

Research on the Amphibia, Reptilia and Mammalia Species of the Köyceğiz-Dalyan Special Protected Area

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Abstract: Following examination of the **amphibia**, **reptilia** and **mammalia** species which are distributed in the Special Protected Area around Köyceğiz-Dalyan, the area's natural resources were investigated. Establishment of the distribution of these species and their population cases has also been attempted by systematical and periodic investigations

As a result, 5 frogs, 5 turtles, 11 lizards, 13 snakes and 18 mammal species have been discovered for the first time in this region. Furthermore, measures which must be taken into consideration for protection of these species, especially turtles, are given.

Key Words: Amphibia, Reptilia, Mammalia, distribution, conservation.

Köyceğiz-Dalyan Özel Koruma Bölgesi Amfibi, Sürüngen ve Memeli Türlerinin Araştırılması

Özet: Bu çalışmada Köyceğiz Dalyan civarındaki özel koruma bölgesinde yayılış gösteren amfibi, reptil ve memeli hayvan türleri incelenerek, buradaki tabii zenginlikler ortaya çıkarılmaya çalışılmıştır. Bölgede yapılan sistemli ve periyodik araştırmalarla buradaki türlerin yayılış alanları ve popülasyon durumları tespit edilmeye çalışılmıştır.

Özel koruma bölgesinde yapılan araştırmalar neticesinde 5 kurbağa, 5 kaplumbağa, 11 kertenkele, 13 yılan ve 18 memeli türünün yaşadığı ilk olarak meydana çıkarılmıştır. Ayrıca başta kaplumbağalar olmak üzere diğer türlerin de korunmaları ile ilgili tedbirler maddeler halinde açıklanmıştır.

Anahtar Kelimeler: Amfibi, Reptil, Memeli, yayılış, koruma.

Introduction

In the special protected area around the vicinities of Köyceğiz-Dalyan, approximately 385 km² of this region is sea, 58 km² is lake, 24 km² is swamp, 118 km² is farming land and 150 km² is natural biotop. The protected area consists of Lake Köyceğiz, the canal that connects the lake to the sea, the swampy area on both sides of this canal, and the beach which is 4.5 km long. This natural eco-system which embodies freshwater and sea media of peerless beauty has deservedly been declared a special protected area. The İztuzu Beach which is located in this protected area is an important area since it is where the *Caretta caretta*, which are nearly extinct in the Mediterranean, come to make their nests. Thus, this issue related to the sea turtles has been regarded in previous years by several different researchers (1-12).

On the other hand, the **amphibia**, **reptilia** and **mammalia** species that live in this protected area

have not been widely and fully examined. Only in some general studies has the existence of some **amphibia** and **reptilia** species in the mentioned area been pointed out (13-26). A study which gives an overall view of the **amphibia** and **reptilia** species of the protected area was realized by Kasperek (27). However, the findings that have been obtained in this study are not the results of a regular and systematic research of the region; these findings reflect the evaluation of the researchers own observations and the information supplied by different researchers who had been working in the protected area. As a result of this, the above mentioned study is insufficient at expanding our knowledge of the **amphibia** and **reptilia** fauna of the region. On the other hand, it is impossible to speak of studies carried out about the mammal species of the special protected area (28).

Subsequently, a systematic research of these **amphibia**, **reptilia** and **mammalia** fauna which will en-

able the exposition of animal species besides the turtles, carries great importance. Thus, in a research period of approximately one year, the protected area has been systematically and continually examined and natural resources have been determined.

Efforts have been made to determine the distribution areas and population densities of the species of the region. In addition to this, efforts were also made to determine protective measures for all the animal species of the region, especially among these, the turtles.

Materials and Methods

This research has been planned and realized in two different parts. The first part covers research on the reptilia, amphibia and mammalia that live in the protected area, and the second part covers research on the *Caretta caretta* and *Trionyx triunguis* species that nest and lay their eggs on the beaches of the protected area.

The first part of our research which is aimed at determining the amphibia, reptilia and mammalia species began on February 28th, 1991. On the weekends and holidays following this date, groups of 4-10 systematically visited the area and made efforts to determine the population densities and distribution areas of the vertebrated animals in their natural environments. A total of 37 different group members have contributed to a total of 95 days of expedition.

The field research ended on December 15th, 1991. As a result of these research expeditions, the majority of amphibia, reptilia and mammalia species in their natural environments, however, not thoroughly including the sea, lake, swamp and farming areas of the protected region, have been recognized. In addition to this, the localities of these species are also shown on distribution maps.

Research on the fresh-water and sea turtles which forms the second part of our study began on May 11th, 1991. In the first stage of this research performed by camping on the İztuzu beach, the adult females who had nested on this beach were examined and specially chosen females were tagged. At the end of approximately two months, egg hatching, the hatchlings, and the harmful effects on the hatchlings and nests were observed. This beach research continued non-stop until Sept. 15th, 1991. This is the first systematic and comprehensive study with the aim of determining the population of the turtles on the İztuzu

beach that has been carried out. Owing to this systematic and regular research, multidimensional and regular information about the reproduction biologies of the *Caretta caretta* and the *Trionyx triunguis* turtles has been obtained. Furthermore, the Ekincik Beach also located in the protected area has been examined non-stop by a research group for approximately two months with the aim of determining the number of nests on this beach.

The species discovered to inhabit the protected area are introduced in the following section, beginning with the amphibia. Again, since the aim of this project is related to the protection of the *Caretta caretta* and *Trionyx triunguis* turtles that nest on the İztuzu Beach, the results about the population of these two particular species are given in a separate section.

Results

1. Amphibia Species

Five different kinds of frogs have been determined. One belongs to the group *Urodela* and the remaining four belong to the group *Anura*. These are as follows:

Mertensiella luschani (Luschans's Salamander)

Samples seen: 601

This is the first species determined in the protected area and it has been found to live on both banks of the Köyceğiz Lake canal and on the stony slopes of the mountains that are near the sea. Although the *Mertensiella luschani* population is very dense around the Kışla and Gökbel districts east of the canal, it is very sparse on the mountains to the west.

This species is mostly found on the slopes of mountains that are made up of light colored calcareous rocks (Figure 1). Thus, this species is non-existent on the mountains that are made up of red colored rocks that contain ferrum-oxide.

Hyla arborea (Common Tree Frog)

Samples seen: 23

The localities of this species which was found on the thickly vegetated parts of the slopes of medium height mountains and under stones are given in Figure 1. A brown sample of this species which is able to change color has been found on the northern slope of the Kaunos ruins.

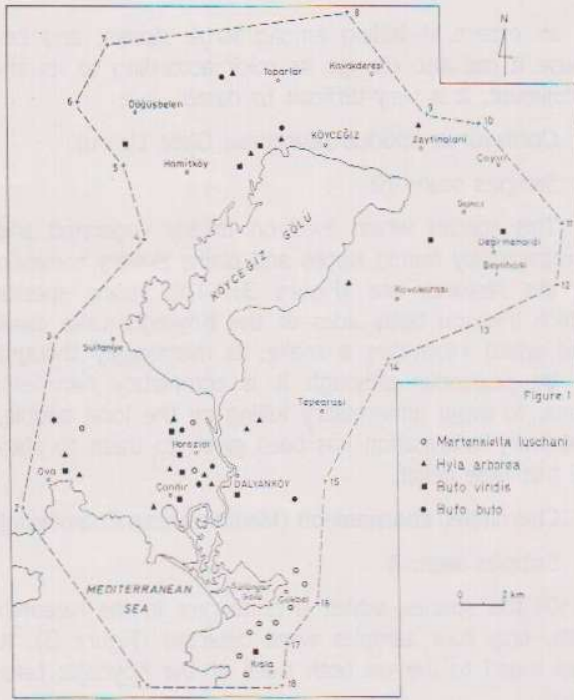


Figure 1. The Localities Where *Mertensiella luschani*, *Hyla arborea*, *Bufo viridis* and *Bufo bufo* have been Detected.

Bufo viridis (Green Toad)

Samples seen: 56 adults, 180 young

The localities of this species, the adults of which are generally found on slopes and the young of which are generally found under stones near water, are shown in Figure 1. According to the number of species found, it has been understood that *Bufo viridis* has a dense population in the protected area.

Bufo bufo (Common Toad)

Samples seen:

The first samples which were found in the research area were detected on the western slopes of the Köyceğiz Lake canal (Figure 1). In March, the larvae of this species were found in four different localities in the water, most of them being in the western part of Lake Köyceğiz.

Rana ridibunda (Lake Frog)

Samples seen: Too many to count.

This species lives in almost every part of the watery research area. It is found not only near natural ponds but also near irrigation canals. This species which cannot travel very far from the waterside, has

a denser population in the highly vegetated biotops in the plains in comparison to the sparsely vegetated ponds and river banks on the slopes. However, in the sweet gum forest near Toparlar village, the population density of *Rana ridibunda* is 16.000 per square kilometer (km²), where as its population density in the Çalca district river in Yangı village northeast of Köyceğiz is 2.500 per square kilometer. The size of the species' members changes in accordance with the density of population. The members of the densely populated areas are smaller than the members of the sparsely populated areas.

2. Reptilia Species

***Testudo graeca* (Spur-thighed Tortoise)**

Samples seen: 1,363 adults, 215 young

This species lives in almost all of the biotops of the research area that have appropriate vegetation. During the project studies, 1,578 samples have been detected. This shows that *Testudo graeca* has a wide distribution in the protected area (Figure 2).

***Mauremys caspica* (Stripe-necked Terrapin)**

Samples seen: 508

Samples of this species which lives near freshwater are often seen in densely vegetated, slow flow-

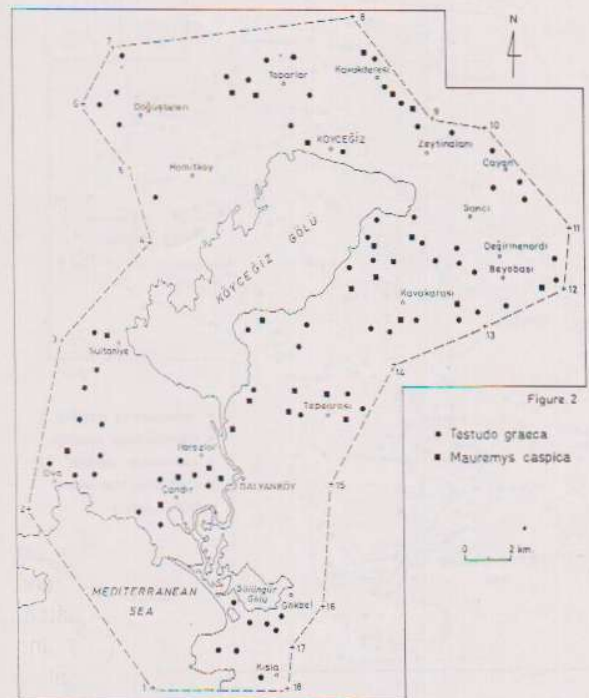


Figure 2. The Localities Where *Testudo graeca* and *Mauremys caspica* have been Detected.

ing rivers and on the banks of small irrigation canals (Figure 2). On the northern slopes of the 1500 m long canal between Dalyan and Eskiköy, 250 samples, sunbathing in groups, were counted. As it is easily understood, this species has a wide distribution in the watery parts of the protected area.

Hemidactylus turcicus (Turkish Gecko)

Samples seen: 43

This species was found on the stony and the comparatively larger rock slopes and in inhabited houses. In the Kaunos ruins which is a very stony biotope, many samples belonging to this species were detected. The localities of these samples are shown Figure 3.

Cyrtodactylus kotschy (Kotschy's Gecko)

Samples seen: 17 adults and young, 139 eggs

This is the first detection of the species in the protected area. It lives on the slopes made up of large stones, especially in the places where there are an abundance of stones (Figure 3). Although many eggs were detected during the research period, the number of adults and young ones observed is comparatively few. The reason for this is that this particular species

is an expert at hiding among large stones, and because it can also change its color according to its environment, it is very difficult to detect.

Ophisaurus apodus (European Glass Lizard)

Samples seen: 79

This species which lives on thickly vegetated and comparatively humid slopes and plains is very common in the research area (Figure 3). This lizard species which lives on both sides of the Koycegiz Lake canal and which resembles a snake, is mistakenly thought to be poisonous although it is completely harmless. Thus, to avoid unnecessary killing by the local people, necessary information has been given to them to clarify this false belief.

Chamaeleo chamaeleon (Mediterranean Chameleon)

Samples seen: 4

Of this species, which is quite rare in the research area, only four samples were detected (Figure 3). It was found to live on both sides of the Koycegiz Lake canal.

Stellio stellio (Agama)

Samples seen: 687

This species has a widespread distribution all over the research area (Figure 3). This species which generally lives on stony rocky biotopes is also found in the forests and on the stone walls that separate fields.

Lacerta oertzeni (Oertzen's Lizard)

Samples seen: 160

This species, which is found in bushy biotopes where there are large stones and rocks, has a widespread distribution in the research area (Figure 4). In the samples detected, a very prominent difference of color and design is noted. The ones living east of the Koycegiz Lake canal have very vague lines on their backs, whereas the ones that live west of the canal are characterized by very prominent lines on their backs. A further study which will evaluate this design differences has been planned.

Lacerta trilineata (Balkan Green Lizard)

Samples seen: 215

This species which lives on the watery and humid river banks and on the fences between the fields has a widespread distribution in the protected area (Figure 4). The detection of this species is quite challenging in the fields, in the plains, and on the thickly vegetated fences near the canals since they can hide easily

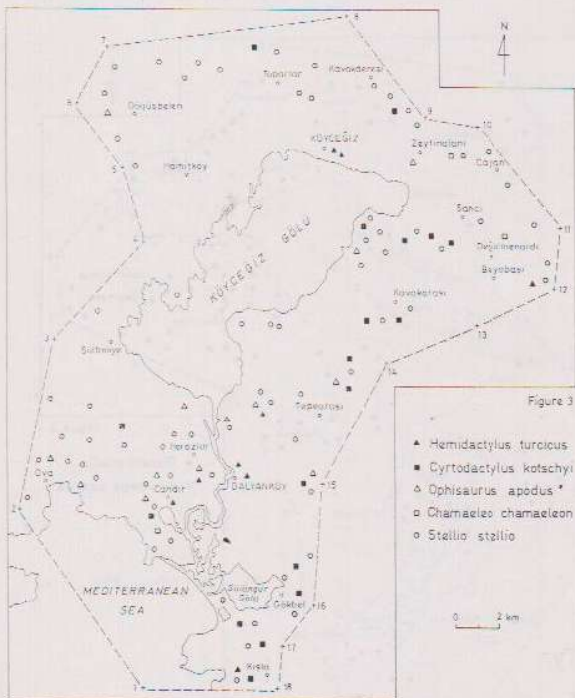


Figure 3. The Localities Where Hemidactylus turcicus, Cyrtodactylus kotschy, Ophisaurus apodus, Chamaeleo chamaeleon and Stellio stellio have been Detected.

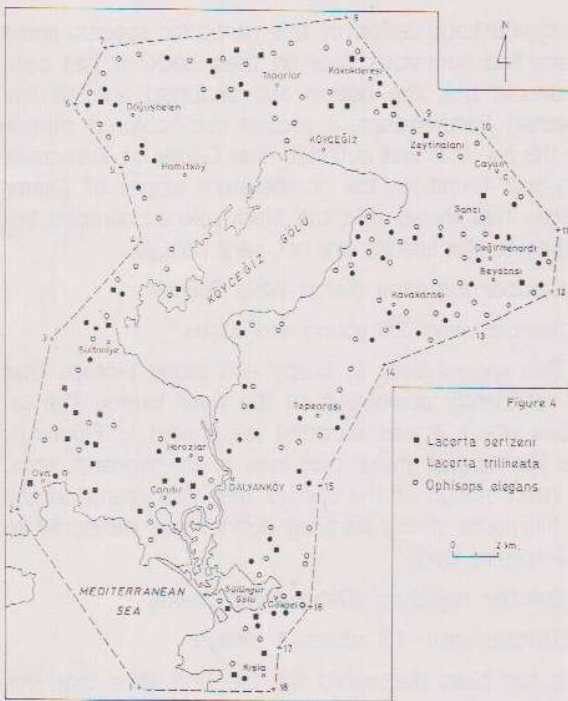


Figure 4. The Localities Where *Lacerta oertzeni*, *Lacerta trilineata* and *Ophisops elegans* have been Detected.

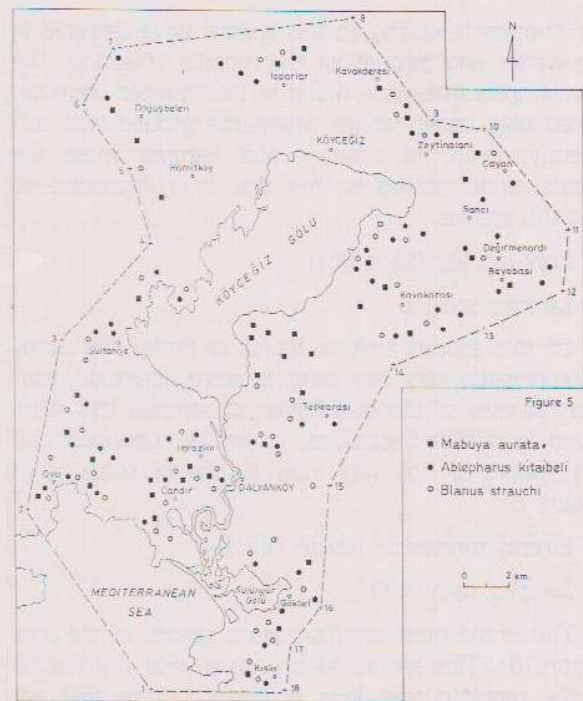


Figure 5. The Localities Where *Mabuya aurata*, *Ablepharus kitaibeli* and *Blanus strauchi* have been Detected.

among dense plants. Thus, accurately determining the population of this species on farm lands is difficult.

Ophisops elegans (Snake-eyed Lizard)

Samples seen: 1315

This is the most common lizard species in the protected area. The localities where our samples were found are shown in Figure 4. *Ophisops elegans* can be found all over the research area except the places where survival conditions are at extremes. Although the natural biotops are appropriate for its survival, its occurrence on fences bordering the fields is comparatively rare. The reason for this may be a lack of appropriate stony areas where it can take shelter.

Mabuya aurata (Gold Skink)

Samples seen: 110

This species was detected for the first time during this research; however, it is not rare to the area. It generally lives in bushy and stony biotops. It moves very fast is quite hard to recognize when seen. The localities of this species are shown in Figure 5.

Ablepharus kitaibeli (Snake-eyed Skink)

Samples seen: 320

This species which lives in meadowlands or dense grass has a wide distribution in the research area (Figure 5). It has a thin body and agile movements; thus it can quickly disappear from sight.

Blanus strauchi (Amphisbaenian)

Samples seen: 537

This species which lives under stones on damp ground is quite widespread in the research area (Figure 5). Whether it can be found under stones depends on the season and in relation to this, the dampness of the ground. Thus, the majority of samples of this species were found in the winter or spring seasons. In the arid months of summer, only their sloughs were detected under stones.

Typhlops vermicularis (Worm Snake)

Samples seen: 206

This species which lives under stones on damp ground has a wide distribution in all appropriate biotops of the research area (Figure 6). The majority of

the samples belonging to this species were detected in the winter and throughout the months of spring. The few samples that were found in the summer were detected only under stones where the ground was sufficiently damp. In summer and autumn when the ground under stones is very dry, it is impossible to find this species.

Eryx jaculus (Sand Boa)

Samples seen: 6

Of this species that is found in bushy and stony environments, very few samples were detected. However, in view of the distribution of samples that were found in different localities, it can be concluded that this species is not very rare to the protected area (Figure 6).

Eirenis modestus (Dwarf Snake)

Samples seen: 499

This is the most common snake species of the area (Figure 6). This species which has a wide distribution in the proteted area lives in bushy biotops that are not very dense and in stony biotops. Although some samples of *Eirenis modestus* that were found had

the typical back design of this particular species, some others had numerous dots on their back. It has been discovered that the dotted and undotted animals live together. Furthermore, a second black-colored sample like the one that was detected near Göcek on Yassicaada (29) was found on the northeastern slopes of Çandır village. This shows that the black-colored samples belonging to this species are not very rare.

Coluber jugularis (Large Whip Snake)

Samples seen: 26 young and adults

This species lives in bushy and stony biotops that are sufficiently damp and on the river banks. The localities where it was detected are shown in Figure 6. It is the longest snake that lives in the research area. An intact slough of the species that was found on the big hill north of the Karadağ district was measured to be 2 meters long.

Coluber najadum (Dahl's Whip Snake)

Samples seen: 15 adults, 1 slough

It has been discovered for the first time that this species, detected in different localities, (Figure 7) is not very rare to this particular region. The samples of

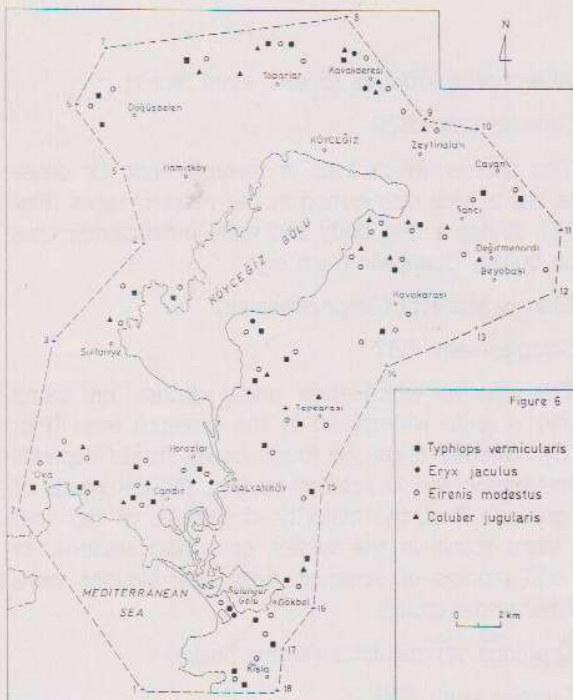


Figure 6. The Localities Where *Typhlops vermicularis*, *Eryx jaculus*, *Eirenis modestus* and *Coluber jugularis* have been Detected.



Figure 7. The Localities Where *Coluber Najadum*, *Coluber rubriceps*, *Coluber ravergieri*, *Elaphe situla*, *Natrix natrix*, *Natrix tessellata*, *Malpolon monspessulanus*, *Telescopus fallax* and *Vipera xanthina* have been Detected.

this species, which moves very fast, were generally seen under stones and sometimes were seen out in the open.

Coluber rubriceps (Taurus Whip Snakes)

Samples seen: 11

The existence of this species in this area has been declared for the first time. The fact that eleven samples of this species were detected is proof that this species which is rare in other areas is quite abundant in this region. This particular species is more sensitive to climatic conditions than the previously mentioned *Coluber najadum*, and has only been detected during the spring. This shows that *Coluber rubriceps* is less resistant to draught conditions.

Coluber ravergieri

Samples seen: 4

This species, the existence of which has been detected for the first time in this area, was seen in four different localities (Figure 7). It was found on both sides of the Köyceğiz Lake canal. It generally lives on sparsely vegetated bushy and stony slopes; it is sometimes also seen in stony olive groves. This snake species which resembles the viper at first sight, is rarely seen in the research area.

Elaphe situla (Leopard Snake)

Samples seen: 2

Two different samples of this species were detected in the protected area for the first time (Figure 7). Until now, the southern board of the distribution area of *Elaphe situla* was known to be Izmir's hinterland. Our new findings show that this species is also distributed in the area between Southern Izmir and the Mediterranean Coast. The samples were found on rocky and sloped river banks.

Natrix natrix (Grass Snake)

Samples seen: 5

This species lives in bushy and sloped biotops near water. The localities where it was found are shown in Figure 7. Although quite a few samples were found during the research period, we believe that it may be quite abundant near swampy areas which were inaccessible for us.

Natrix tessellata (Dice Snake)

Samples seen: 48

Of this species that lives in water, many samples were found (Figure 7) near areas of water. There is a

very complex lagoon system, lake system and irrigation canal system in the research area. Although only a part of these were examined, many samples were found. A more extensive research of the water banks will provide more accurate information about the population of this species in this particular region.

Telescopus fallax (Cat Snake)

Samples seen: 9

The existence of this species in this area has been found for the first time. The places where the samples were detected are shown in Figure 7. *Telescopus fallax* generally lives in stony and sparsely vegetated biotops. In view of the number of samples found, this species is not very rare to the research area.

Malpolon monspessulanus (Montpelier Snake)

Samples seen: 5 half-mature, 2 sloughs

This half poisonous snake species is not very rare to the research area and lives in stony and bushy biotops. The localities where it was found are shown in Figure 7. All of the samples belonging to this species, which mostly lives on the southern slopes of hills, were found under stones.

Vipera xanthina (Ottoman Viper)

Samples seen: 7 adults, 1 half-mature, 3 sloughs

This *Vipera xanthina* species was detected in the protected area for the first time. It is the only *Vipera* species found in the region. The localities in which it was detected are shown in Figure 7. This species which mostly lives in arid and stony biotops, is sometimes seen in the olive groves among the woods.

3. Turtle Species

Since the aim of our project is to examine the population of sea turtles and fresh water turtles which are nearly becoming extinct in the Mediterranean, it is more appropriate to give the findings about *Caretta caretta*, *Chelonia mydas* and *Trionyx triunguis* in a separate section. The population of the above mentioned turtle species on the Ekincik and Dalyan beaches of the protected area has been ceaselessly examined by different research groups for four months, beginning on May 11th, 1991, and detailed information has been gathered.

1. *Caretta caretta* (Loggerhead)

The İztuzu Beach consists of the eastern and western sides of the 4.5 kilometer long Köyceğiz Lake ca-

nal. The first adults that came to the beach to build nests were detected on May 11th, 1991. After this date, the number of adults that were seen on the beach gradually increased (386 in June, 286 in July) until the 10th of August. After this date, no new adults were seen on the beach for eleven days; however, on the 21st of August, one more new nest was detected. After this, arrival of adult turtles to the beach ceased. On the 10th of September a track was detected but no new nest was seen. Arrival of adult females to the beaches and egg laying was realized during the period between the middle of May and the middle of August. The monthly distribution of the arrival of adult females is given in Table 1. This table shows that, most of the arrivals (false crawls and arrivals that resulted in nests) were seen in June. In August, a significant decrease in arrivals was observed.

Table 1. The Number of False Crawls and Nestling Arrivals to the Dalyan Beaches and Ratio of These to the Total Arrivals

	May	June	July	August	Sept.	Total
False Crawls	120	235	199	27	1	582
Nest. Arrivals	22	151	87	9	-	269
Total Arrivals	142	386	286	36	1	851
Nest-Arv. Ratio	15.5	39.1	30.4	25.0	0	31.6
False Crawl Ratio	84.5	60.9	69.6	75.0	100	68.4

During the breeding season of 1991, 851 arrival tracks were detected on Dalyan Beach, 269 of which resulted in active nests. The ratio of nestling arrivals to the total arrivals is 31.6.

During the arrival of adult females to the beach, tagging activity was continued. During the reproduction season, a total of 53 *Caretta* females were tagged. On one of these turtles, a previously dated tag was detected. In addition to this, the arrivals of four females that had tagged before during our research were detected.

In the nests on the Dalyan beaches in 1991, 18,469 eggs were deposited. Within approximately two months, hatchlings were produced from 160 of these nests.

The hatchlings continued to hatch during July, August and September according to the dates nests were made. In August, hatchlings were produced in 100 nests, whereas in July and again in September hatchlings resulted from only 30 nests.

One hundred of the nests that were made on the Dalyan beaches were opened and the eggs were destroyed by foxes. These particular nests are the ones north of the Iztuzu Beach and the ones near the edges of the slopes of the mountain beside the K oyceġiz Lake canal. On the west end of the beach near the canal and on the little beach, no fox predation was detected. A total of 5,612 of the eggs that were laid on the Dalyan beaches were found to be destroyed by predators.

In addition this, some of the eggs laid on the beaches deteriorated due to natural causes or because they could not complete their embryological development. The number of eggs that could not hatch was found to be 4,717. It has also been found that some of the hatchlings could not find an access to the sea. The number of such hatchlings is 865. The number of eggs that were destroyed, that had deteriorated or that could not complete their development, and the number that could and could not find an access to sea are given in Table 2.

Table 2. The Number of Eggs that were Destroyed by Predators; the Number of Eggs that Deteriorated or Could not Complete Their Development; and the Number of Hatchlings that Could and Could not Find an Access to the Sea are Given.

	The Large Beach	The small Beach	Total
Destroyed by predators:	5612	-	5612
Deteriorated eggs and the eggs that could not develop:	3880	837	4717
The hatchlings that could not reach the sea:	517	348	865
The hatchlings that could reach the sea:	4099	3176	7275
Total number of eggs:	14108	4361	18469

On the Ekincik Beach, a total of 13 adult female arrivals were detected in two months. Only one of these built a nest and laid eggs. During the same period, eight nests from which hatchlings resulted were detected. In only three of these nests were the eggs and the hatchlings observed; in the others, sufficient and regular observation was not possible due to their inconvenient location on the beach. In the three nests that were observed, after hatching was completed, the total number of eggs was found to be 289. From these eggs, 226 hatchlings resulted. The rest underwent deterioration.

As it is understood from this general information, very few turtles come to Ekincik Beach to nest. The ratio of the nests to the arrivals is also quite low. The most important reason for this is the structure of the sand on Ekincik Beach; the grains of sand are quite large and the layer of sand under the fine and dry sand of the surface is very difficult to dig. Thus, for these reasons, Ekincik Beach is not as popular as the Dalyan region for making nests.

2. *Trionyx triunguis* (Nile Soft Turtle)

The nestling and hatching processes of the *Trionyx triunguis* were observed for the first time during this research period. This species which lives in the fresh water system north of Dalyan Beach, makes its nests on the beach on the southern coast of the fresh water system. The number of arrival tracks was found to be 59; 26 of these arrival tracks resulted in the making of nests. Since the nests of this species are mostly found near the mountainous region behind the İztuzu Beach, it is very easy for the foxes to have access to these nests. Thus, 13 of the nests on this beach were opened by foxes and the eggs were destroyed. Hatchlings resulted from the remaining 13 nests. Since the nests of this species are mostly found near the mountainous region behind the İztuzu Beach, it is very easy for the foxes to have access to these nests. Thus, 13 of the nests on this beach were opened by foxes and the eggs were destroyed. Hatchlings resulted from the remaining 13 nests.

The total number of eggs deposited in the nests from which 292 hatchlings resulted is 308. The number of eggs found to be destroyed by predators or that deteriorated is 25. The number of turtles able to reach the lake is 283. The ratio of the hatchlings which hatched from the intact *Trionyx triunguis* nests is very high when compared to the ratio of hatchlings from intact *Caretta caretta* nests.

The Dalyan Beach carries great importance since it is also the reproduction area for the *Trionyx triunguis*. This species lays less eggs when compared with the sea turtles, but the ratio of hatchlings is higher. However, as mentioned before, almost half of the nests on the beach were destroyed by foxes. Fox predation seems to be the most limiting factor for the *Trionyx triunguis* population on Dalyan Beach.

3. *Chelonia mydas* (Green Turtles)

Chelonia mydas is very rare in the research area. During the long and ceaseless research period in the reproduction season of 1991, only one false crawl

track of an adult female was detected. On July 18th, 1991, the carcass of a young turtle was found on the beach; however, no *Chelonia mydas* arrivals have been observed.

Our findings show that the beaches of the protected area are not used by *Chelonia mydas* as nesting places. The fact that only one *Chelonia mydas* female that was tagged during the research period between 1980-1988 has visited the beach during our four-year research should be evaluated only as a coincidence. Furthermore, it would be beneficial to point out that the structure of the Dalyan beaches is not suitable for the nestling of this particular species.

4. Mammalia Species

Twenty mammal species have been detected in different localities of the protected area. As it is understood, the region is quite rich as far as mammal species are concerned. The localities where the mammal species have been found are shown in Figure 8.

As we have pointed out formerly, no research has been done on the mammal species of Köyceğiz and its hinterland. Our research project exposes the existence of these mammal species in this particular region for the first time.

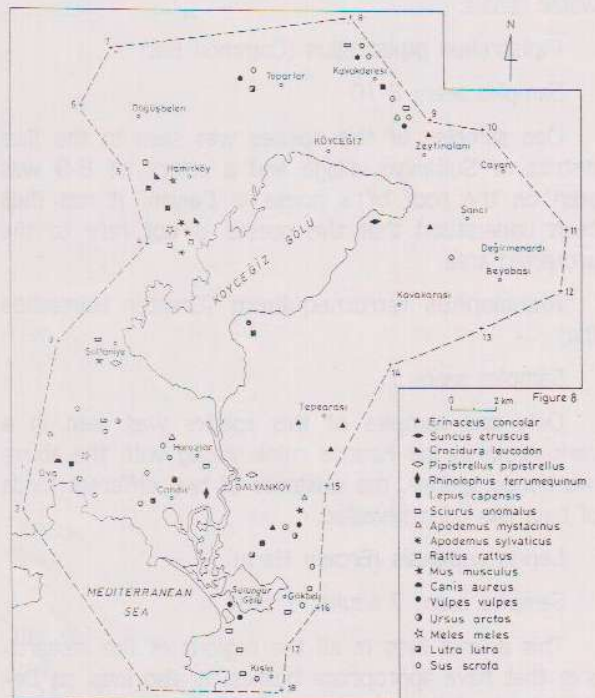


Figure 8. The Localities Where the Mammal Species have been Detected.

Erinaceus concolor (Hedgehog)

Samples seen: 11 dead, 1 alive

The carcasses were found mostly on the roads during the daytime. This particular species which inhabits the fields in the plains and bushy flatlands is not rare to the research area.

Suncus etruscus (Etruscan Shrew)

Samples seen: 1

The existence of this species was detected in only one locality of the research area for the first time. This locality was around Köyceğiz village in a stony-biotope with thick and dense bushes; it was found during the daytime and under a stone. The existence of this species in the protected area is of great value since *Suncus etruscus* is very rare throughout Turkey.

Crocidura leucodon (Bicoloured White-toothed Shrew)

Samples seen: 3

The samples which were detected in two different localities of the protected area have notified us of the existence of this species in this particular region. This species lives on the bushy and grassy biotops near the water canals.

Pipistrellus pipistrellus (Common Bat)

Samples seen: 8-10

One sample of this species was seen in the Ilica district of Sultaniye village and a colony of 8-9 was seen on the roof of a house in Dalyan. It has thus been understood that this species is not rare to the protected area.

Rhinolophus ferrumequinum (Greater Horseshoe Bat)

Samples seen: 1

Only one sample of this species was seen in a dark room in the Kaunos ruins. Along with the above mentioned species, the existence of two different kinds of bats has been revealed.

Lepus capensis (Brown Hare)

Samples seen: 7 adults, 7 skull

This animal lives in all the regions of the research area that have appropriate bushes. It also lives on Delikli Island which is opposite the Köyceğiz canal, in the sea, and on Gedova Island located in Köyceğiz Lake.

However, although the region provides an excellent survival medium for *Lepus capensis*, due to the hunting habits of the local people, only a few samples were found.

Sciurus anomalus (Red Squirrel)

Samples seen: 8

This species which lives in mountainous and forested biotops on both sides of the Köyceğiz Lake canal is quite widespread in the protected area. It was discovered that it lives in eight different localities.

Apodemus mystacinus (Field mouse)

Samples seen: 16

The existence of this species has been discovered for the first time. It has been detected in three different localities. This species which is a mountain form lives in the rocky biotops among the forest.

Apodemus sylvaticus (Taurus Field Mouse)

Samples seen: 6

This species has been observed for the first time in only one region of the protected area. It lives in the bushy biotops in sparsely forested areas.

Rattus rattus (House Rat)

Samples seen: 6

This species has been detected for the first time in the protected area and the samples were found in three different localities. This species which lives in the bushy biotops of the sparsely forested areas probably has an even wider distribution in the research area.

Mus musculus (House-mouse)

Samples seen: 13

The samples of this species were seen in four different localities, providing awareness of the existence of this mammal species in the protected area. This species lives in the bushy and grassy biotops along irrigation canals and near fields. It is also seen in the cellars and barns of the village houses. In relation with the biotops it lives in, it can be said that this species is quite widespread throughout the research area.

Canis aureus (Jackal)

Samples seen: None

Although no samples of this species were detected, its call was heard from the olive groves behind Ekinçik Beach and from the sparsely forested areas. Thus, its existence in the region has been detected for the

first time. However, it is probably very rare to the research area.

Vulpes vulpes (Fox)

Samples seen: 8

This species is quite widespread throughout the region and it is mostly found on the sparsely forested hills north of İztuzu Beach. Most of the *Caretta caretta* nests on the eastern part of İztuzu Beach are being destroyed by the foxes that descend to the beach from the hills. In addition, adult samples and their dens have been seen in other parts of the research area. The existence of this species on the banks of the Köyceğiz Lake and on Gedova Island, which is located in a marshy and reedy area, has been detected for the first time.

Ursus arctos (Brown Bear)

Samples seen: None

Although no samples of this species have been seen; however, it has been observed that they often destroy the honey-combs of the bee colonies on the southern slopes of the mountain which is located between Çandır and Sultaniye. Bee-keepers have organized a drive hunt to eliminate the bears, but they have not yet been able to locate any bear because of its high mobility.

Meles meles (Badger)

Samples seen: 1 alive, 1 dead

This species has been detected in two different localities in the western part of the Köyceğiz Lake canal. The locality where the living sample was found is the forested region north of Ekincik Beach.

Lutra lutra (Otter)

Samples seen: None

Information about the existence of this species in the reedy and marshy parts of the protected area has been gathered from explanations of the local people and from the studies of Kasperek (30). We believe that our forthcoming project in the marshy regions will reveal the distribution of this species in this particular region.

Sus scrofa (Wild Boar)

Samples seen: 1 dead, 1 skull, 3 lower-jawbone and many traces.

Many fresh traces of this species which is quite abundant in the research area have been seen in ten different localities. In addition to the traces, one dead

sample was found and skull bones were observed in four different localities. Thus, we conclude that this species is quite widespread in the protected area.

Capra aegagrus (Ibex)

Samples seen: None

No samples nor traces were detected in the research area. However, information given by the local people shows that this species was once very abundant on the mountain between Sultaniye and Çandır villages 13-15 years ago. There is one male kid that was caught on the mountains between Marmaris and Köyceğiz and is in very good health and living in a house in Sultaniye village. The population that used to live on the mountain in the protected area has become extinct due to unplanned hunting.

Discussion

Because of the systematic research that was performed in 1991, the existence of five frogs, five turtles, eleven lizards, thirteen snakes and eighteen mammal species in the protected area has been brought to our awareness for the first time. Thus, the protected area is very rich in **amphibia**, **reptilia** and **mammalia** species. It would be very beneficial to make a comparison of the results of this study of the protected area with the results of two other studies carried out by foreign researchers, leaving the publications about the Turkish fauna in general, aside. Thus, in Kasperek's publication (31) about the herpetofauna of this region and in Klein et al.'s report (32), a total of 25 and 15 different species were mentioned, respectively (Table 3). There is not any other similar research about the mammal species of this area.

Table 3. The Species Discovered to Live in the Protected Area During Our Research and During the Studies of Other Researchers.

Species Groups	Kasperek 1990	Klein et al. 1991	Baran 1991
Frog	3	-	5
Turtle	5	5	5
Lizard	9	6	11
Snake	8	4	13
Mammal	-	-	18
Total	25	15	52

Examining Table 3, the number of vertebrata species found during our research is quite different when compared with the two former studies. The reason for this difference is our continuous, systematic and ceaseless observation of the protected area. It has thus been possible to detect the localities in which different species inhabit and to show these localities on charts and figures. As it is understood from the figures, the most common frog species in the protected area is *Rana ridibunda*, the most common turtle species is *Testudo graeca*, the most common lizard species are *Agama stellio*, *Ophisops elegans*, *Ablepharus kitaibeli*, *Blanus strauchi*, and the most common snake species is *Eirenis modestus*. The majority of the vertebrata species noted in our research have been introduced as to their type and distribution. However, the *Elaphe quatuorlineata* which is known to have a wide distribution in Western Anatolia, has not been detected as yet. Additionally, there may only be a few mammal species that we have failed to detect. We believe that these deficiencies will be overcome by future studies.

Since our research involved observation of the turtle species that nest on the beaches of the protected area, the beneficial findings about *C. caretta* and *T. triunguis* have been summarized below.

The Dalyan Iztuzu Beach was examined for three years to record its *Caretta caretta* population. (However, the research of 1990 was not a regular and systematic study.) These values are shown in Table 4.

Table 4. The *C. caretta* Population of Iztuzu Beach According to Years

	1988	1989	1990	1991
Number of nests	146	235	52	269
Nests with hatchlings	47	59	57	160
Number of eggs	11055	16135	5244	18469
Hatchlings able to access the sea	3109	1611	3036	7275

The reason for the great number of hatchlings able to reach the sea in 1991 is because the values for the Dalyan beaches have been given together as a total. It has been discovered that hatchlings from 4,099 of the 14,108 eggs that were laid on Iztuzu Beach and hatchlings from 3,176 of the 4,361 eggs that were

laid on the little beach were able to find and access to the sea. The ratio of hatchlings able to reach the sea is very high when compared with Iztuzu Beach. This lies in the fact that on Iztuzu Beach, fox predation is a great danger for the nests. However, there is no fox predation on the little beach. On the little beach, 348 of the hatchlings (8 %) died before they could reach the sea. On Iztuzu Beach, this ratio is quite low (4 %); only 517 turtles were not able to reach the sea.

The reason for the high ratio of hatchlings that were not able to reach the sea on the little beach is closely related with the structure of the beach. The layer of dry sand on the surface is much thicker than it is on Iztuzu Beach. This results in a great loss of time when the hatchlings are struggling to find access to the sea. Some hatchlings become so exhausted that they cannot proceed and the sand becoming increasingly hotter with time proves fatal for them. In spite of this natural negative factor, the ratio of hatchlings able to reach the sea has been found to be 73 %. This ratio is much lower for Iztuzu Beach (29%). This again is related to fox predation; when the foxes dig the nests open, the eggs deteriorate due to the change of temperature. In addition to this, the crab species, *Ocypoda cursor*, also harmful for the hatchlings is quite abundant on Iztuzu Beach.

From our evaluation, the *Caretta caretta*'s of 1991 were more successful than in former years regarding nestling, egg laying, and reaching the sea. However, we believe that taking additional protective measures, as explained in the next section of our report, will increase for the sea turtles' productivity in the coming years.

The *Trionyx triunguis* which was examined and observed for the first time in 1991 nests on the Dalyan Iztuzu Beach in June, July and August. Egg hatching occurred between August 1 and September 9, 1991. The number of eggs laid in one nest was found to change between 9-41, the average being 25.3. These values show that the number of eggs in *Trionyx triunguis* nests is quite lower than the number of eggs in *Caretta caretta* nests. Furthermore, the nests that are made near the coastal part of the lake are not dug as deeply as the *Caretta caretta* nests. Since these nests are near the hill north of Iztuzu Lake, fox predation seems to be a great danger in this particular area. In spite of all these negative points, quite a high number of hatchlings were able to find access to the sea. With the help of the protective measures which we are planning to apply next year,

we believe that there will be a great decrease in fox predation.

The protected area is also quite suitable for mammal species; of these, the most widespread mammal species is wild boar. Although no live sample have been detected, many traces and parts of skeletons have been seen. Hare is also quite abundant in the area. However, the hare population is not as dense as it normally should be. The same situation is true for the fox. Many of the local people are hunters; due to long years of unplanned and excessive hunting, about 12 years ago the mountain goats that used to live on the forested mountains between Çandır and Sultaniye villages became extinct. The excessive employment of agricultural chemicals is another reason for the decrease in the mammal population of this particular area.

Protective Measures

General Protective Measures

Necessary precautions to preserve the general ecological balance of this special protected area should be taken. These precautions are listed below:

1. Illegal sand haulage from Ekincik Beach should be stopped. This is a practice which spoils the natural ecological balance of the beach. During the two months of our research period we were able to stop this practice; however, necessary measures to prevent this practice throughout the year should be taken.

2. It has been observed that night and day hunting continues all around the protected area throughout the year. Approximately half of the local population are hunters. This practice is a great danger for all the mammals species and especially for the birds.

In the protected area where hunting is strictly forbidden, a healthy application of this rule carries great importance regarding the fauna of the region. For this issue, cooperation with the town and village muhtars is necessary. If the muhtars are held responsible for the application of hunting restrictions, the desired results will be achieved. We believe that the Institution of Ecological Protection and the Ministry of Ecology will provide the necessary legal regulation in the shortest time possible. We also want to point out that we are ready to do whatever we can be to realize the application of such a hunting restriction. We believe that controlled hunting will be possible only if the local people are sufficiently informed and if the muhtars of small inhabitation units attach sufficient importance to this issue. We also believe that a seminar organized by the Ministry of Ecology for the muhtars of the region

will be very beneficial. Thus, the muhtars who are the representatives of the local people will be informed about the protected area, and their assistance with protection and control of the natural riches of the region will be provided.

3. We believe that a contribution by the Ministry of Ecology for the construction and repair of the asphalt road within the protected area will be very beneficial.

Special Protective Measures

The Dalyan beaches are important nestling places for the *Caretta caretta* and *Trionyx triunguis*. The natural ecological balance of the region enables the turtles to lay and to reproduce. On the other hand, taking artificial measures which will affect the natural ecological balance of the region is not thought to be proper. However, since the sea turtles have become very rare in the Mediterranean, some simple regulations on the beaches where they nest are necessary. These precautions which are easy to realize are as follows:

1. Our four-year study on the Dalyan Beach has shown that the most important negative factor which affects the emerging of hatchlings is fox predation. During this particular research period, it has been discovered that fox predation eliminates approximately 40% on Iztuzu Beach. To reduce this damage, a caging system for the nests that are in the fox predation area will be very beneficial. For this caging system, holes of 20 cm. diameter will be opened on cage wires with 80x80 cm. dimension and these will be buried under the layer of dry sand. This system will prevent foxes from digging up the nests and at the same time will enable hatchlings to emerge without any harm. If this system can be applied to the majority of the nests in the fox predation area, majority of hatchlings will be able to emerge.

2. Another method is to change the places of the nests that are damaged by the predators. However, for now we believe that the application of this method will not be helpful on Iztuzu Beach. To do this, the most important factor that should be known is the temperature profile of the beach. This profile is a part of our future research program.

When this study is completed we believe that this method will be applicable.

3. The area west of Iztuzu Beach near the canal is being used as a public swimming area with a quickly increasing population. These people naturally place

their towels on the beach and tread on the sand. This causes a change of temperature in the nests and a hardening on their surface which has a negative effect on egg hatching. Necessary warnings have been given on this issue during our research period and generally people are more aware. However, keeping in mind the ongoing increase in the number people coming to the beach, an absolute restriction of this practice would be very beneficial. The employment of wire mats on the nests in the areas where people often go for swimming would be very helpful. These wire mats, which are different from those that are used for the prevention of fox predation, can stop this human-caused damage. Furthermore, since this practice will increase the area that is used as a beach, restrictions on the amount of people can be reduced to a great extent. On the other hand, it is hoped that this visual type of protective measure will elevate the curiosity of people and cause them to be more aware and mindful of the turtle nests.

The success of this wire cage system depends on the following points:

a- The fixing and placing of the wire cages should be done by experts, in other words by people who have performed a similar research in this particular region or at some other area.

b. The visual character of this wire-cage system necessitates the presence of guards on the beach only then will people stop damaging the nests out of curiosity.

c. The people who come to the beach should be given written and oral information about this practice.

d. If the above mentioned conditions are impossible to apply, then the wire cage system should not be employed.

4. After the temperature profile of the beach is recorded in our future studies, only experts should relocate the nests that had been made in an inconvenient area of the beach.

Otherwise, the risk of damaging the nests and hatchlings will be very high.

5. On the little beach which is very important regarding the high ratio of hatchlings that are able to emerge, people seem to cause a lot of damage to the nests. It has been detected that people open the newly made nests and take the eggs. In addition to this, the little beach is being used as a camping site and bonfires are being built on the sand. The presence of a

guard on this beach would be very beneficial. Also, the employment of beach chairs and sun umbrellas on the beach should be forbidden.

6. In order to obtain healthy information about the turtle population of the Dalyan beaches, the tagging activities that were carried out in 1991 should be continued for at least 5 or 10 years.

7. During this research period, the nestling and hatching processes of the *Trionyx triunguis*, which is a fresh water turtle, were examined for the first time. In order to determine the population of this species in the protected area, females should be tagged.

8. On the parts of the İztuzu Beach that are near the Köyceğiz Lake canal, due to the topographic conditions of the area, the hatchlings either first go to the sea and then to the lake or vice versa. This indecision causes a great loss of time. The hatchlings which cannot determine which direction to go remain on the beach until morning. When the sun rises causing a temperature increase, and the turtles die of dehydration. This confusion is especially seen on the 900-1400 meter long beach east of the canal. It is thought that the planting of oleander trees in this area may prevent this confusion. However, more necessary research should be carried out before realizing this project.

9. In Dalyan, necessary measures should be taken to control the illumination of the city since this issue is closely related with the gradual increase in construction activities; the lights that are reflected on the beach may attract some of the hatchlings causing them to lose their way. In order to reduce this negative affect, the lights of the Dalko building in Dalyan, Çandır village, and the light from the fire watching tower should be screened.

We believe that the special Ecological Protection Institution will do what is necessary for the realization of these simple but very important precautions.

10. During the reproduction period, many vehicles come to the Dalyan beaches during the night. Although they are stopped by the guards, headlights of the vehicles are very harmful for the adults and hatchlings; therefore, this vehicle traffic to the beach should be prohibited during the night. A designated parking area should be established at sufficient distance from the beaches so that the turtles will not be disturbed by the headlights.

11. During the reproduction period and at other times, some vehicles have been seen to enter the

beach in the daytime and to drive on the sand as far as the canal. To prevent this practice which destroys the natural structure of the beach, necessary measures should be taken not to allow any vehicles beyond a certain point.

12. On Ekincik Beach, race horses are being trained. Necessary precautions should be taken to stop this practice, which we were able to prevent during the research period.

13. The entrance of domestic animals to the beach should be prohibited since their grazing is very harmful for the natural vegetation of the beach.

14. The boats that come to the beach at night during the reproduction period should not turn their lights on, should not anchor very near the land, and the people from the boats should not come onto the beach. We have witnessed such events during the research period, and although this did not occur very often necessary measures should be taken to stop this kind of behavior.

15. The parking lot planned to be built near the foundations of the old hotel on the east end of the İztuzu Beach should be allowed only after necessary studies about its probable effects on the ecological balance are realized. It will thus be possible to reduce the harmful effects of this project to the lowest possible limits.

16. Occasionally, fishing nets are spread very near the coast of İztuzu Beach. This is very harmful both for the adult females that come onto the beach to lay and for the hatchlings that emerge. Spreading fishing nets near the coast should be prohibited.

17. An information center which will satisfy the curiosity of the Turkish and foreign tourists about the sea turtles should be established; the center should also provide scientific information about these turtles. Booklets which give information about the present situation of the turtles and about the protective measures should be prepared and made available for the tourists who visit the area. By this way, necessary medium which may attain the help of these people can be provided. The information bureau which is operating in Dalyan is presently quite insufficient at providing this kind of service.

18. Necessary measures which solve the waste problem in the area of the İztuzu Beach near the canal should be taken. Otherwise, this problem may spoil the very sensitive ecological balance of the region.

19. In relation with the increasing boat traffic of the Dalyan coasts, excessive oil pollution in the sea has been observed. This will harm the sea turtles along with the rest of the ecological system. This issue necessitates the taking of precautions.

20. The sea turtles that mate in Alagöl and in the canals in April and May should never be disturbed; necessary measures should be taken to provide their comfort. Although this kind of disturbance has not been detected as yet, keeping in mind that there is always a possibility, necessary measures should be taken.

21. Speed boat traffic in the canals should be prohibited since this will harm the *Trionyx triunguis* that live in the fresh water system. Furthermore, these speed boats also harm the reeds in the canals thus spoiling the natural balance of the ecosystem. However, such a negative effect has not yet been detected.

22. It has been observed that some people or institutions are trying to gather information about the sea turtles that live in the protected area. Research carried out by people who are not experts of the subject will result in wrong or insufficient information. This information is transferred to the public opinion through wrong and insufficient interpretations. This creates various problems in relation to the protection of the sea turtles of the region. Necessary measures should be taken to prevent the gathering of wrong and insufficient information and interpretation of this information. In other words, such reports prepared by people whose interest in the sea turtles rests not on scientific foundations but only on curiosity and love for nature should be prohibited. Otherwise, our institutions that have undertaken the protection of the region and that are exerting great effort on this issue will be confronted with many problems.

These twenty two special protective measures do not cause a great financial burden. Furthermore, they are easily applicable. With the application of these proposals and precautions, a protection program of international level will be realized. We believe that the Ministry of Ecology and the private Ecological Protection Institution will provide the necessary programs and regulations for the realization of the above mentioned articles.

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