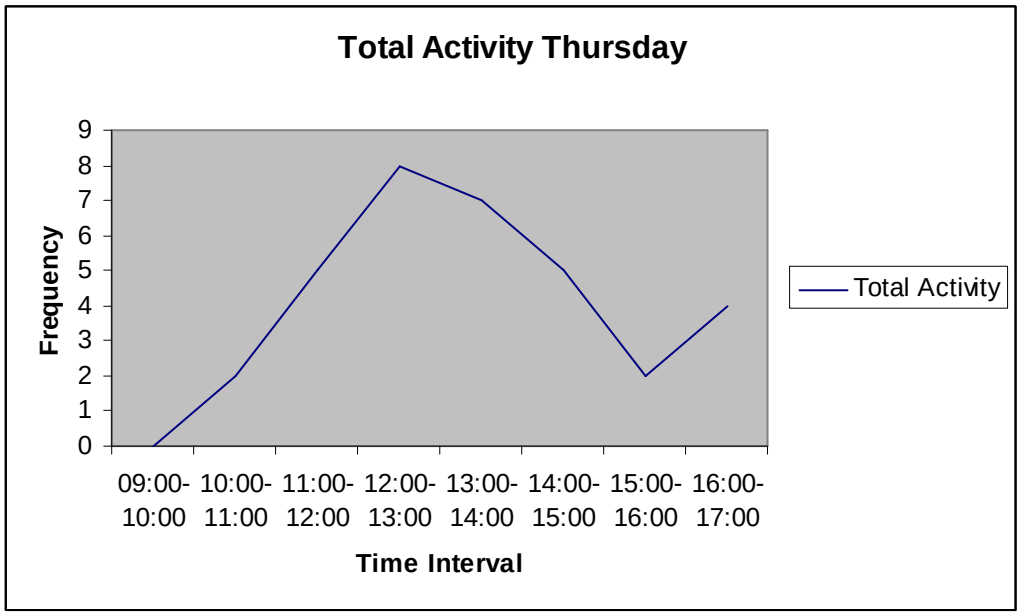
Total Activity Wednesday

Time interval	Vehicle	Safe zone	Permitted zone	Total activity
09:00-10.00	Jet Ski	0	0	0
	Water sport boat	0	0	
	Rented boat	0	0	
10:00-11:00	Jet Ski	0	2	3
	Water sport boat	0	0	
	Rented boat	0	1	
11:00-12:00	Jet Ski	0	3	8
	Water sport boat	3	0	
	Rented boat	1	1	
12:00-13:00	Jet Ski	0	2	5
	Water sport boat	3	0	
	Rented boat	0	0	
13:00-14:00	Jet Ski	0	0	4
	Water sport boat	3	1	
	Rented boat	0	0	
14:00-15:00	Jet Ski	0	1	2
	Water sport boat	0	1	
	Rented boat	0	0	
15:00-16:00	Jet Ski	0	4	12
	Water sport boat	4	2	
	Rented boat	1	1	
16:00-17:00	Jet Ski	1	1	8
	Water sport boat	3	3	
	Rented boat	0	0	



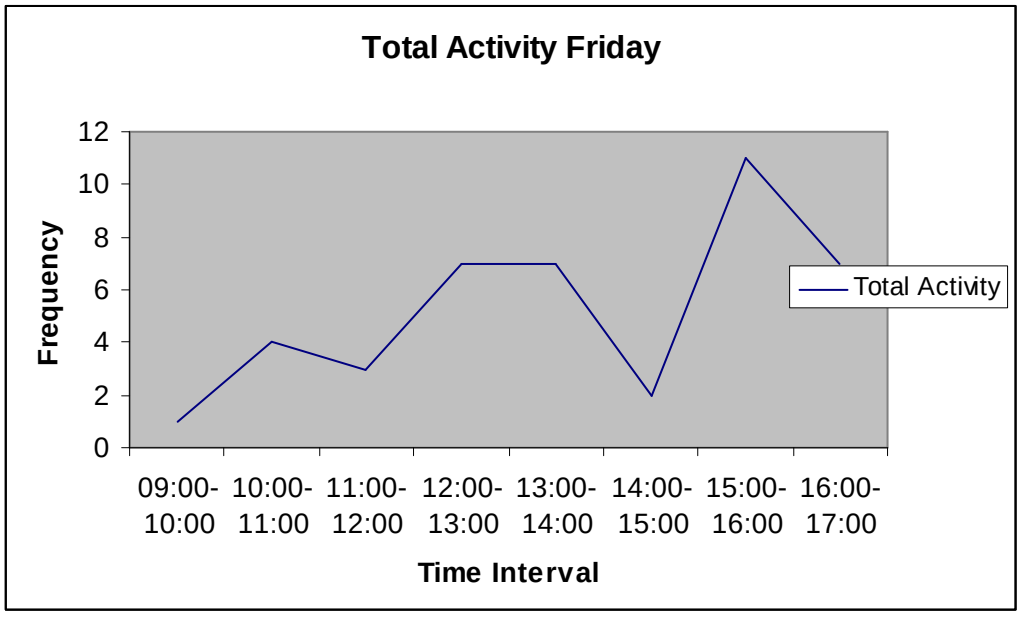
Total activity Thursday

Time interval	Vehicle	Safe zone	Permitted zone	Total activity
09:00-10.00	Jet Ski	0	0	0
	Water sport boat	0	0	
	Rented boat	0	0	
10:00-11:00	Jet Ski	1	1	2
	Water sport boat	0	0	
	Rented boat	0	0	
11:00-12:00	Jet Ski	0	2	5
	Water sport boat	3	0	
	Rented boat	0	0	
12:00-13:00	Jet Ski	0	5	8
	Water sport boat	2	0	
	Rented boat	1	0	
13:00-14:00	Jet Ski	0	4	7
	Water sport boat	0	2	
	Rented boat	1	0	
14:00-15:00	Jet Ski	0	2	5
	Water sport boat	2	0	
	Rented boat	1	0	
15:00-16:00	Jet Ski	1	0	2
	Water sport boat	0	0	
	Rented boat	1	0	
16:00-17:00	Jet Ski	0	3	4
	Water sport boat	1	0	
	Rented boat	0	0	



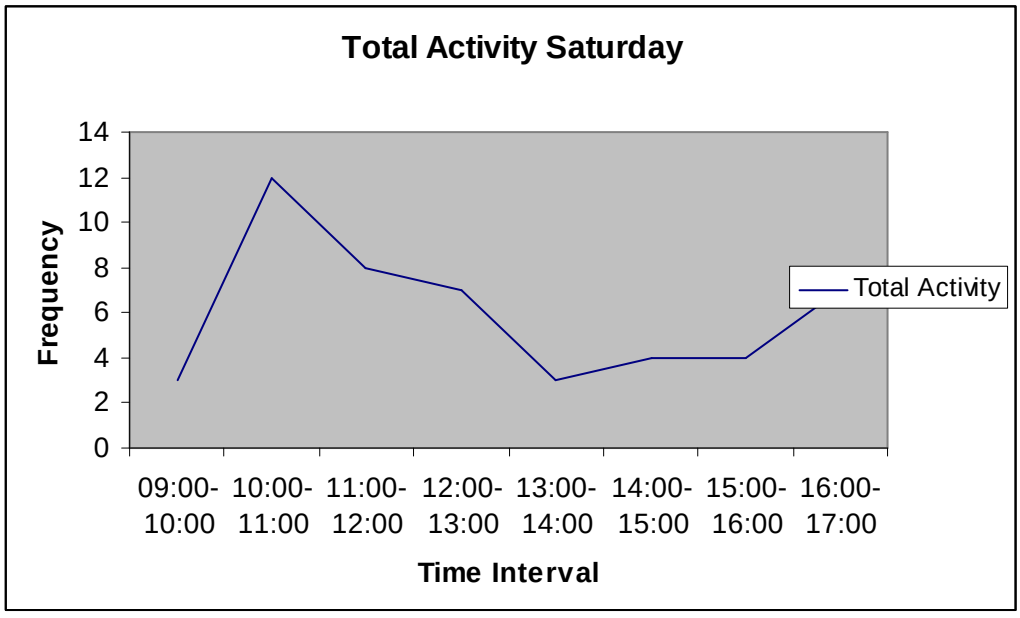
Total activity Friday

Time interval	Vehicle	Safe zone	Permitted zone	Total activity
09:00-10.00	Jet Ski	1	0	1
	Water sport boat	0	0	
	Rented boat	0	0	
10:00-11:00	Jet Ski	2	2	4
	Water sport boat	0	0	
	Rented boat	0	0	
11:00-12:00	Jet Ski	1	2	3
	Water sport boat	0	0	
	Rented boat	0	0	
12:00-13:00	Jet Ski	1	5	7
	Water sport boat	1	0	
	Rented boat	0	0	
13:00-14:00	Jet Ski	0	2	7
	Water sport boat	2	3	
	Rented boat	0	0	
14:00-15:00	Jet Ski	0	0	2
	Water sport boat	2	0	
	Rented boat	0	0	
15:00-16:00	Jet Ski	2	2	11
	Water sport boat	5	2	
	Rented boat	0	0	
16:00-17:00	Jet Ski	0	1	7
	Water sport boat	5	1	
	Rented boat	0	0	



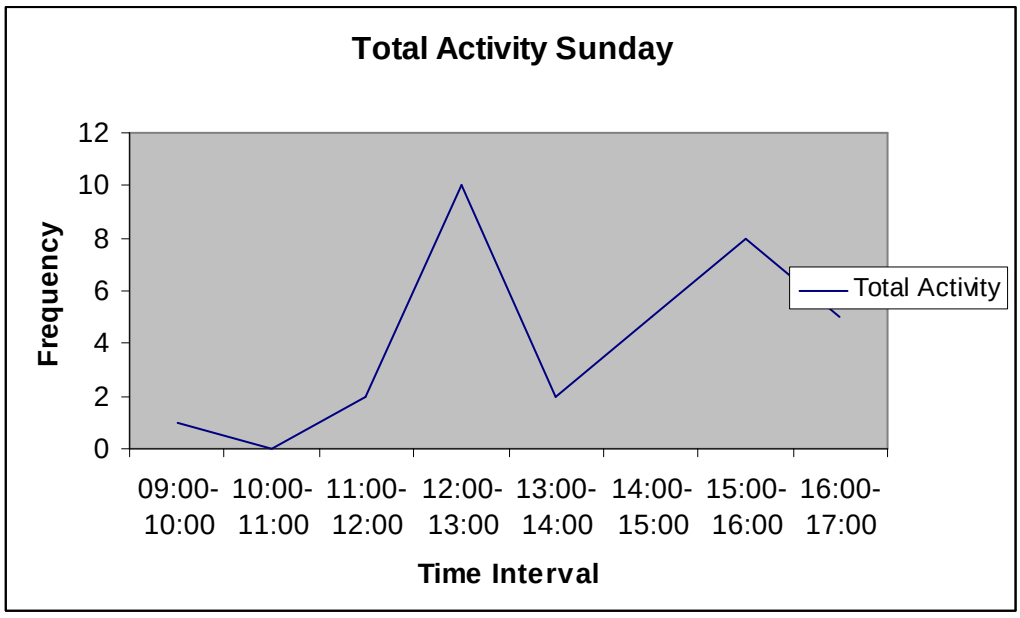
Total Activity Saturday

Time interval	Vehicle	Safe zone	Permitted zone	Total activity
09:00-10.00	Jet Ski	0	2	3
	Water sport boat	1	0	
	Rented boat	0	0	
10:00-11:00	Jet Ski	0	12	12
	Water sport boat	0	0	
	Rented boat	0	0	
11:00-12:00	Jet Ski	1	6	8
	Water sport boat	1	0	
	Rented boat	0	0	
12:00-13:00	Jet Ski	1	3	7
	Water sport boat	3	0	
	Rented boat	0	0	
13:00-14:00	Jet Ski	0	0	3
	Water sport boat	2	0	
	Rented boat	1	0	
14:00-15:00	Jet Ski	0	0	4
	Water sport boat	2	1	
	Rented Boat	1	0	
15:00-16:00	Jet Ski	1	2	4
	Water sport boat	0	1	
	Rented boat	0	0	
16:00-17:00	Jet Ski	1	3	7
	Water sport boat	1	2	
	Rented boat	0	0	



Total activity Sunday

Time interval	Vehicle	Safe zone	Permitted zone	Total activity
09:00-10.00	Jet Ski	0	0	1
	Water sport boat	1	0	
	Rented boat	0	0	
10:00-11:00	Jet Ski	0	0	0
	Water sport boat	0	0	
	Rented boat	0	0	
11:00-12:00	Jet Ski	1	0	2
	Water sport boat	0	0	
	Rented boat	1	0	
12:00-13:00	Jet Ski	0	4	10
	Water sport boat	5	1	
	Rented boat	0	0	
13:00-14:00	Jet Ski	0	0	2
	Water sport boat	2	0	
	Rented boat	0	0	
14:00-15:00	Jet Ski	1	1	5
	Water sport boat	3	0	
	Rented boat	0	0	
15:00-16:00	Jet Ski	0	0	8
	Water sport boat	3	1	
	Rented boat	3	1	
16:00-17:00	Jet Ski	1	0	5
	Water sport boat	2	1	
	Rented Boat	1	0	



Bachelor Thesis

Seafinding orientation of sea turtle hatchlings (loggerhead turtle, *Caretta Caretta*)

Patrick Randa

Aspired academic title
Bachelor of Science (BSc)

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KURZFASSUNG

Unter natürlichen Bedingungen, schlüpfen Meeresschildkröten primär in der Nacht. Sie graben sich ihren Weg durch den Sand bis sie die Oberfläche erreichen. Dort angekommen versuchen sie so schnell wie möglich das Meer zu erreichen. Die Orientierung der kleinen Schildkröten hängt von verschiedenen Faktoren ab. Einerseits werden sie von hellen Arealen oder den hellsten Punkten ihrer Umgebung angezogen andererseits versuchen sie dunkle Silhouetten zu vermeiden. Der Einfluss künstlicher Lichtquellen ist bei der Orientierung Richtung Meer sehr stark. In einem 5 wöchigen Praktikum der Universität Wien sammelte ich Daten. Stichproben von 13 Nestern sollen zeigen, ob Hatchlinge (geschlüpfte Meeresschildkröten) den direkten Weg ins Meer finden, oder ob sie durch diverse Lichtverschmutzung abweichen. Der Niststrand von Yaniklar ist ein Special Enviromental Protection Area. Trotzdem befinden sich zwei große Hotelanlagen und weitere kleine Camping Plätze auf diesem Strand. Der Balance Akt zwischen Tourismus, Wirtschaft und dem Naturschutz wird immer wichtiger. Um die Sterblichkeit der Meeresschildkrötenjungen zu verringern ist es notwendig die Lichtverschmutzung durch künstliche Lichtquellen zu reduzieren und die Kontrollen am Strand während der Nistzeit zu erhöhen. Es muss jedoch Aufgabe der Regierung und der lokalen Bevölkerung sein diese Schritte zu unternehmen. Wissenschaftler, NGOs und Organisationen können dabei nur Aufklärungsarbeit leisten und die Bevölkerung und die Freiwilligen dabei unterstützen die Schildkröten zu schützen. Die Ergebnisse der Untersuchungen zeigen, dass wenn künstliche Lichtquellen vorhanden sind, Die Meeresschildkrötenjungen abgelenkt werden. Auf dem Strandabschnitt Akgöl könnten Schildkröten die vor Mitternacht geschlüpft und die Oberfläche erreicht haben, durch die Signallichter des Fahnenmasts am Anleger des Hotel Majesty Club Tuana Park abgelenkt worden sein. Am Abschnitt Yaniklar erreichten die meisten Meeresschildkröten die direkt, ohne Ablenkung das Meer. Nur einige wenige wurden leicht abgelenkt, fanden jedoch trotzdem ins Meer. Nur ein Nest zeigte eine gravierendere Ablenkung.

Schlüsselwörter: *Caretta caretta*, Lichtverschmutzung, Orientierung, Ablenkung

ABSTRACT

Under natural conditions, sea turtle hatchlings emerge from their nests primarily at night. They dig their way through the sand until they reach the surface. Their only intention is to get into the ocean. The seaward orientation of hatchlings depends on various factors. They are attracted by the brightest areas or points in their surroundings and they avoid dark

silhouettes. The impact of artificial lights is therefore very strong. In a five-week project of the University of Vienna I collected data to see how sea turtle hatchlings orientate, why they deviate from their path to the sea and how far they crawl until they reach the sea. The nesting beach of Yaniklar is a Special Environmental Protection Area. Nevertheless, two big hotel complexes and a several smaller camping sites are on this beach. The balancing act between tourism, economics and the protection of the environment is becoming increasingly important. Reducing the light pollution, as well as stronger controls of the beach during the nesting period, would help to reduce the mortality rate of hatchlings. These efforts have to be done by the local government and the local residents at Yaniklar. Scientists and organisations can support and help them and make clear how important the protection of marine turtles is. The results of the examination show that, if there are artificial light sources, the hatchlings are distracted. At the Agköl section, hatchlings which reached the surface before midnight could have been distracted by the signal lights of the flagpole at the jetty of the Hotel Majesty Club Tuana Park. At the Yaniklar section, most of the hatchlings crawled straight into the sea. A few hatchlings were minimally distracted but found their way into the sea. Only one nest showed a major distraction.

Keywords: *Caretta caretta*, light pollution, orientation, distraction

INTRODUCTION

When sea turtle hatchlings emerge from their nests at night, they try to reach the sea as fast as possible. The orientation is guided by visual signals. Hatchlings always attempt to move away from dark silhouettes and towards the brightest areas on the horizon or spots in their surroundings (ocean surface, lights on the beach). The result is that sea turtle hatchlings try to reach the sea and move away from vegetation and trees on the beach.The orientation can be disturbed by vegetation on the beach, such as bushes and high plants which cover the horizon or the reflecting sea (Godfrey and Barreto, 1995). Hatchlings are also deviated by artificial light because it interferes with natural cues (Bourgeois et al., 2009). Not only the reduction of lights on the beach can raise the nesting success, but also the restoration of dunes. Pairing light reduction with dune restoration should significantly improve the orientation of hatchlings (Tuxbury and Salmon, 2005).

The beach in Yaniklar, Turkey is major nesting beach of loggerhead sea turtles (*Caretta caretta*) is divided in two parts: Yaniklar and Akgöl. The two parts are separated by a river. A bridge connects the two sections. Most of the substrate of Akgöl is pebbles and cobbles. There is a sandy area at the northern end of the beach. The beach is flat and the vegetation starts far in the back. The Yaniklar section is sandier, less flat and littered. The first kilometer is a mixture of sand and pebbles, cobbles and litter. The vegetation contains small grasses and bushes. The middle section is only cobbles and quite steep. The end of the beach is sandy both in the middle and back, the intertidal zone is stony. It is a Special Enviromental Protection Area (SEPA), but there are two big hotel complexes and a few smaller camping sites. The beach is also well frequented by tourists from both abroad and locally. The next village Calis, a touristic area with a bright boardwalk, is located on the east. This leads to a conservation problem for sea turtles. The light pollution from Calis and its promenade disrupts the orientation of hatchlings. This causes them to crawl away from the sea, towards the brightest object in their sight. The hotels have long jetties with big flag poles bearing signal lights. Since this year, the hotel managers are apparently trying to make their lights more sea turtle friendly: The signal lights on the flag poles are switched off in the late night; the lights at foot path of the Lykia Botanika Beach Club were covered on one side with black paint, so they reflected their light away from the beach.

To determine if the light pollution is high enough to distract hatchlings from their way to the sea, the tracks of emerged hatchlings where recorded over a period of 5 weeks. The main aim was to determine how far they have to crawl until they reach the sea. Additionally, an attempt

was made to document why they deviate from the direct path to the ocean (light pollution, or other reasons), how far they deviate from this direct track and in which direction they spread.

MATERIAL AND METHODS

The beach of Yaniklar is divided in two parts, Yaniklar and Akgöl. The total distance of the section in Yaniklar (so called long way) was about 3.7km. The total distance of Akgöl (so called short way) was about 1.6 km. Every day, two teams, consisting of two to three people, inspected those beach sections and controlled the nests. The team members operated from a site called “Onur Camping”. The shifts started here. The morning shift started at 6:00 and was adapted to sunrise. So, in late summer, September, it started around 6:30. The two shifts were done alternately. The teams were equipped with a back-bag. The equipment contained: the shift-book, a tape measure, gloves, a measuring rod and a bucket (if hatchlings had to be transported back to the base camp). During the shift the team members controlled the beach and looked out for sea turtle tracks. The team members walked parallel to each other at a certain distance: one person walked on the upper side of the beach, one in the middle and one at the waterline. Nests which were already known were marked on a map noted in the shift-book. The book also contained a table when the specific nests should hatch. The nests were numbered with the letter “Y” for Yaniklar and with the letter “A” for Akgöl and a number for their date of discovery. If the turtle hadn’t been observed during nest laying and only tracks of hatchling were sighted, the nests were termed “Secret nests”. Secret nests were marked on the list with an “S” after the “Y” or “A”. For example “Y3” for a nest where the body pit of a sea turtle or the sea turtle itself was spotted. Or “YS3” for a nest where only the hatchling tracks were found or the nest was found but without date. The data collection was done from 14 August until 10 September. If new tracks were found, the lengths were measured and the total number of tracks was counted. If they deviated from a straight line to the sea, then we noted how far and in which direction. A sketch was drawn. After the shift was completed, the data was digitalized on a computer-written data sheet. The data sheet contained a table in which the total number of tracks, the distance nest-sea, the sectors 1 – 8; in a radius of 3-4 m, the close vicinity of the nest was divided in 8 sectors. These sectors were important to see if the hatchlings crawled directly to the sea or deviated from their path. On the data sheet this sectors are arranged in a circle around the nest. This was done to make it easier to see in which direction the hatchling crawled. The data sheet also contained the total numbers of hatchlings reached the sea; number of hatchlings died because of heat, disorientation or got

stuck in an obstacle. The data sheet contained a sketch illustrating the distance from nest to the sea. The overall time of a nest lasted from the first hatch until the last one. Because of the changing shifts every day it was not possible to observe each nest daily. So the data collection is random. The data from the observation can differ from the main results (which show the total number of hatchlings). Four days after the last hatch, the nests were excavated.

Example of the sectors:

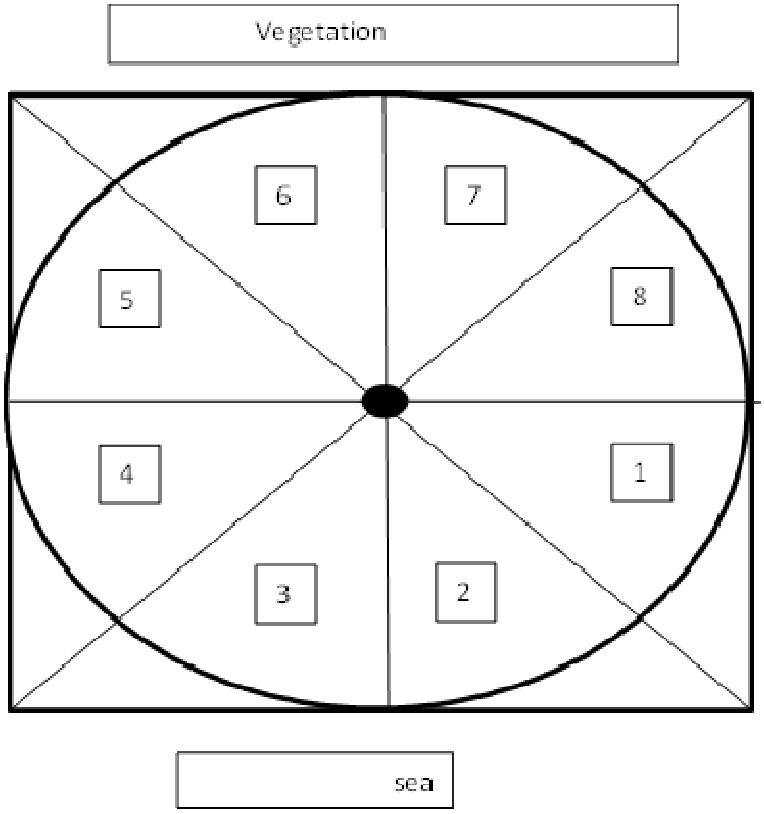

Figure 1: shows the organization of the sectors; black dot in the middle shows the nest
Abbildung 1: zeigt die Anordnung der Sektoren; der schwarze Punkt in der Mitte symbolisiert ein Nest

RESULTS

Total amount of nests in Yaniklar examined: 9

Total amounts of nests in Akgöl examined: 4

Distance nest – sea

Yaniklar:

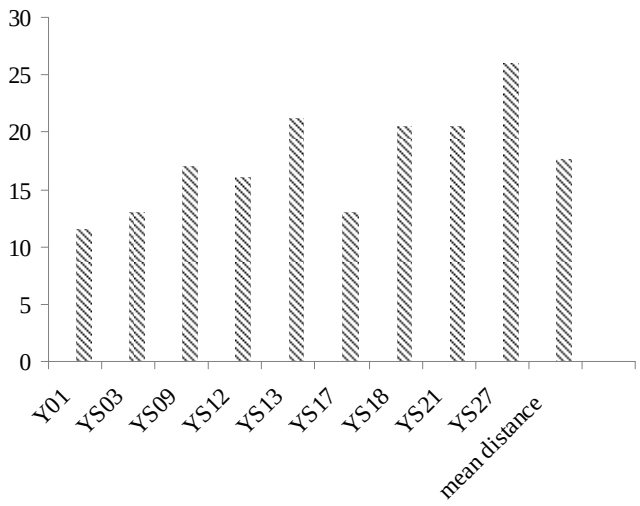

Figure 2: The total distance of each nest to the sea and the mean distance of all observed nests
Abbildung 2: zeigt die totale Distanz jedes Nestes zum Meer und die durchschnittliche Distanz der untersuchten Nester

Figure 2 shows the total distance of the observed nests of the beach section Yaniklar. This is the distance hatchlings had to crawl to reach the sea. Distance “nest-sea” of the observed nests in Yaniklar:

- Y01: 11m
- YS03: 13m
- YS09: 17m
- YS12. 16m
- YS13: 21.2m

- YS17: 13m
- YS18: 20.5m
- YS21: 20.6m
- YS27: 26m

The mean distance of the observed nests to the sea was 17.58m. This is the average distances hatchlings had to crawl from their nests to the sea.

Akgöl:

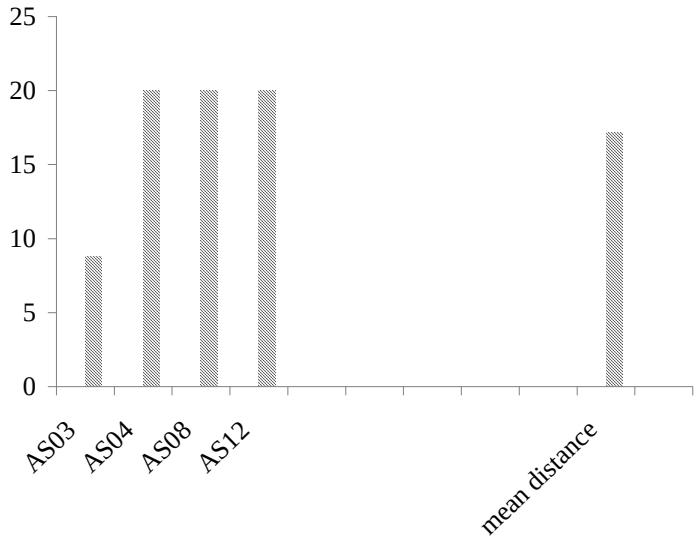

Figure 3: The total distance of each nest to the sea and the mean distance of all observed nests
Abbildung 3: zeigt die totale Distanz jedes Nestes zum Meer und die durchschnittliche Distanz der untersuchten Nester

Figure 3 shows the total distance of the 4 nests selected on the beach section Akgöl. This is the distance hatchlings had to crawl to reach the sea.

Distance “nest - sea” of the observed nests in Agköl:

- AS03: 8.8m
- AS04: 20m
- AS08: 20m
- AS12: 20m

The mean distance of the 4 selected nests is 17.2 m.. This is the average distances hatchlings had to crawl from their nests to the sea.

Deviation of hatchlings on their way to the sea:

Special tracks which were very long were measured and marked with a fat dotted line in the sketch.

Yaniklar:

Y01: Date of observation: 03.09.2011

This nest hatched from 02.09 - 06.09. Total number of hatchlings reached the sea: 56. Total number of eggs: 84.

Three hatchling tracks were found. All three tracks went straight to the sea. No deviation. One track passed sector 3, 2 passed sector 2.

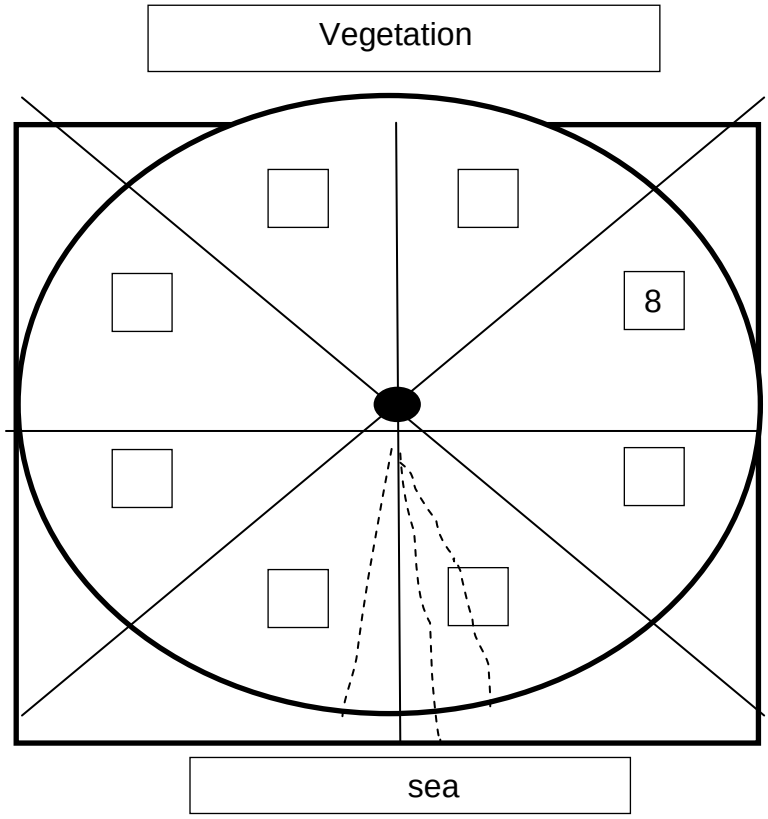

Figure 4: shows the deviation of each hatchling on its way to the sea; the point in the middle shows the nest; the dotted line shows the hatchling track

Abbildung 4: zeigt die Abweichung der Hatchlinge am Weg ins Meer; Punkt in der Mitte symbolisiert das Nest; die strichlierte Linie zeigt die Spur der Hatchlinge

YS03: This nest hatched from 09.08 - 18.08. Total number of hatchlings reached the sea: 111. Total number of eggs: 119.

Dates of observation:

- 15.08.2011
- 17.08.2011
- 18.08.2011

First time of observation (15.08.2011):

7 tracks were found on the first date of observation. All 7 tracks went straight to the sea. No deviation. 3 tracks passed sector 3, 4 tracks passed sector 2.

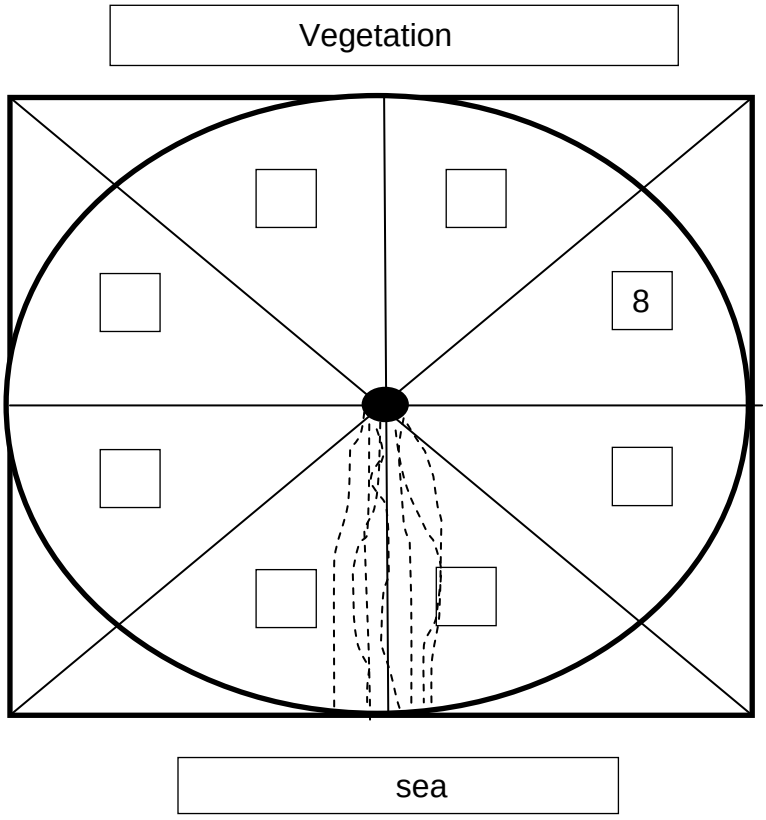

Figure 5: shows the deviation of each hatchling on its way to the sea; the point in the middle shows the nest; the dotted line shows the hatchling tracks

Abbildung 5: zeigt die Abweichung der Hatchlinge am Weg ins Meer; Punkt in der Mitte symbolisiert das Nest; die strichlierte Linie zeigt die Spur der Hatchlinge

Second time of observation (17.08.2011):

Two tracks were recorded on the second date of observation. Both tracks went straight to the sea. No deviation. One track passed sector 3 and one passed sector 2.

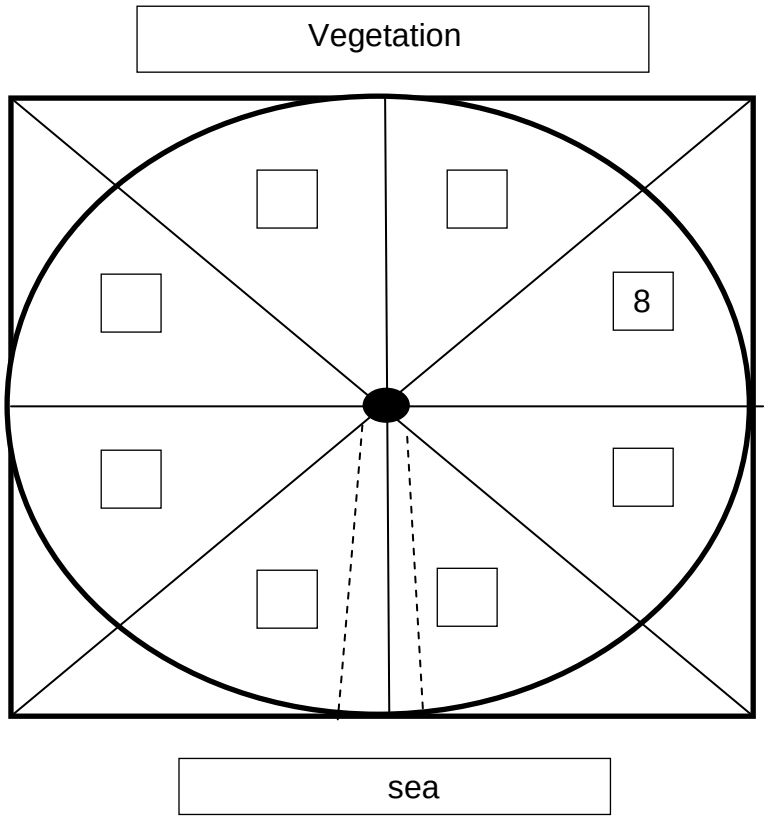

Figure 6: shows the deviation of each hatchling on its way to the sea; the point in the middle shows the nest; the dotted line shows the hatchling tracks

Abbildung 6: zeigt die Abweichung der Hatchlinge am Weg ins Meer; Punkt in der Mitte symbolisiert das Nest; die strichlierte Linie zeigt die Spur der Hatchlinge

Third time of observation (18.08.2011):

Two tracks were found on the third date of observation. Both tracks went straight to the sea. No deviation. One track passed sector 3 and one passed sector 2.

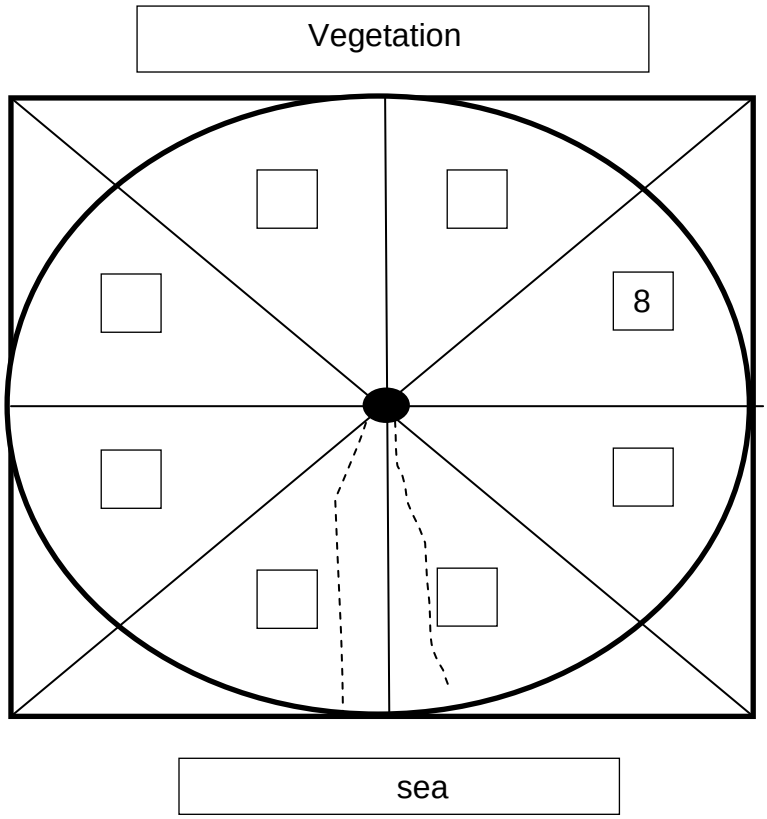

Figure 7: shows the deviation of each hatchling on its way to the sea; the point in the middle shows the nest; the dotted line shows the hatchling tracks

Abbildung 7: zeigt die Abweichung der Hatchlinge am Weg ins Meer; Punkt in der Mitte symbolisiert das Nest; die strichlierte Linie zeigt die Spur der Hatchlinge

YS09: Date of observation was the 15.08.2011

YS09 hatched from 02.08 - 08.08, from 10.08 - 11.08 and on the 15.08. Total number of eggs: 72. Total number of hatchlings reached the sea: 72.

Three tracks were recorded on the observed day. All three tracks went straight to the sea. No deviation. One track passed sector 3 and two passed sector 2.

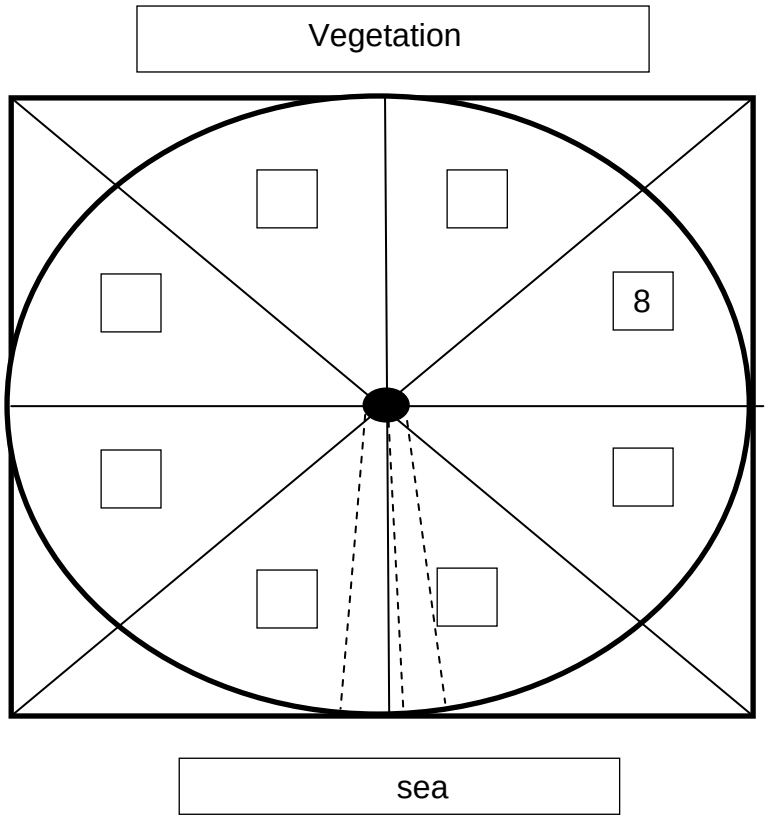

Figure 8: shows the deviation of each hatchling on its way to the sea; the point in the middle shows the nest; the dotted line shows the hatchling tracks

Abbildung 8: zeigt die Abweichung der Hatchlinge am Weg ins Meer; Punkt in der Mitte symbolisiert das Nest; die strichlierte Linie zeigt die Spur der Hatchlinge

YS12: This nest hatched from 11.08 - 21.08. Total number of eggs: 106. Total number of hatchlings reached the sea: 99.

Dates of observation:

- 15.08.2011
- 17.08.2011
- 21.08.2011

First time of observation (15.08.2011):

21 tracks were found on the first day of observation. Six tracks went straight to the sea. 15 deviated from their path but reached the sea. Two disorientated completely and got lost. The two that got lost crawled through sector 6; two tracks passed the sectors 7, 8, 1 and 2; one track passed sector 8 and 1; 6 tracks went straight to the sea through the sectors 2 and 3; two tracks passed sectors 5 and 4. All tracks except 2 reached the sea.

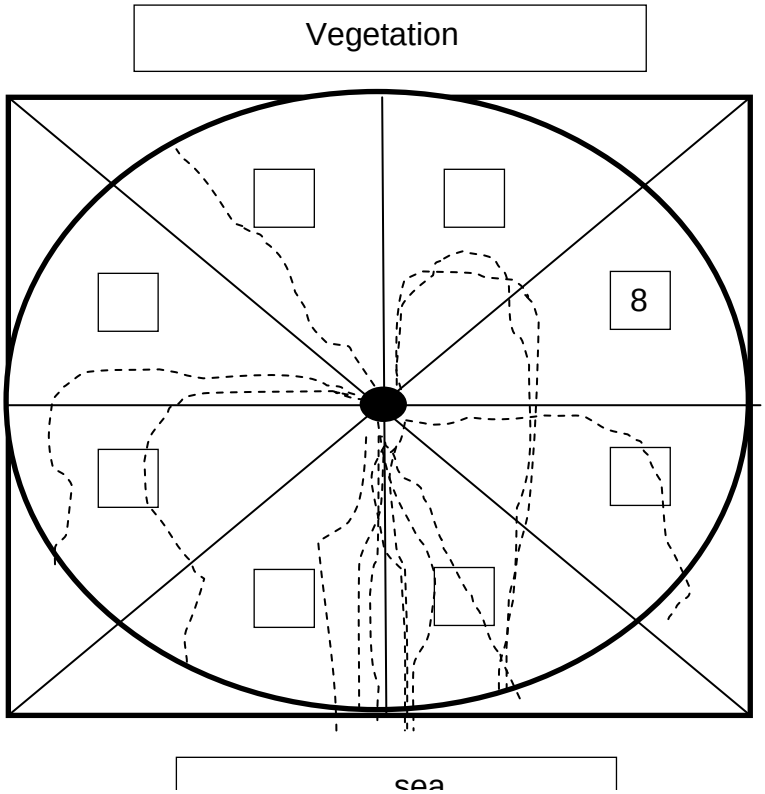

Figure 9: shows the deviation of each hatchling on its way to the sea; the point in the middle shows the nest; the dotted line shows the hatchling tracks

Abbildung 9: zeigt die Abweichung der Hatchlinge am Weg ins Meer; Punkt in der Mitte symbolisiert das Nest; die strichlierte Linie zeigt die Spur der Hatchlinge

Second time of observation (17.08.2011):

1 track was recorded on the second day. The track went straight to the sea. No deviation. The hatchling passed sector 2 on its way to the sea.

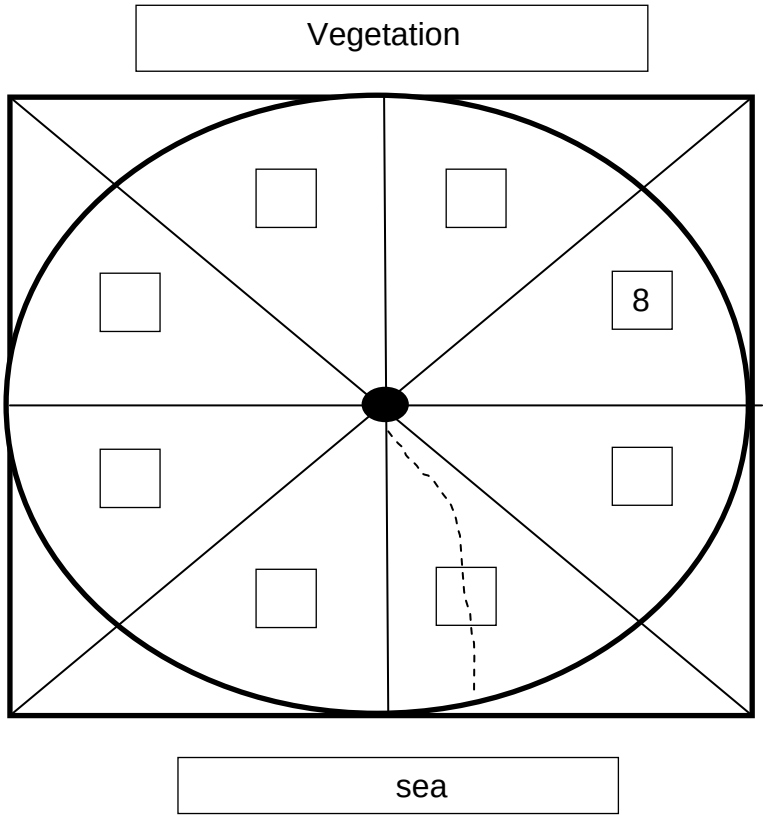

Figure 10: shows the deviation of each hatchling on its way to the sea; the point in the middle shows the nest; the dotted line shows the hatchling tracks

Abbildung 10: zeigt die Abweichung der Hatchlinge am Weg ins Meer; Punkt in der Mitte symbolisiert das Nest; die strichlierte Linie zeigt die Spur der Hatchlinge

Third time of observation (21.08.2011):

11 tracks were found on the third day. 6 of them went straight into the sea. 5 tracks deviated on their way to the sea but finally they reached it. 2 tracks (A) deviated and passed the sectors 5, 4 and 3, total distance: 17m. One track (B) deviated and passed the sectors 7, 8 and 1, total distance: 22m. One track started to crawl straight and after a few meters it deviated and passed sectors 2 and 1, total distance: 18m.

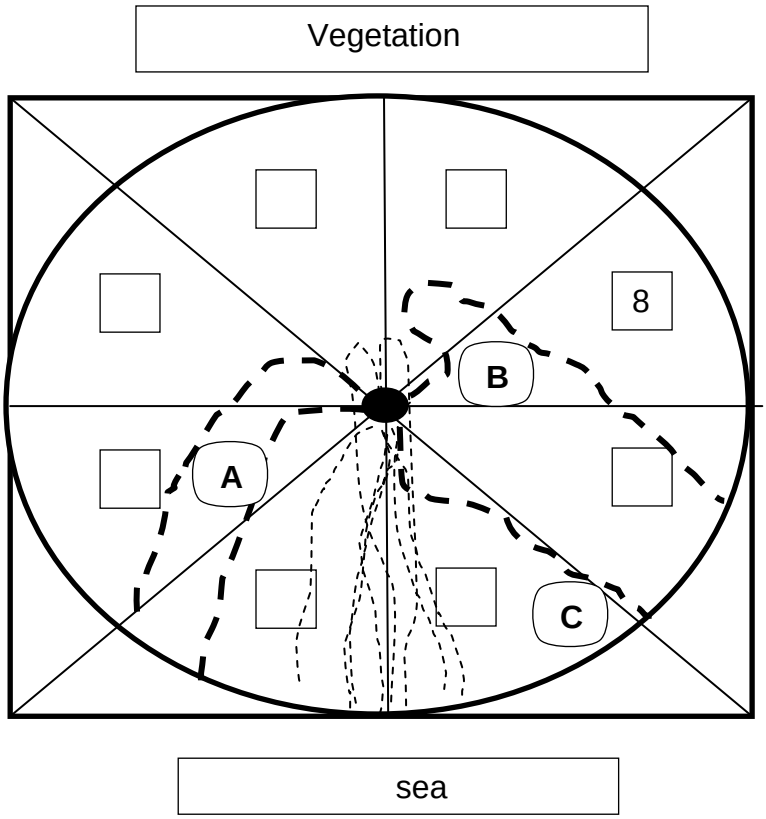

Figure 11: shows the deviation of each hatchling on its way to the sea; the point in the middle shows the nest; the dotted line shows the hatchling tracks, the fat dotted line shows the measured track; Total distance nest - sea: 16,97m

Abbildung 11: zeigt die Abweichung der Hatchlinge am Weg ins Meer; Punkt in der Mitte symbolisiert das Nest; die strichlierte Linie zeigt die Spur der Hatchlinge, die fett strichlierte Linie zeigt die vermessene Spur; Distanz Nest - Meer: 16,97m

YS13: Date of observation: 15.08.2011

The nest hatched from 10.08 - 12.08, on the 14.08 and on the 15.08. Total number of eggs: 69. Total number of hatchlings reached the sea:68.

6 tracks were recorded. 5 tracks directly reached the sea; one (A) deviated first and reached the sea after 25m.

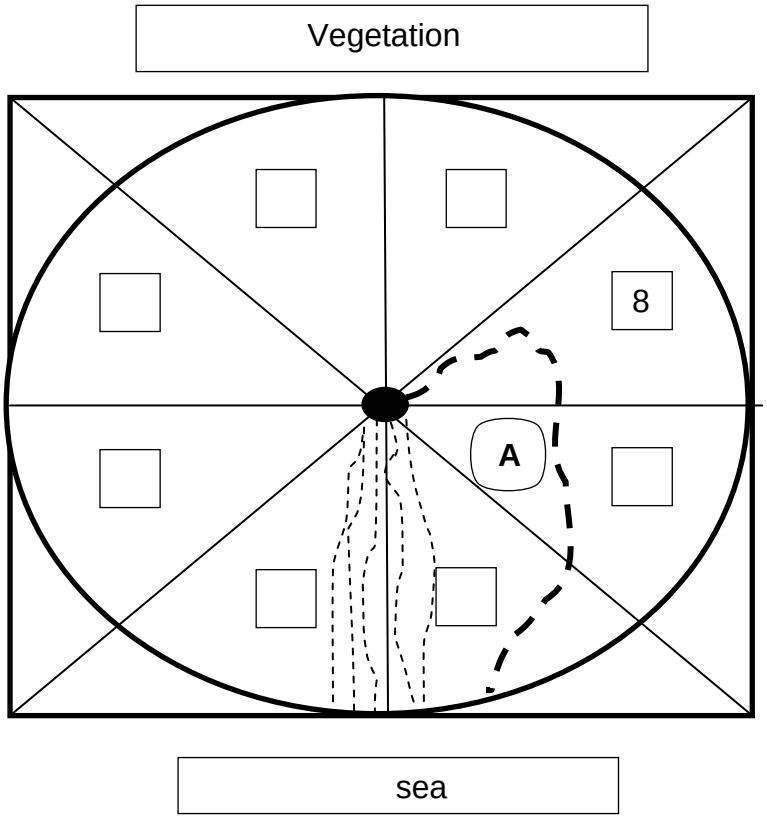

Figure 12: shows the deviation of each hatchling on its way to the sea; the point in the middle shows the nest; the dotted line shows the hatchling tracks, the fat dotted line shows the measured track; Total distance nest - sea: 21,62m

Abbildung 12: zeigt die Abweichung der Hatchlinge am Weg ins Meer; Punkt in der Mitte symbolisiert das Nest; die strichlierte Linie zeigt die Spur der Hatchlinge, die fett strichlierte Linie zeigt die vermessene Spur; Distanz Nest - Meer: 21,62m

YS17: The nest hatched from 17.08 - 19.08, on the 22.08, 24.08 and on the 27.08. The total number of eggs: 91. The total number of hatchlings reached the sea: 85.

Date of observation:

- 17.08.2011
- 24.08.2011

First day of Emergence (17.08.2011):

One track was found on the first day. The track deviated from the direct path and reached the sea after 16m.

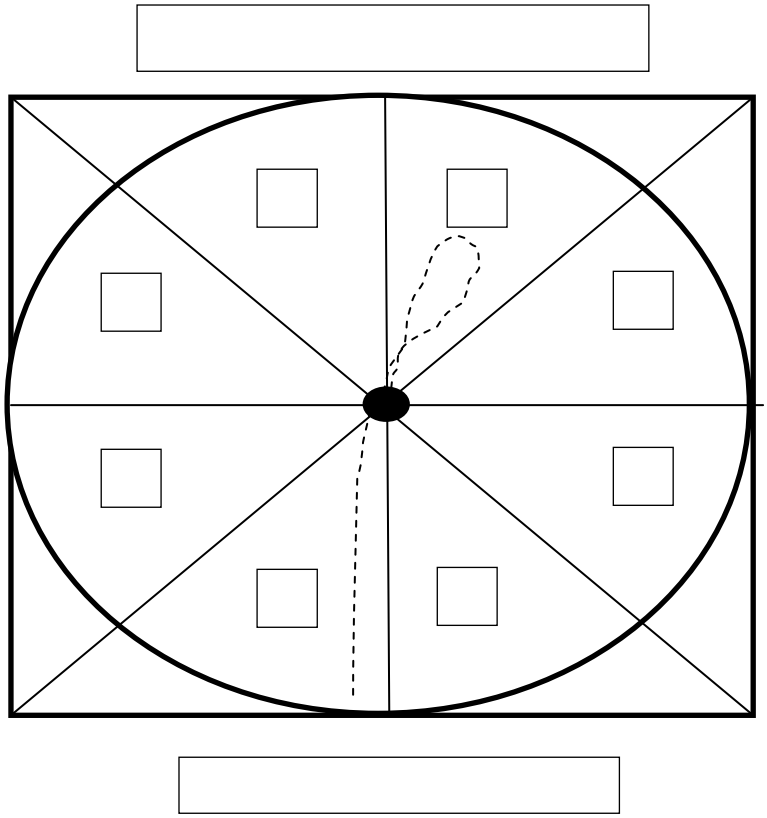

Figure 13: shows the deviation of each hatchling on its way to the sea; the point in the middle shows the nest; the dotted line shows the hatchling tracks; Total distance nest - sea: 13m

Abbildung 13: zeigt die Abweichung der Hatchlinge am Weg ins Meer; Punkt in der Mitte symbolisiert das Nest; die strichlierte Linie zeigt die Spur der Hatchlinge; Distanz Nest - Meer: 13m

Second day of observation (24.08.2011):

Two tracks were recorded. One track went straight to the sea, passing sector 2. The other one (A) deviated and reached the sea after 25m.

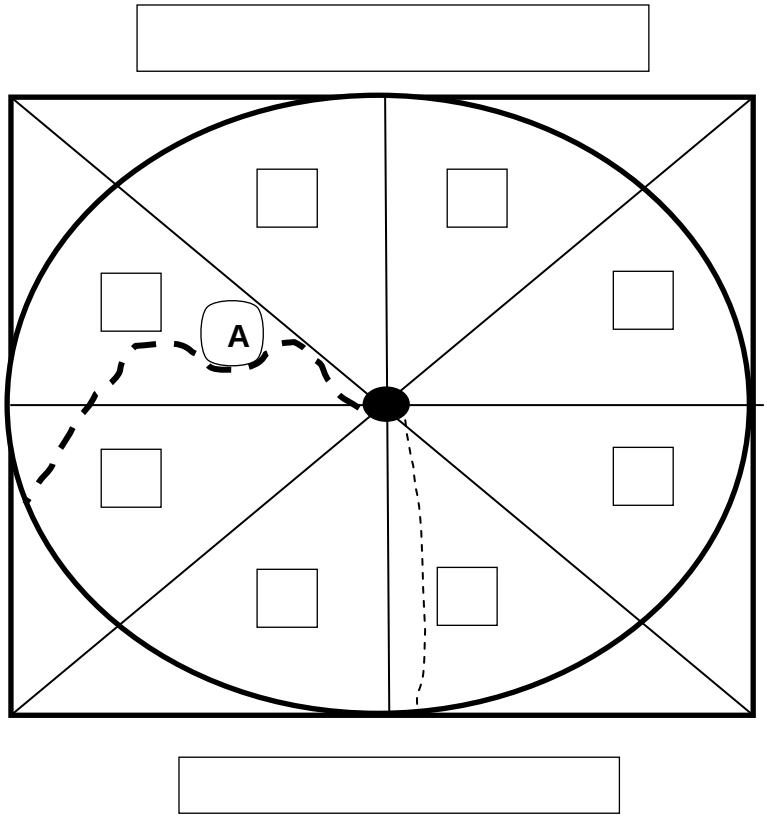

Figure 14: shows the deviation of each hatchling on its way to the sea; the point in the middle shows the nest; the dotted line shows the hatchling tracks, the fat dotted line shows the measured track; Total distance nest - sea: 13m

Abbildung 14: zeigt die Abweichung der Hatchlinge am Weg ins Meer; Punkt in der Mitte symbolisiert das Nest; die strichlierte Linie zeigt die Spur der Hatchlinge, die fett strichlierte Linie zeigt die vermessene Spur; Distanz Nest - Meer: 13m

YS18: Date of observation: 27.08.2011

YS18 hatched from 23.08 - 24.08 and from 27.08 - 28.08. Total number of eggs: 67. Total number of hatchlings reached the sea: 65.

13 tracks had been found. All except one went straight to the sea; they passed sectors 2 and 3. One track (A) deviated and reached the sea after 26m, passing sectors 8 and 1.

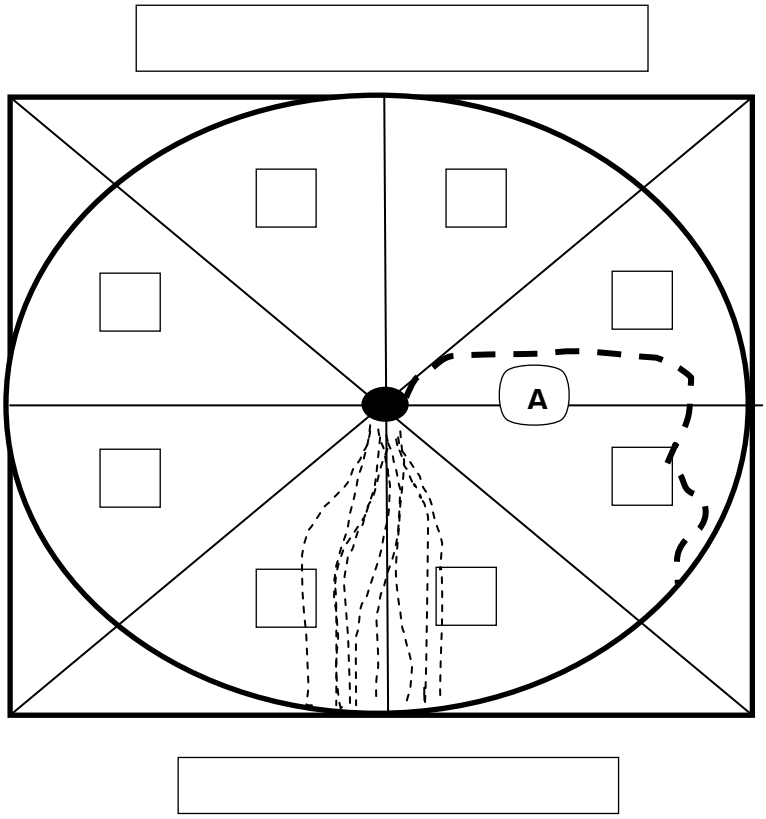

Figure 15: shows the deviation of each hatchling on its way to the sea; the point in the middle shows the nest; the dotted line shows the hatchling tracks, the fat dotted line shows the measured track; Total distance nest - sea: 20,5m

Abbildung 15: zeigt die Abweichung der Hatchlinge am Weg ins Meer; Punkt in der Mitte symbolisiert das Nest; die strichlierte Linie zeigt die Spur der Hatchlinge, die fett strichlierte Linie zeigt die vermessene Spur; Distanz Nest - Meer: 20,5m

YS21: hatched on the 24.08 and on the 29.08. Total number of eggs: 54. Total number of hatchlings reached the sea: 17.

Date of observation: 24.08.2011

16 tracks were found. All went straight to the sea, they passing sectors 2 and 3.

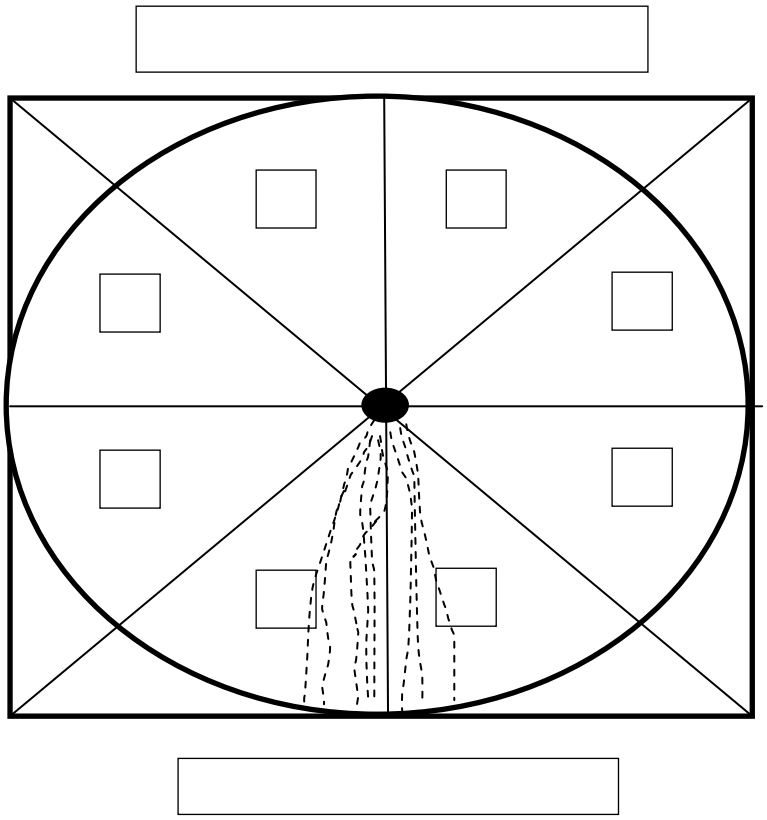

Figure 16: shows the deviation of each hatchling on its way to the sea; the point in the middle shows the nest; the dotted line shows the hatchling tracks

Abbildung 16: zeigt die Abweichung der Hatchlinge am Weg ins Meer; Punkt in der Mitte symbolisiert das Nest; die strichlierte Linie zeigt die Spur der Hatchlinge

YS27: This nest hatched on the 28.08 and the 03.09. Total number of eggs: 92. Total number of hatchlings reached the sea: 80.

Date of observation: 28.08.2011

20 were recorded. 14 went straight to the sea, passing sectors 2 and 3. 6 tracks (A) deviated and reached the sea after 50.5m, passing sectors 8 and 1.

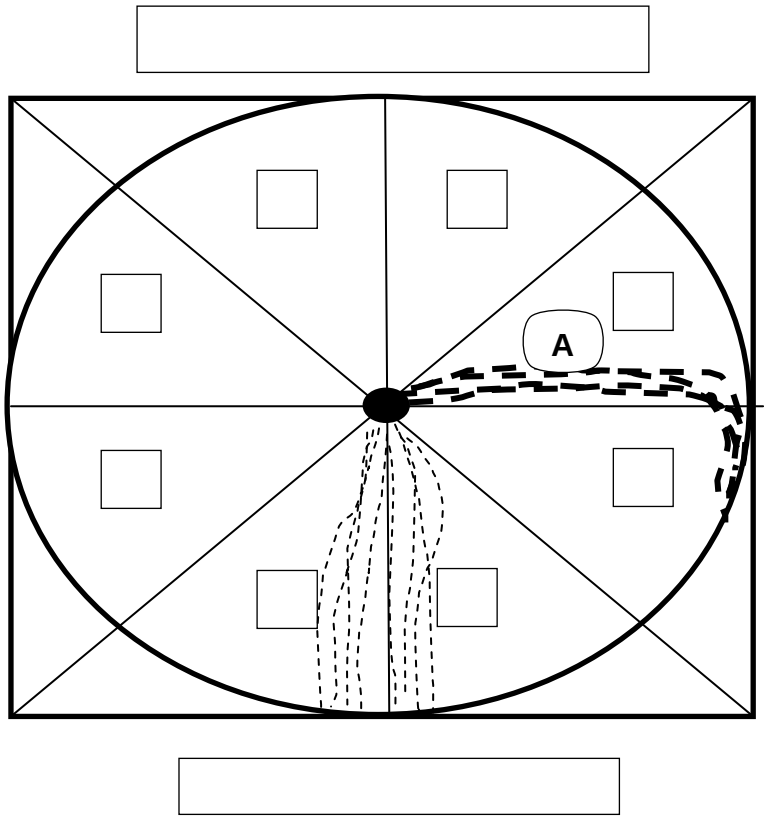

Figure 17: shows the deviation of each hatchling on its way to the sea; the point in the middle shows the nest; the dotted line shows the hatchling tracks, the fat dotted line shows the measured track; Total distance nest - sea: 26m

Abbildung 17: zeigt die Abweichung der Hatchlinge am Weg ins Meer; Punkt in der Mitte symbolisiert das Nest; die strichlierte Linie zeigt die Spur der Hatchlinge, die fett strichlierte Linie zeigt die vermessene Spur; Distanz Nest - Meer: 26m

Akgöl:

AS03: hatched on the 02.09. Total number of eggs: 41. Total hatchlings reached the sea: 16

Date of observation: 02.09.2011

14 tracks were found. 12 slightly deviated from their path passing sectors 1 and 2. One track (A) deviated and reached the sea after 19m; passed sectors 8 and 1. Track B deviated and reached the sea after 9.4m; it went through sector 1.

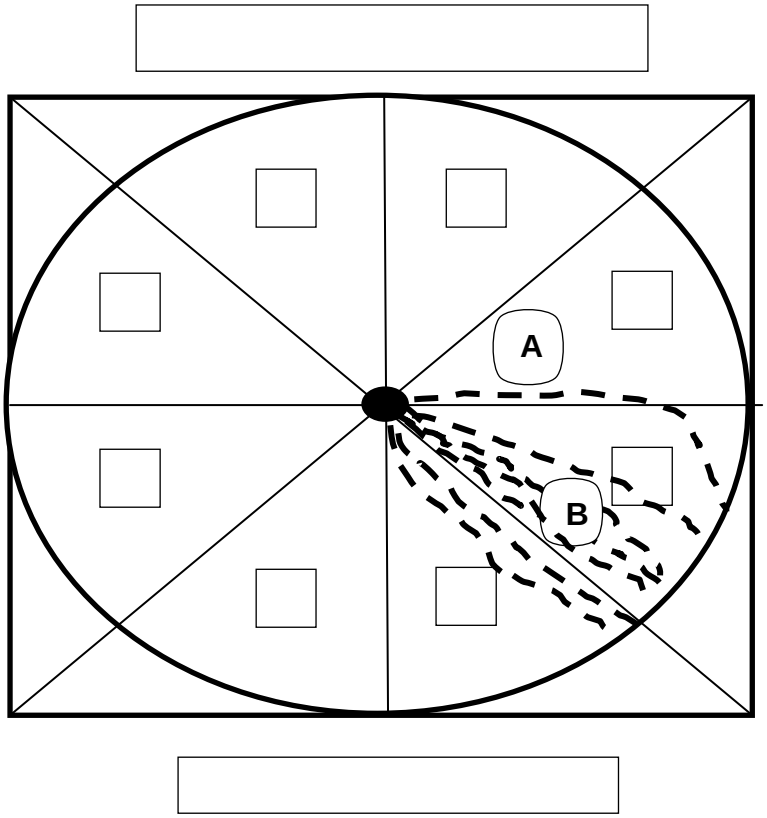

Figure 18: shows the deviation of each hatchling on its way to the sea; the point in the middle shows the nest, the fat dotted line shows the measured track; Total distance nest - sea: 8,8m

Abbildung 18: zeigt die Abweichung der Hatchlinge am Weg ins Meer; Punkt in der Mitte symbolisiert das Nest; die strichlierte Linie zeigt die Spur der Hatchlinge, die fett strichlierte Linie zeigt die vermessene Spur; Distanz Nest - Meer: 8,8m

A04: This nest hatched from 29.08 - 31.08. Total number of eggs: 70. Total hatchlings reached the sea: 51.

Date of observation: 29.08.2011

4 tracks had been found. All 4 slightly deviated from the straight path to the sea. They passed the sectors 1 and 2.

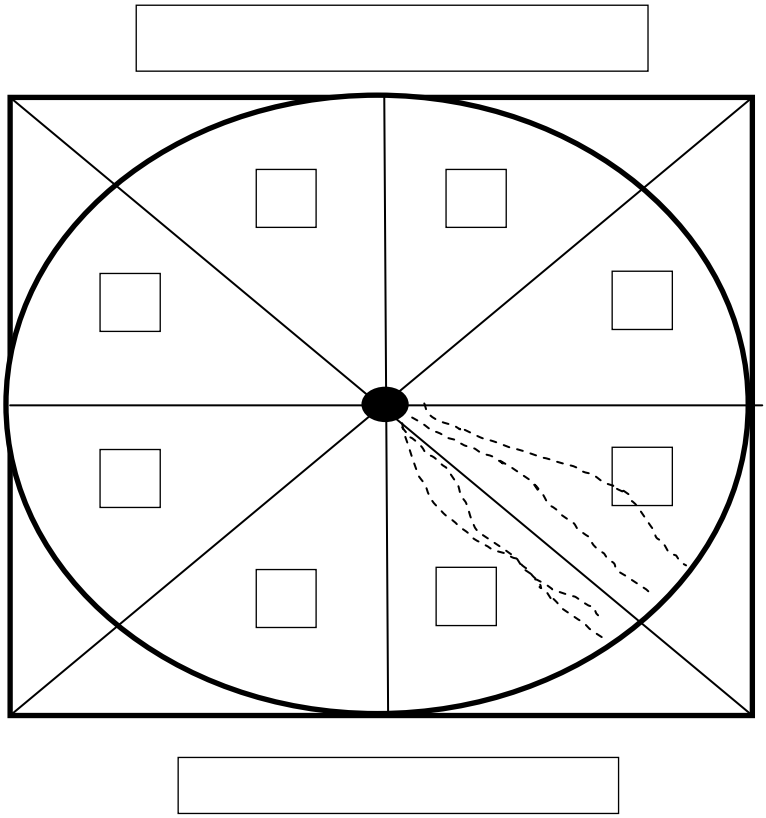

Figure 19: shows the deviation of each hatchling on its way to the sea; the point in the middle shows the nest; the dotted line shows the hatchling tracks

Abbildung 19: zeigt die Abweichung der Hatchlinge am Weg ins Meer; Punkt in der Mitte symbolisiert das Nest; die strichlierte Linie zeigt die Spur der Hatchlinge

AS08: hatched on the 15.08, from 17.08 - 18.08 and on the 20.08. Total number of eggs: 61. Total number of hatchlings reached the sea: 49

Dates of observation:

- 17.08.2011
- 18.08.2011

First day of observation (17.08.2011):

4 tracks were recorded. All 4 slightly deviated from the direct way to the sea; they passed sectors 1 and 2.

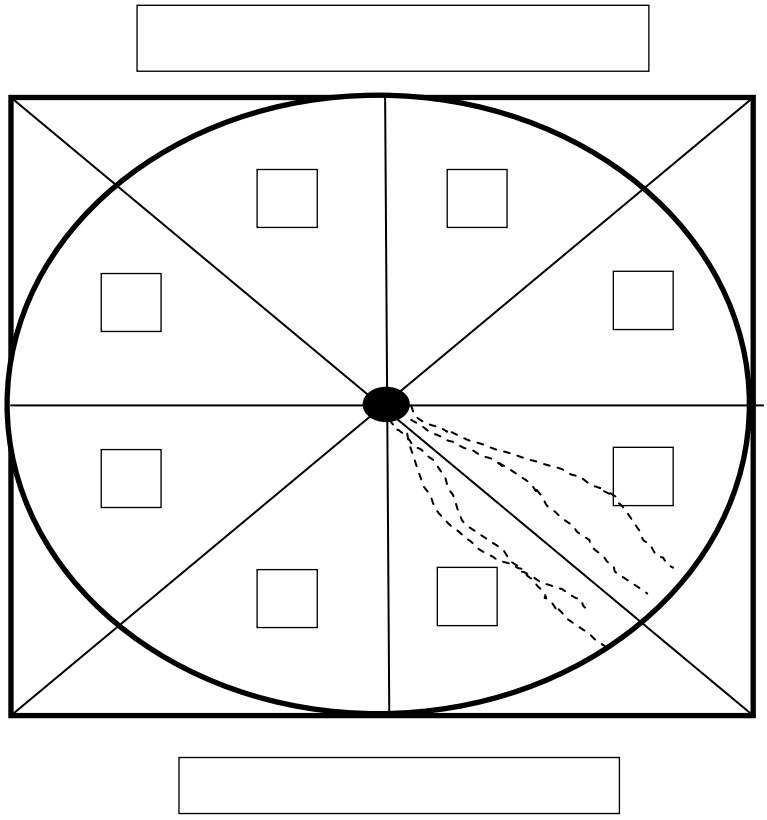

Figure 20: shows the deviation of each hatchling on its way to the sea; the point in the middle shows the nest; the dotted line shows the hatchling tracks

Abbildung 20: zeigt die Abweichung der Hatchlinge am Weg ins Meer; Punkt in der Mitte symbolisiert das Nest; die strichlierte Linie zeigt die Spur der Hatchlinge

Second day of observation:

One track was found. The track slightly deviated and passed through sector 1.

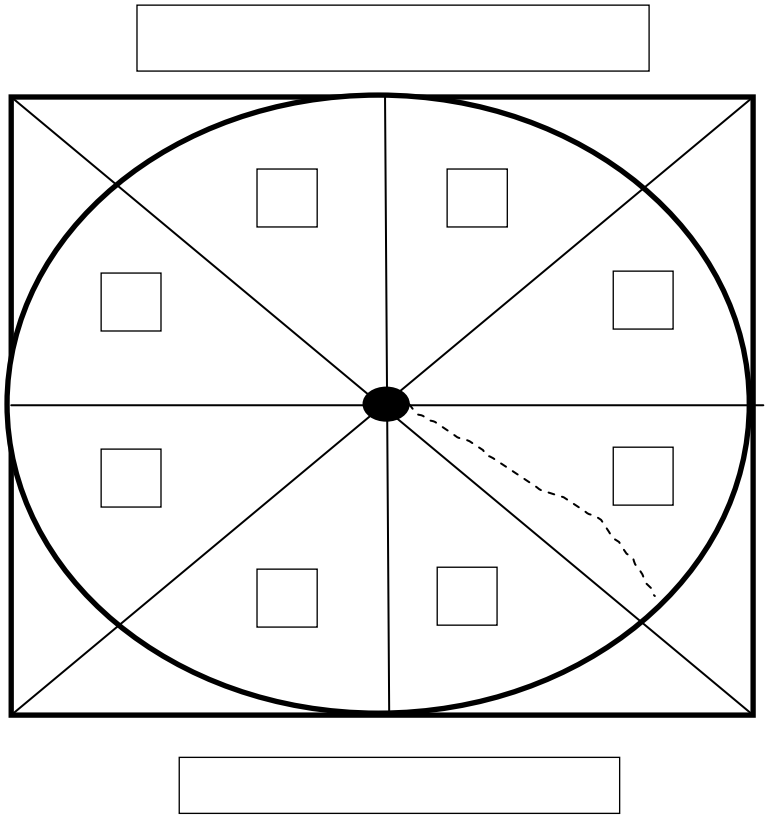

Figure 21: shows the deviation of each hatchling on its way to the sea; the point in the middle shows the nest; the dotted line shows the hatchling tracks

Abbildung 21: zeigt die Abweichung der Hatchlinge am Weg ins Meer; Punkt in der Mitte symbolisiert das Nest; die strichlierte Linie zeigt die Spur der Hatchlinge

AS12: hatched on the 19.08.

Date of emergence and of observation: 19.08.2011

4 Tracks were recorded. All 4 slightly deviated from their way to the sea, passing sectors 1 and 2.

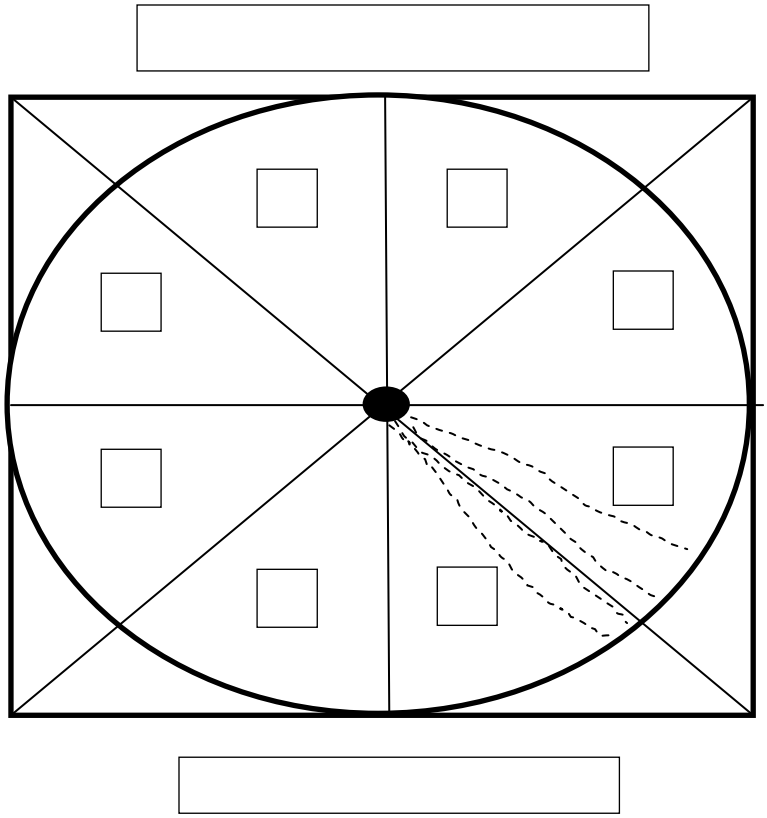

Figure 22: shows the deviation of each hatchling on its way to the sea; the point in the middle shows the nest; the dotted line shows the hatchling tracks

Abbildung 22: zeigt die Abweichung der Hatchlinge am Weg ins Meer; Punkt in der Mitte symbolisiert das Nest; die strichlierte Linie zeigt die Spur der Hatchlinge

Total distance “nest - sea” versus actual distance crawled:

The distances in the figures 23 - 27 are the average distances of “nest to the sea” versus the average distances which all hatchlings crawled on their way to the sea.

This comparison is only about the tracks which were measured, in the figures 5 - 22 the fat dotted lines.

Yaniklar:

YS12: The total distance nest – sea was 16m. On the third day of observation two hatchlings (A) crawled 17m, one (B) crawled 22m and one (C) crawled 18m. The other 6 tracks went straight to the sea.

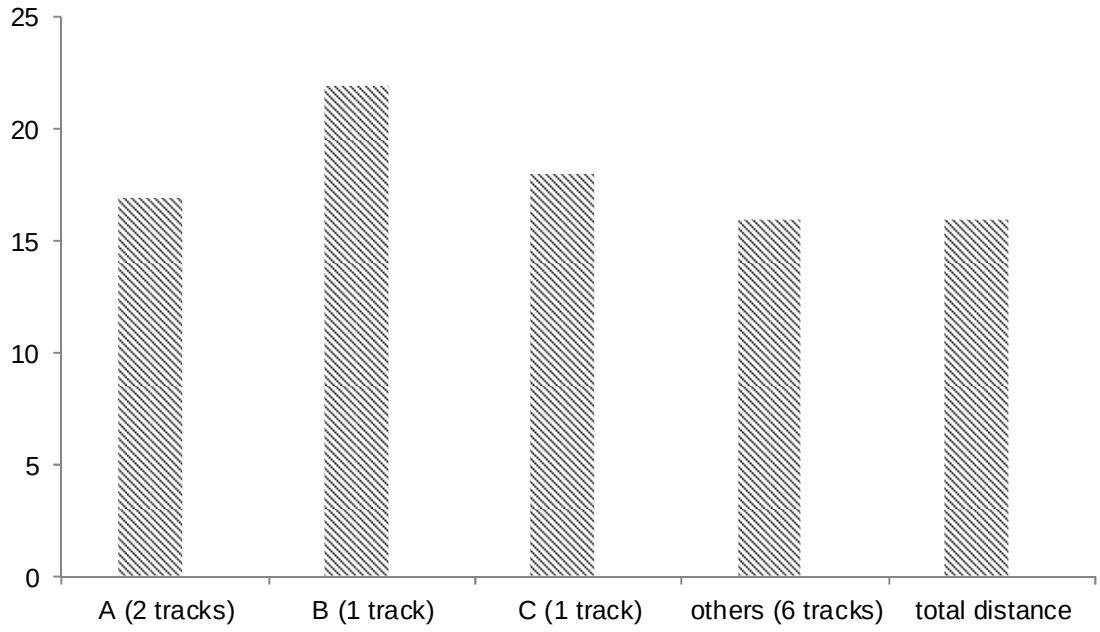

Figure 23: nest YS12; shows the total distance "nest - sea" vs. the actual crawled distance (m)

Abbildung 23: Nest YS12; zeigt die Distanz “nest - sea” versus die Distanz die tatsächlich von den Hatchlingen zurückgelegt wurde

YS13: The total distance nest – sea was 21.20m. 6 hatchlings crawled straight to the sea, they crawled 21.20m. One hatchling deviated and crawled 25m before he reached the sea.

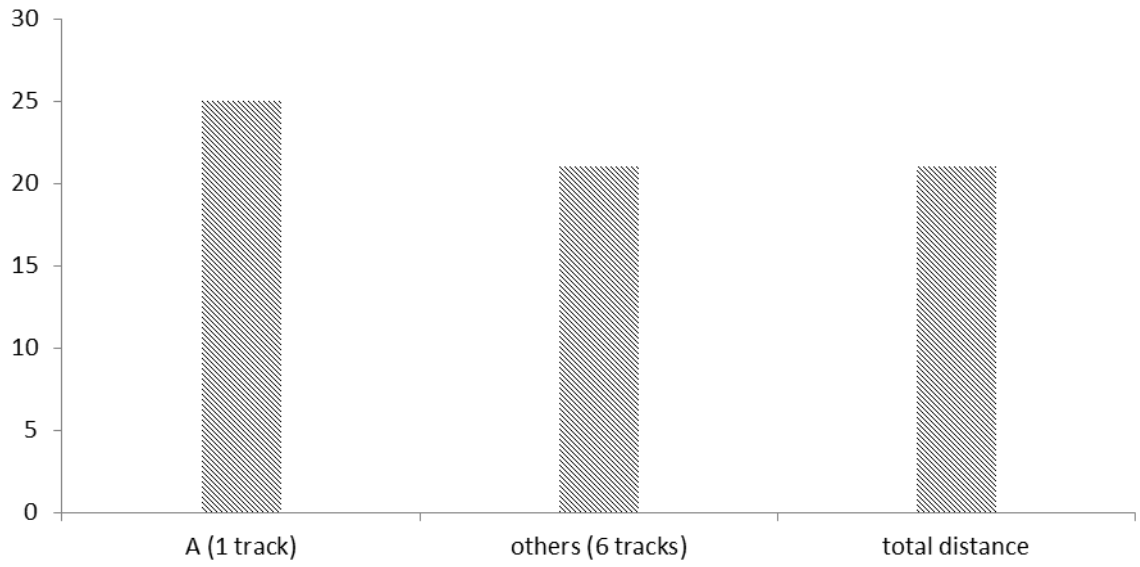

Figure 24: nest YS13; shows the total distance "nest - sea" vs. the actual crawled distance (m)

Abbildung 24: Nest YS13; zeigt die Distanz “nest - sea” versus die Distanz die tatsächlich von den Hatchlingen zurückgelegt wurde

YS17: The total distance nest – sea was 16m. On the second day of observation (only on the second day the tracks were measured) two hatchlings emerged. One crawled straight to the sea. The other (A) crawled 25m before it reached the sea.

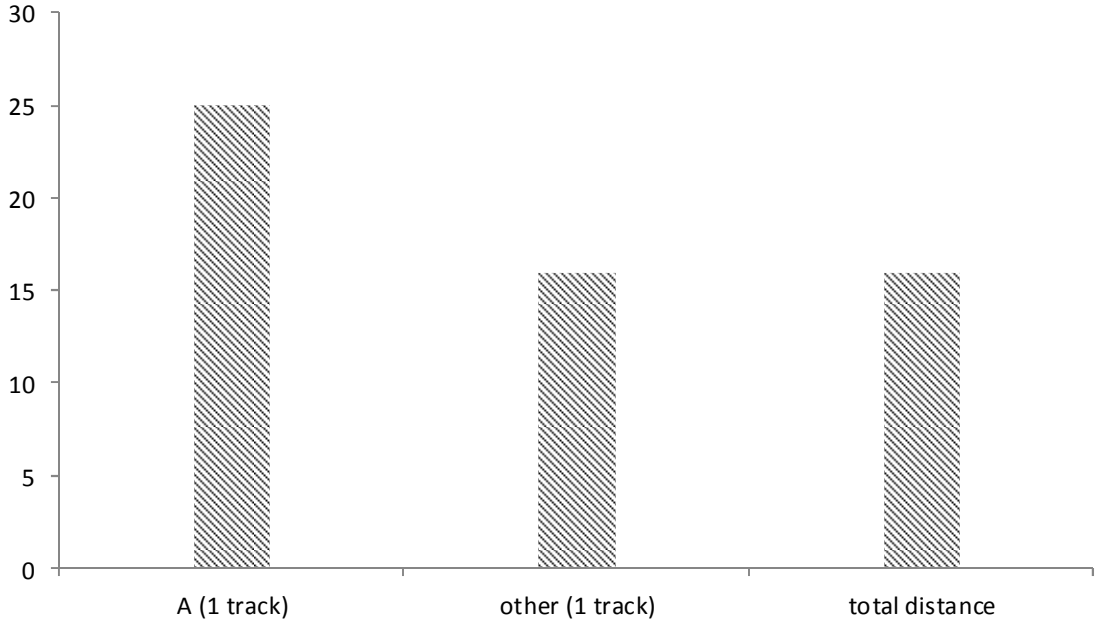

Figure 25: nest YS17; shows the total distance "nest - sea" vs. the actual crawled distance (m)

Abbildung 25: Nest YS17; zeigt die Distanz “nest - sea” versus die Distanz die tatsächlich von den Hatchlingen zurückgelegt wurde

YS18: The total distance nest – sea was 20.5m. Thirteen tracks were found, twelve of them went straight to the sea, 20.5m. One track (A) reached the sea after 26m.

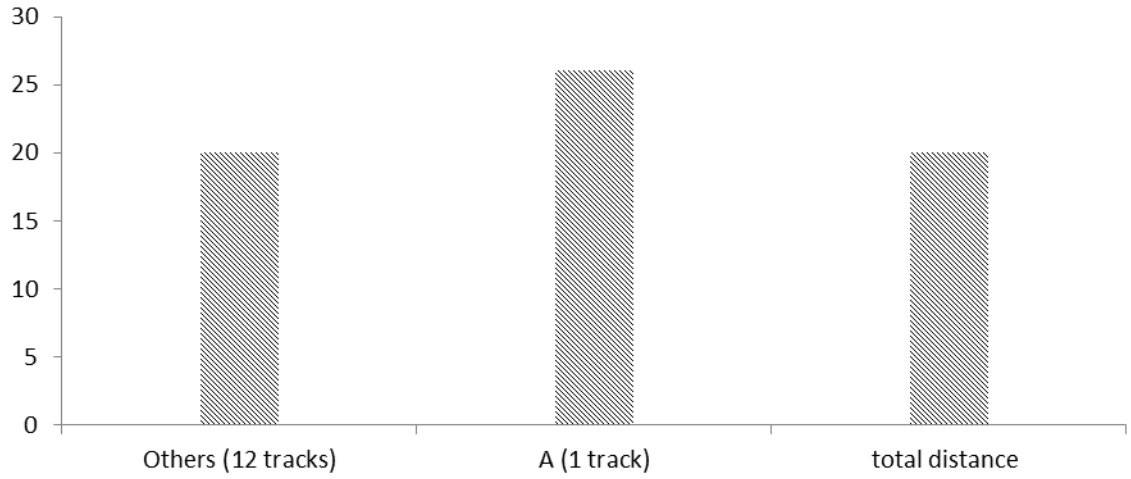

Figure 26: nest YS18; shows the total distance "nest - sea" vs. the actual crawled distance (m)

Abbildung 26: Nest YS18; zeigt die Distanz “nest - sea” versus die Distanz die tatsächlich von den Hatchlingen zurückgelegt wurde

YS27: The total distance nest – sea was 26m. Fourteen hatchlings crawled straight to the sea, 26m. Six hatchlings (A) deviated and crawled 50.5m.

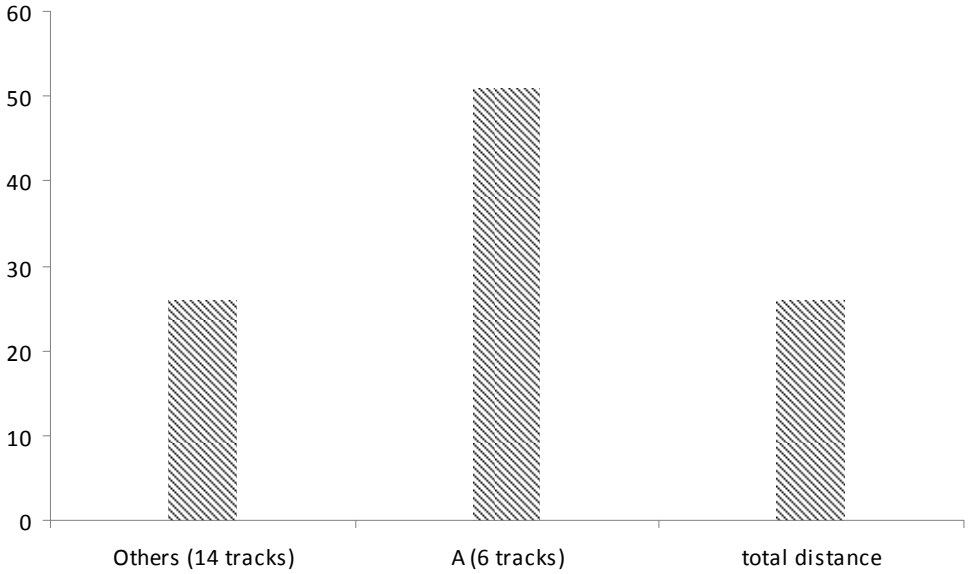

Figure 27: nest YS27; shows the total distance "nest - sea" vs. the actual crawled distance (m)

Abbildung 27: Nest YS27; zeigt die Distanz “nest - sea” versus die Distanz die tatsächlich von den Hatchlingen zurückgelegt wurde

Akgöl:

AS03: Total distance “nest - sea” was 8.8m. 14 tracks were found. 12 hatchlings (A) slightly deviated and reached the sea after 9.4m. One hatchling (B) deviated and reached the sea after 19m.

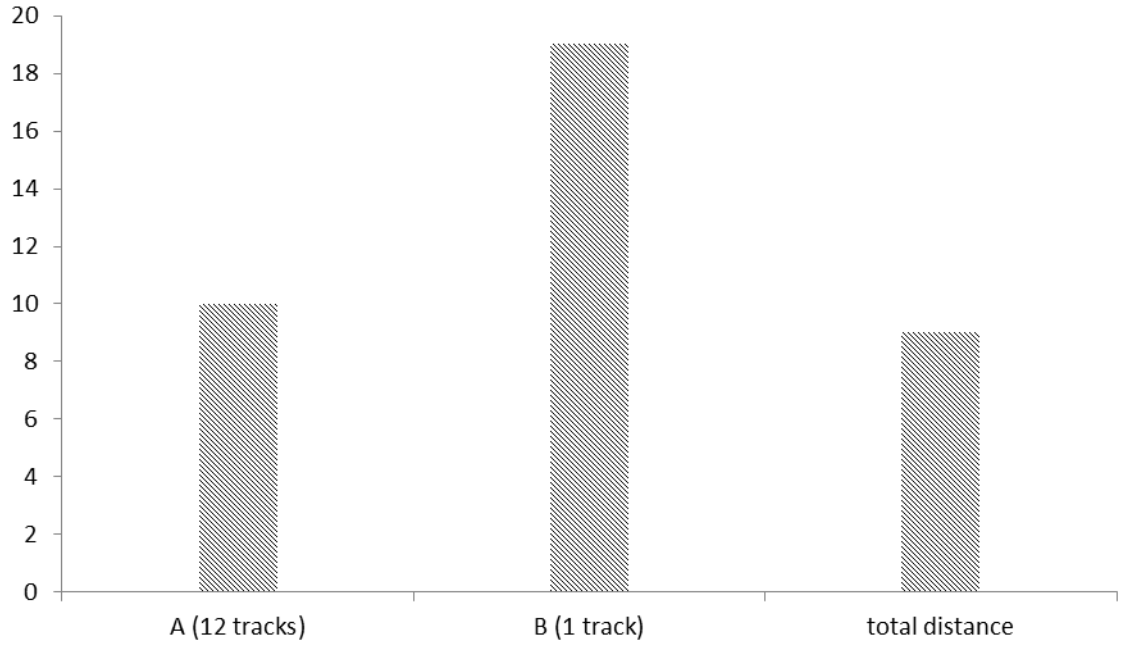

Figure 28: nest AS03; shows the total distance "nest - sea" vs. the actual crawled distance (m)

Abbildung 28:Nest AS03; zeigt die Distanz “nest - sea” versus die Distanz die tatsächlich von den Hatchlingen zurückgelegt wurde

DISCUSSION

Since 2011, the two big hotel complexes, Hotel Majesty Club Tuana Park and Lykia Botanika Beach Club, apparently want to do more for the sea turtles. During the investigation period, it could be observed that the Lykia Botanika Beach Club turns off all his lights on the jetty after 24:00. The lights on the foot path to the beach were half covered with black paint, so the beach received less light. The Hotel Majesty Club Tuana Park did less to reduce his light pollution but also turned off its lights on the jetty after midnight. The other lights inside the hotel area were switched on. The highest disorientation of the hatchlings was on Akgöl. A reason for the deviation there could probably be the big jetty with the flagpole full of lights of the Hotel Majesty Club Tuana Park but only before midnight, after midnight the lights

were switched off. Figure 29 shows the beach sector Akgöl. Based on the results, one could conclude that the jetty is the reason for the deviation because the other artificial light sources, such as street lamps or the restaurant on the beach weren't as bright as the jetty. Only two cars were spotted on the beach during the investigation period.

It is not clear if there were bigger artificial light sources on Yaniklar. A possible artificial light source was the bar on the beach (red dot on figure 30). The Lykia Botanika Beach Club turned off all its lights on the beach after 24:00 or covered them partially with black paint. Most of the studied nests were in the corner between the hotel and the river (figure 30) or after, so the lights of the hotel were not visible from the nest site. Here, the results show no major disorientation of hatchlings on their way. Most of them crawled straight to the sea.13 hatchlings (observed nests on Yaniklar) deviated and two got lost (nest YS17). The orientation of sea turtle hatchlings is depends, among various factors, also on light: the hatchlings orientate towards the brightest point of their view (Bourgeois et al., 2009).

The proper reason for the deviation in Akgöl could be the lights of the jetty. On Yaniklar the lightest spot was the sea surface. Comparing the two sections of beach, points to the big impact of artificial light on seaward orientation. All of the studied nests in Akgöl show a deviation towards the jetty. None of the studied nests in Yaniklar had a deviation based on artificial light sources, and most of the hatchlings crawled straight to the sea. Nest YS12 on Yaniklar featured an interesting deviation from the straight path, maybe predators surprised the hatchlings during the emergence Another reason could also be the lower vegetation behind the nest and so the brighter silhouettes (Tuxbury, Salmon, 2005). But not only light is an important factor for orientation, also natural cues such as high or low silhouettes play a role (Tuxbury, Salmon, 2005). If light emission is reduced and the natural environment restored, the hatchling mortality would decrease and more hatchlings would reach the sea (Tuxbury, Salmon, 2005). The moon usually decreases the impact of artificial light sources by reducing the contrast between background illumination and directivity of artificial lights (Bourgeois et al., 2009).

All the work to reduce the threats and to improve the conditions for sea turtles on this SEPA - nesting beach is insufficient, the awareness of the local residents is not raised. It is important to demonstrate how fascinating and how important sea turtles are. The local residents and stuff must have the wish to support and help the protection of sea turtles.

It was interesting to see how far hatchlings crawl until they finally reach the sea. Some possible reasons for that could be: they could crawl up against an obstacle and forced to change their way. Some parts of the beach are very stony, if they crawl against a bigger stone they are stopped or they have to change their way. Many even become trapped in larger cobbles and die.

Figures

Figure 29: Beach sector Agköl; the red dot on the left indicates where the nests were, the red dot in the middle is a restaurant, the red dot on the right is the jetty of the Hotel Majesty Club Tuana Park; the white arrow marks the direction hatchlings crawled

Abbildung 29: Strand Abschnitt Agköl; der rote Punkt symbolisiert wo Nester waren, der rote Punkt in der Mitte signalisiert ein Restaurant; der Rechte zeigt den Anleger des Hotel Majesty Club Tuana Park; der weiße Pfeil markiert die Richtung in die die Hatchlinge gekrochen sind

Figure 30: The left red dot shows the Lykia Botanika Beach Club, the dot in the middle shows a river, the right one a bar on the beach

Abbildung 30: Der linke rote Punkt zeigt das Hotel Lykia Botanika Beach Club, der Punkt in der Mitte zeigt einen Fluss, der rechte Punkt zeigt die Bar am Strand

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