MedPAN South - Turkey Pilot Project

Executive Summary
Results of Marine Biodiversity Research

PREPARED BY

UMUT TURAL

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OVERVIEW of the PROJECT

The Kas-Kekova region, sometimes called Lycian coasts, has a unique natural heritage. Lycia is a part of the Turkish Mediterranean coast where some sections are still not destroyed by human development. This coastline includes the most variable and spectacular coastal and marine landscapes, as well as fauna and flora. Kas-Kekova region supports a wide array of habitats and species including *Posidonia oceanica* meadows, groupers, common dentex and many invertebrates species. The surrounding waters support marine turtles, monk seals and dolphins, and the small islets (Bes Adalar) are home to feeding and breeding colonies of these species.

Marine bio-diversity assessment carried out in the framework of MedPAN South Project in 2009 to figure out complete biodiversity within the border of Kas-Kekova SPA. It was a complementary study of the work has been done in 2002 and 2006. During the previous studies only certain species were investigated that were selected based on their IUCN status (endangered, threatened) and protection status under international conventions or under the National Fisheries Manual and their presence in the survey area and in addition some flagship species were selected to highlight the habitats. In the framework of this project not only the marine species were examined, but also as much information as possible about the sediment structure, physical properties, fauna and flora of the region was gathered, due to the nature of the project as being the first and most detailed of its kind.

According to the previous projects' results, Kas area was the richest area after the Antalya / Tekirova --Uc Adalar (Uc Islands) area. Both areas are the most popular diving sites of Turkey. Based on the findings, a proposal prepared to be enlarged the Kekova SPA to include the Kas area was sent to EPASA (Environmental Protection Agency for Special Areas) Authority for Specially Protected Areas with strong documentation regarding the findings coupled with GIS maps. Eventually Kas Kekova SPA was officially declared by the Council of Ministers and published in the Official Gazette, in 2006.

After designation of Kas-Kekova SPA, in 2009 a new project started in-Kas-Kekova region. Within the framework of the SAP BIO implementation Programme, RAC/SPA and WWF MedPO have jointly prepared this project for the development of a Mediterranean Marine and Coastal Protected Areas (MPAs) Network. It constitutes a part of the project "Strategic Partnership for the Mediterranean Sea Large Marine Ecosystem" specifically the component regarding the conservation of the marine and coastal biodiversity and the establishment of a network of MPAs in areas under national jurisdiction in the Mediterranean Sea.

The MedPAN South Projects, led by WWF-MedPO, aims at enhancing the effective conservation of regionally important coastal and marine biodiversity features by assisting the 13 countries of the south and east of the Mediterranean improving the management of their marine protected areas (MPAs) and promoting the establishment of new MPAs. South MedPAN project was developed in order to respond to the problems and risks of Specially Protected Areas (SPA) which had been determined by SAP BIO ;

i) Lack of well defined conservation objectives and management plans
ii) Lack of local support because of little information available and participation
iii) Insufficient funds
iv) Insufficient and poorly trained field staff
v) Insufficient information about protected areas status and basic ecological issues that allow for an appropriate management
vi) Weak networking and sharing capacities among MPAs managers, practitioners and responsible authorities

vii) High interference with other human activities occurring in the coastal zone, mainly tourism and fisheries
viii) Weak MPAs integration into landscape and into broader development plans.

The main objective of The MedPAN South Projects consists enhancing the effective conservation of regionally important coastal and marine biodiversity features, through the creation of an ecologically coherent MPA network in the Mediterranean region. This will be achieved through a series of demonstration activities in specific pilot sited and targeted capacity-building exercise at regionally and local level.

DESCRIPTIONS OF THE REGION

KAS

Kas is the oldest settlement in Lycia. Its oldest name is “Habesos”. But it has been known as “Andifli” until recent times. The city was built upon the antique city, Antiphellos, which was the most important harbour of Lycia. The ruins of the antique city continue on the Çukurbağ Peninsula toward east. “Phellos”, meaning “rocky place” is well matched with the geography of the region. In BC IV, Antiphellos was a small settlement and was the harbour of Phellos located just above it. With the start of Hellenistic era, Phellos entered a regression period while Antiphellos become more developed. This situation continued through the Roman times. The improving sponge and cedar trades resulted in the urbanisation of Antiphellos. It became a rich, self-sufficient city, independent of Phellos.

The presence of many antique cities within Kas indicates that this region has been an important center throughout history. The harbour preserved its importance until the beginning of 20th century, but with the development of land transportation, it lost its value like the other seaside settlements. However, within the last 10 years, as the tourism sector has shifted focus towards this region, the area started to urbanise once again. Until recently, Kas was known as a small fisherman village, but today it is a very important center of cultural and yachts tourism with its 5star hotels, restaurants, pensions reflecting the authentic architecture. Besides the historical remains, Kas is also rich in its natural beauties. Visitors are offered many opportunities for activities such as trekking, climbing, rafting, hillside parachuting and diving.

In this region, the coastline is surrounded by steep rocky mountains of which the feet extend down to several hundreds of meters below the sea. There is not any sandy beach on the coastline. The shores of confined coves and bays are covered with gravel but not with sand. The coastline has a carstic formation. Fresh water springs draining from caves, cavities and rocks are common. An underwater set located between Gata Cape and Meis Island (Castellorizo), connects Meis to the mainland. The small islands emerging on this set contains the most important dive sites of Kas. Diving is prohibited on the west shores of Gata Cape and in the Bohcaiskelesi Cove because of archaeological remains.

KEKOVA

The region, including many important antique settlements, is famous with its sunken city on the Kekova Island. Üçağız and Kaleköy settlements are on the coastline, and they are not well developed since they are located in an archaeologically protected site. Even though Kekova is a very important touristic center, the tourism intensity depends on daily tours coming from Kas and Demre by sea or land transportation. It is also an important area for the yachters to stay overnight.

The area between Kekova Island and Ucağız (Oludeniz) is an archaeologically protected site and diving is prohibited. Kekova region has a very similar geological structure with Kas. But Oludeniz is facing an environmental pollution because of the bilge that is being dumped by yachters. There is not enough water circulation in Oludeniz since it is very confined. The difference in water quality between the inside and outside of Oludeniz is obvious, and can easily be recognised when passing through the strait between Sıcak Peninsula and Kekova Island.

OCEANOGRAPHIC PROFILE OF THE REGION

Being the west boundary of our Mediterranean coast, the Lycian region has a temperate climate. Even though it is not as hot as Iskenderun Gulf, on average, the Lycian coasts have a significantly high seawater temperature when compared to the whole Mediterranean.

Although this temperature distribution may seem the same all throughout the region, it differs where there is a fresh water spring on the coast. The fresh water springs found in Kas and Kalkan regions are cold, where as the ones observed in Bes Adalar and Uc Adalar were, not hot, but warmer than the seawater. However, none of these water sources have been found adequate to change the average water temperature of any section analyzed in the project area.

Freshwater influx results in a local decrease in the salinity. But the rough open sea conditions prevents the formation of a freshwater layer on the sea surface, thus only very little local variations are observed in average salinity of the sections.

The Mediterranean Sea evaporates due to the temperate climate observed all throughout the year. The decrease in its surface level is compensated by the inflow of Atlantic waters from Gibraltar. The cold Atlantic water follows an anticlockwise route in the Mediterranean, passing by the north African coasts it reaches the Iskenderun Gulf, then changes its direction to west. The current keeps on moving towards the western Mediterranean after leaving the Lycian coast. The southwestern coast of Antalya is under the influence of this current. But the magnitude of the current is not the same everywhere on the Lycian coast. The currents of Antalya Gulf run towards the Gelidonia Cape. The sea bottom between Antalya and Gelidonia Cape has a uniform smooth structure, except the elevation of Uc Adalar. The islands arise from the sea bottom and split the currents into two directions. The benthic structure of the passage between the islands and the mainland is shallower than the outer side of the islands which results in a difference in the magnitudes of the currents. The outer current may be so strong that it can prevent even swimming, but it lessens if moved towards the mainland.

The currents of Antalya Gulf gather at Gelidonia Cape, and meet the emerging islands of Bes Adalar and the narrow straits between them. The water moves into the straits forming enormous currents. The currents around Devecitası Island may be so strong to halt even motor boats. After passing the Gelidonia Cape, the water changes its direction to southwest. When moved from Gelidonia Cape towards west, the magnitude of the current observed in coastal waters decreases. The current may have a speed of 1-2 Knots on the shores of Kekova Island and Sıcak peninsula, but again increases in the funnel shaped strait (Akar Bogazi) located between the Sıcak Peninsula and the Eleksi Island (Uç Ada), exceeding 3-4 knot. As we it moves to the west, the magnitude of the current decreases thus loses its importance.

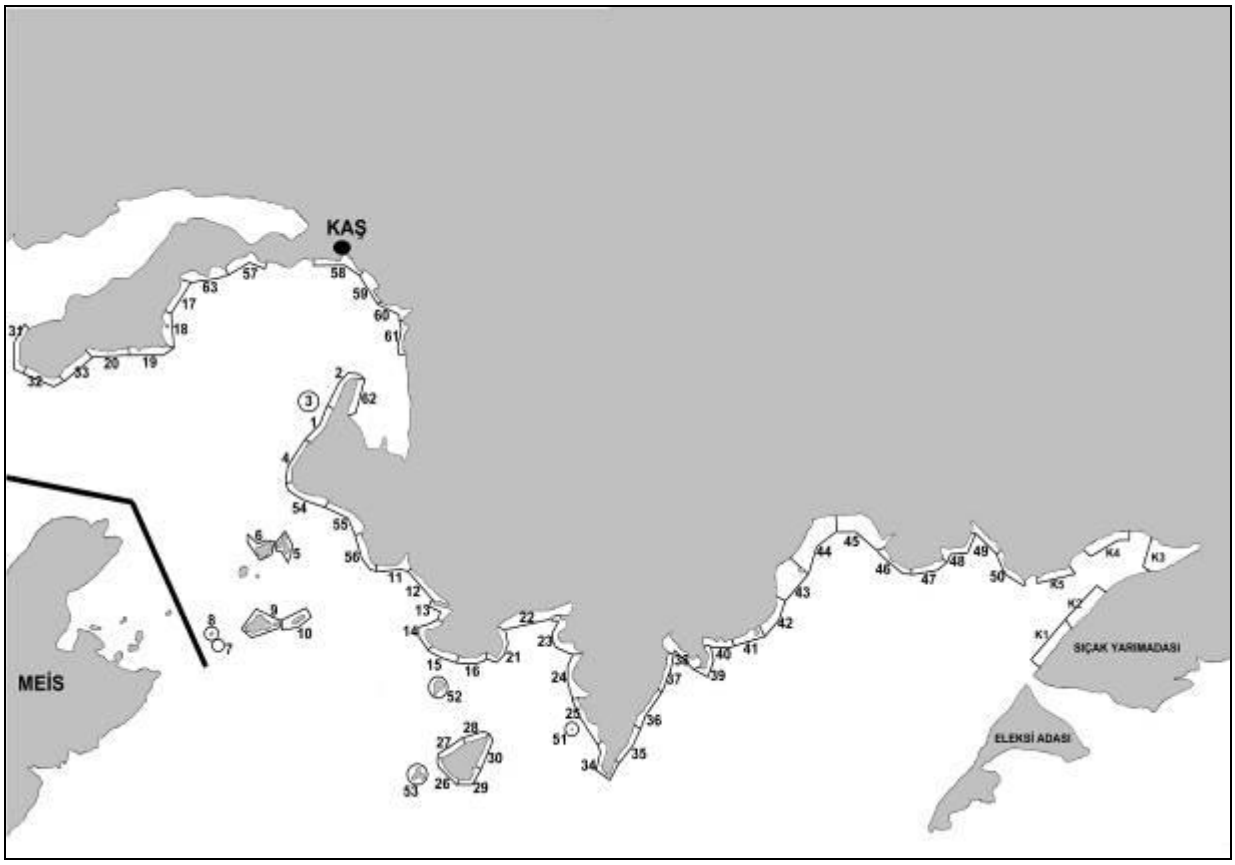
METHODS

UNDERWATER SURVEY TEAM

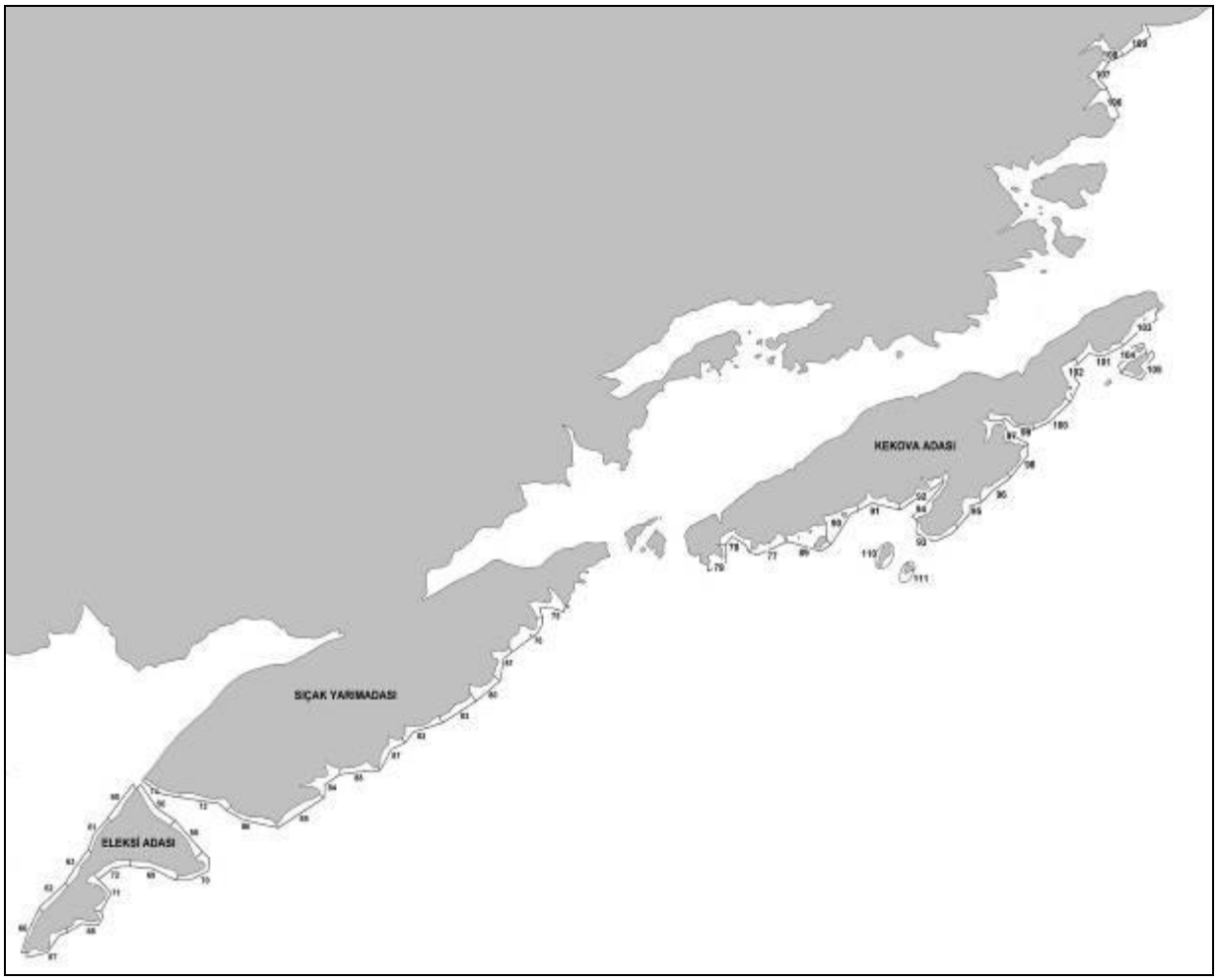
The research team was composed of diving instructors, dive leaders and experienced divers. The underwater survey team consisted of 81 divers were selected from the members of Bogazici University Skin and Scuba Diving Club (BUSAS) and 10 researchers & marine biologist who are from seven different universities located in Turkey. The research team was divided into task groups. A group of divers stayed in the field throughout the whole project, while other groups joined them according to a schedule, on a timely basis. The latter mentioned groups interchanged periodically every 2 weeks, making it possible for a group of 12 divers being in the Project area all through the time.

MARKING THE SECTIONS

The Kas-Kekova SPA region, 81,41 km coastline were divided into sections, total 121 sections along the coast. "Starting" and "End" points of each section were marked with buoys anchored at 30m of depth. After marking the starting point of a section, 500m was measured parallel to the coastline by using GPS.

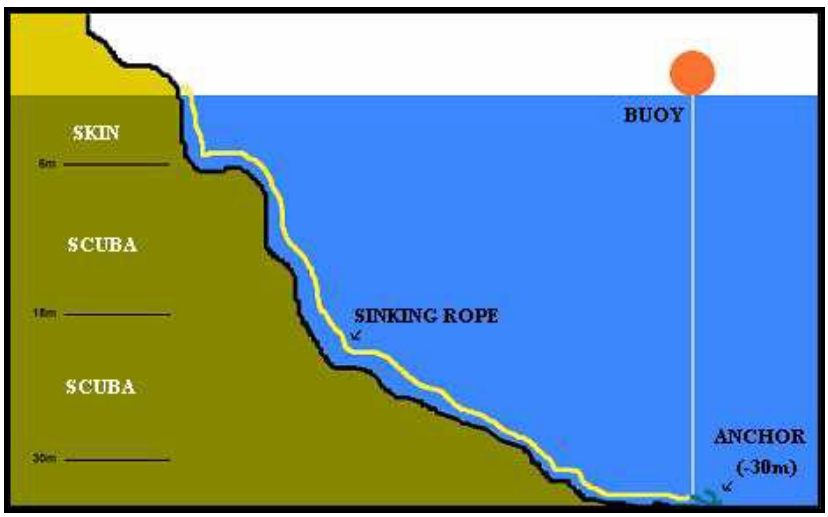


** 121 sections along the study area.*



** 121 sections along the study area.*

Sinking ropes that were fastened to the anchors of the buoys were extended vertically to the shore, so that the starting and end points of each section became visible under the water. The coordinates and the positions of the sections are shown in Appendice 1-5. The sections were subdivided into 3 imaginary zones of different depth ranges: Zone-1: 0-6m; Zone-2: 6-18m; and Zone-3: 18-30m. Different diving groups examined each zone.



Marking the "starting" and "end" points of the sections

RECORDING AND SAMPLING

Divers recorded the species they encountered on the Plexiglas plates that they were carrying during the dives or they take sample of specimen if divers encounter interesting or different kind of species. A school of fish was hard to be counted one by one in a limited time, so instead of counting; an estimated total number was recorded. The sea bottom was examined in detail and the sediment structures as well as the distribution patterns of sea grass and algae species were recorded. Sediment samples were collected from each zone of a section to identify gastropod and foraminifer species. All specimen observed under the water were photographed by underwater photographers or if not, the specimen were photographed at the surface in the aquarium or sampling pot.

At the end of each dive, the data on the plexy-glass plates were copied to the record forms. The species which need further analysis for their identification were sampled and sent to laboratory. The sediment and other species samples were fixed in the %70 alcohol solution or %5 formaldehyde and packed to be further analyzed after the data such as section/depth/date was recorded. Marine biodiversity assessment's field work completed between 27 of July – 01 September 2009, total 536 dives were performed within the framework of this research.

FINDINGS & RESULTS

The increase in touristic activities, which is as a result of an incline in urbanization, negatively affects both terrestrial and marine ecosystems. Today, many species inhabiting the Mediterranean are going extinct because of the pressure exerted by anthropogenic activities, and are being taken under protection by international conventions. Comparing to the western Mediterrnean, Turkish coasts are rich in some rare native and invasive species, thus have a great importance for the Mediterranean ecosystem.

More than 1000 species were identified during the studies from 2002 up till today (Distribution maps of this species according to the sections given below). Distribution of these identified species are; 117 fish species (14 threatened, 11 invasive species), 729 invertebrate species (19 threatened, 51 invasive species), around 160 algae species (2 threatened, 7 invasive). According to the results of the studies within the border of Kas-Kekova SPA since 2002, it has been observed that the economically important species and the threatenedfish populations are in decline dramatically. However, parallel to this there is no increase on the commercial fishing capacity, fishing fleets, CPUE (Catch Per Unit Effort) or anthropogenic effects in the region. As the population of Epinephelinae (Grouper) species decrease, on the other hand when Sparidae (two-banded sea bream, common sea bream) species population analyzed, it has been observed that there is no significant decrease since 2002, even it was recorded that some Sparidae species population which are living in the same habitat with grouper species and accepted as an indicator species for healthy habitats increased. This situation shows that there is a special situation exists in the Kas-Kekova SPA rather than general ecologic problems.

** Variation of P.pagrus and the grouper species' visual frequency per dive according to the years in Kas region*

		E. marginatus		***E. costae***		***E. aeneus***		***E. caninus***		***E. haifensis***		***M. rubra***		***P. pagrus***	
Year	Number of dives	n	gs	n	gs	n	gs	n	gs	n	gs	n	gs	n	gs
2002	136	959	7,05	169	1,24	16	0,12	16	0,12	1	0,01	63	0,46	100	0,74
2006	130	319	2,45	313	2,41	6	0,05	1	0,01	2	0,02	92	0,71	6	0,05
2009	129	194	1,50	279	2,16	20	0,16	4	0,03	0	0,00	27	0,21	11	0,09

n: number of recorded individuals , gs: *visual frequency per dive*

** Variation of P.pagrus and the grouper species' visual frequency per dive according to the years in Kekova region*

		E. marginatus		***E. costae***		***E. aeneus***		***E. caninus***		***E. haifensis***		***M. rubra***		***P. pagrus***	
Year	Number of dives	n	gs	n	gs	n	gs	n	gs	n	gs	n	gs	n	gs
2002	145	575	3,97	142	0,98	7	0,05	10	0,07	5	0,03	80	0,55	56	0,39
2009	139	120	0,86	108	0,78	16	0,12	1	0,01	1	0,01	28	0,20	3	0,02

n: number of recorded individuals , gs: *visual frequency per dive*

While the population of Epinephelinae species, common seabream (*Pagrus pagrus*), common dentex (*Dentex dentex*) decrease which have highly economical value and one of the most target species for recreational fishery especially also for spear fishery, on the other hand there are no changes on the population of the species which have a low economical value and low interest

from recreational fishermen indicates that there is a recreational fishing pressure on the some specific species.

** Variation of Sparidae species according to the visual frequency per dive between years 2002-2009 in Kas region*

		D. dentex		***D. vulgaris***		***D. sorgus***		***D. puntazzo***		***S. cantharus***		***L. mormyrus***		***S. salpa***	
Yıl	Dalış sayısı	n	gs	n	gs	n	gs	n	gs	n	gs	n	gs	n	gs
2002	136	91	0,67	1970	14,49	1521	11,18	269	1,98	17	0,13	111	0,81	1157	8,50
2009	129	24	0,19	3596	27,88	1396	10,82	162	1,26	257	1,99	10	0,08	1262	9,78

n: number of recorded individuals , gs: *visual frequency per dive* (n/number of dives)

** Variation of sparidae species according to the visual frequency per dive between years 2002-2009 in Kekova region.*

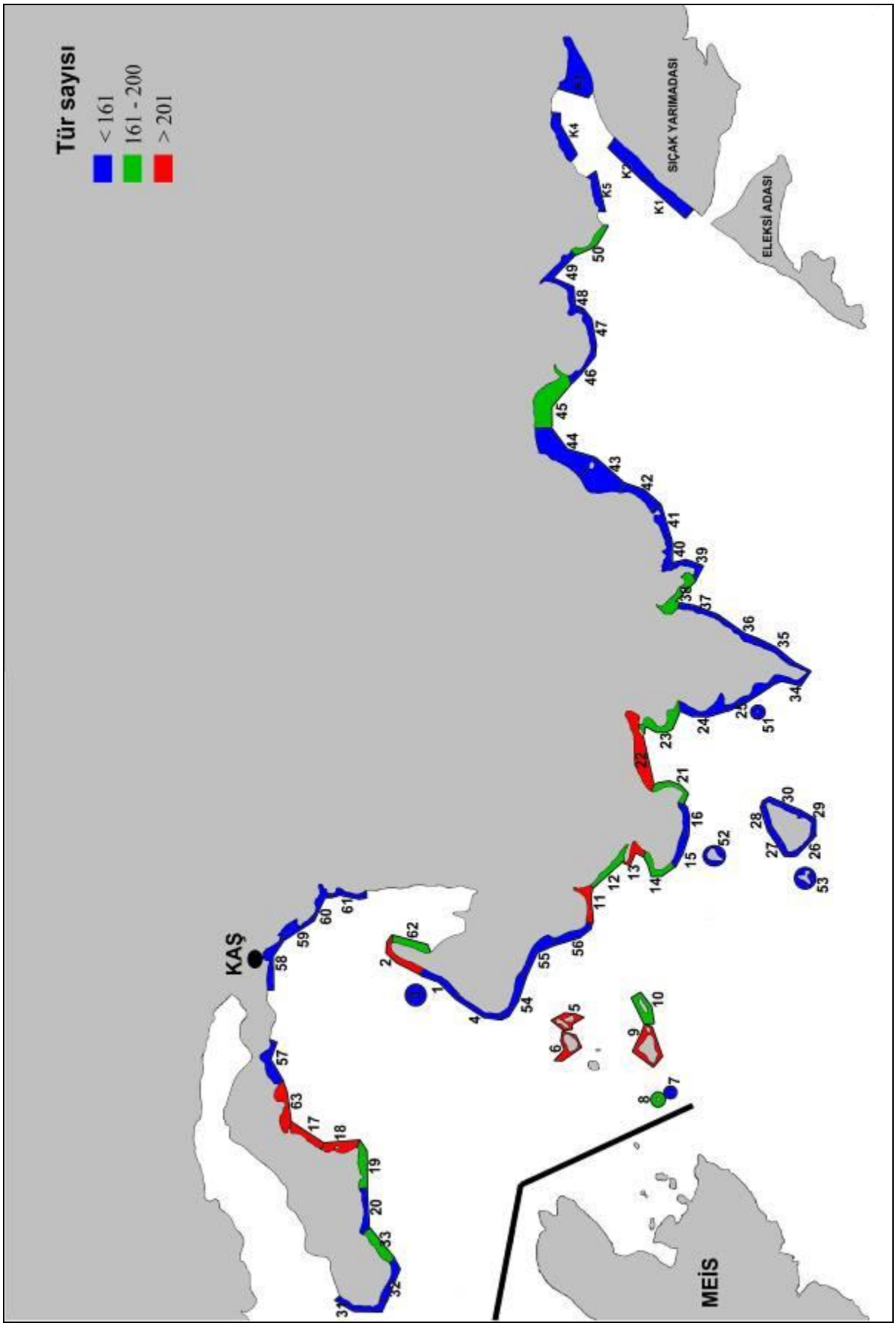
		D. dentex		*D. vulgaris*		*D. sorgus*		*D. puntazzo*		*S. cantharus*		*L. mormyrus*		*S. salpa*	
Yıl	Dalış sayısı	n	gs	n	gs	n	gs	n	gs	n	gs	n	gs	n	gs
2002	145	80	0,55	1633	11,26	1098	7,57	128	0,88	58	0,40	7	0,05	264	1,82
2009	139	10	0,07	1781	12,81	891	6,41	22	0,16	85	0,61	3	0,02	879	6,32

n: number of recorded individuals , gs: *visual frequency per dive* (n/number of dives)

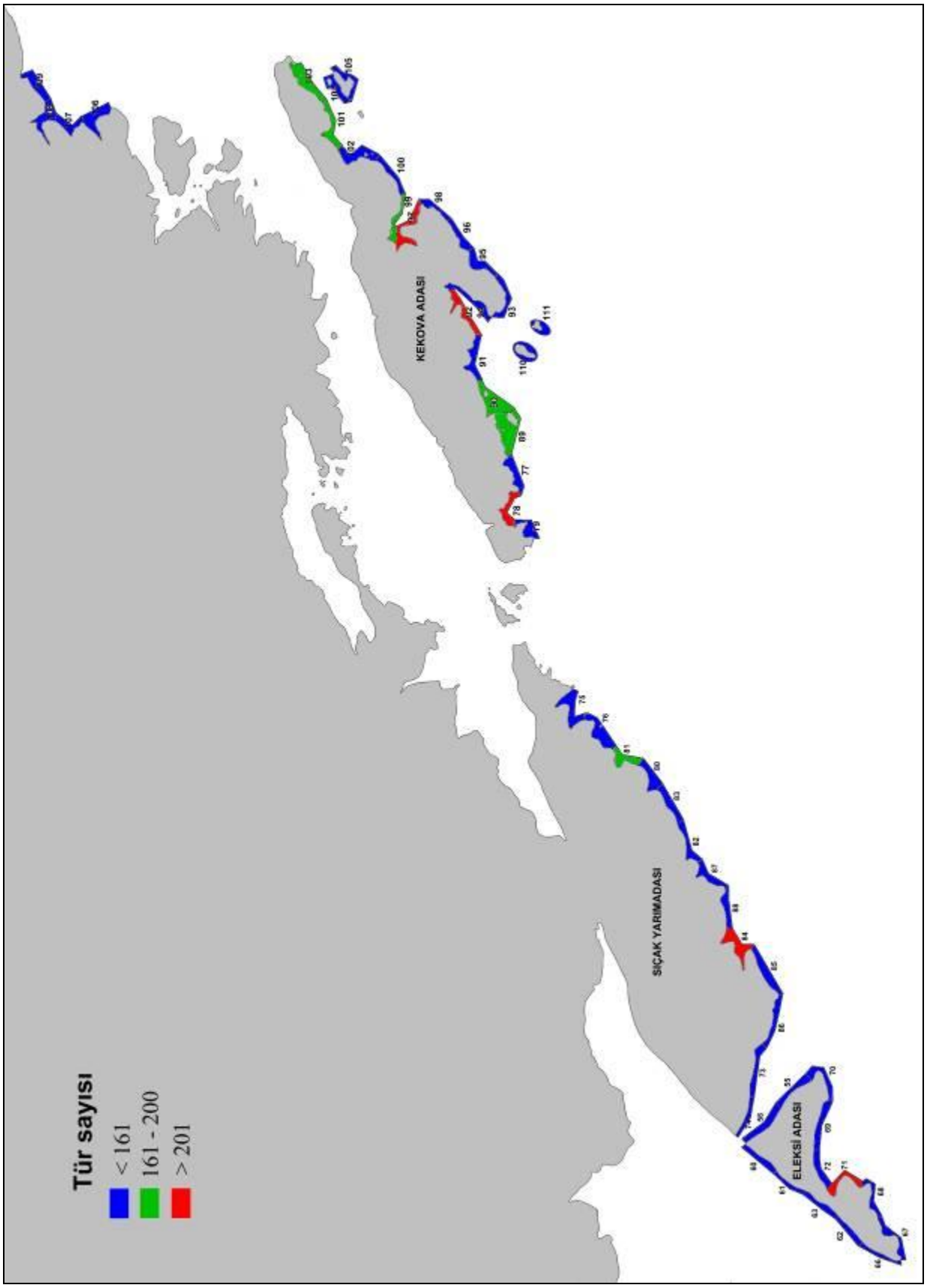
According to the length frequency distribution analysis, the most of the fish species population consist juvenile individuals. It is gladsome to see that in terms of these species, still can reproduce successfully and still have a reproductive potential. It is not enough only to protect these species population against fishing which have a reproductive potential. Also shelter and feeding habitats of the young individual species must be protected as well.

When Kas and Kekova regions are comparing in terms of biological diversity and also as a method called visual census, Kas region is the most richness area in the SPA. The most richness area is between Inceburun and Uluburun. The reason of the high biodiversity rate in the sheltered bay is *Posidonia oceanica* and *Cymodocea nodosa* beds. The *P.oceanica* communities were extremely damaged because of intense anchoring. Today, the anchors and chains of the daily boats, charter boats and diving boats that use the area very frequently threaten this community. The same situation is valid for the *C. nodosa* communities. The seagrass communities (beds) should be protected and urgently must be taken actions to prohibit anchoring in those areas and enough number of mooring systems should be installed.

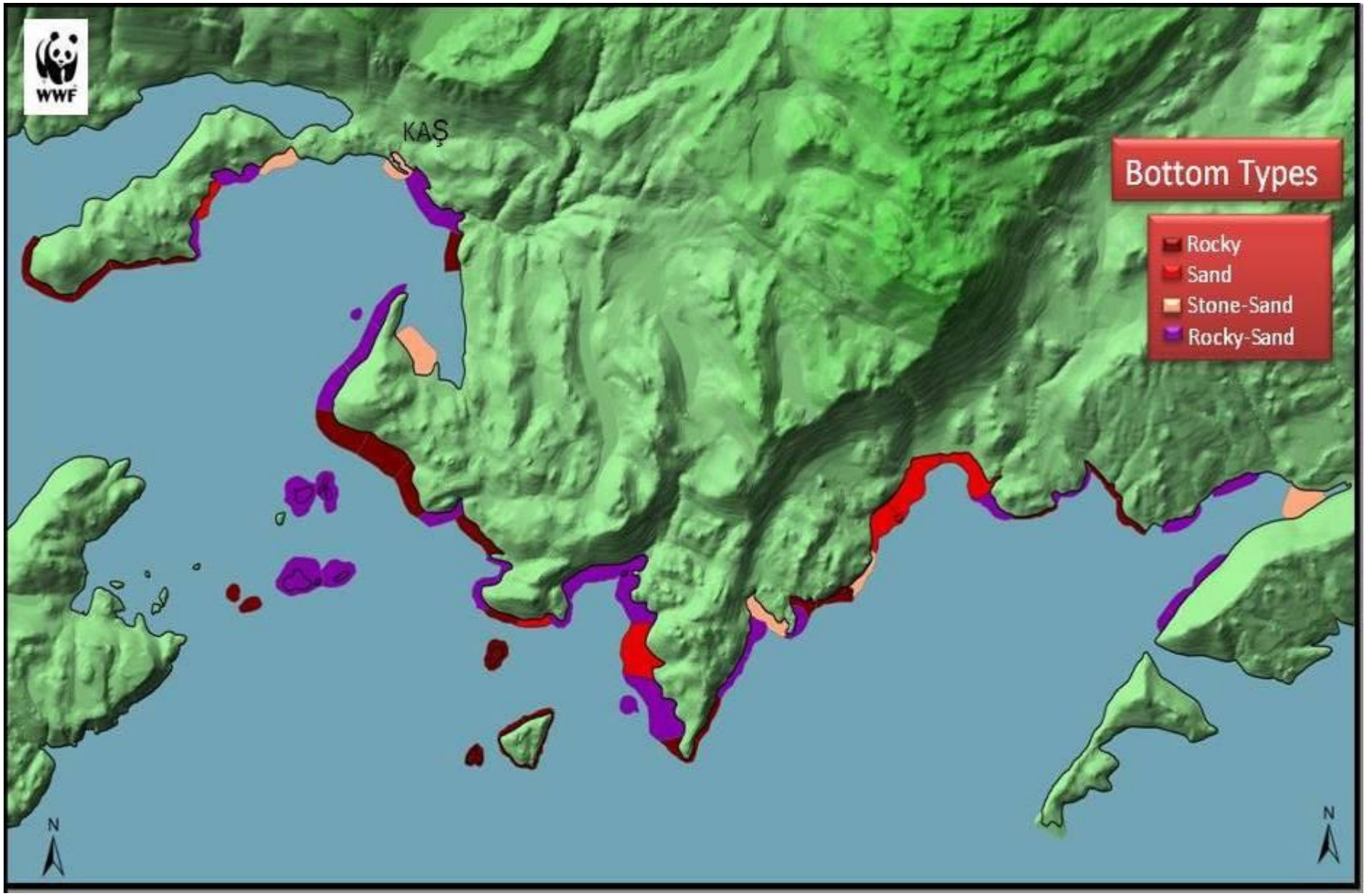
Within the border of Kas-Kekova SPA, the "No-Take Zone" should be established between Uluburun-Inceburun, include the small islets (Bes island). This region is a suitable zone to be banned any kind of fishery activities and established "No Take Zone" for mature individuals, has got reproductive potential living within this area and its islets. Also precautions should be taken urgently to protect juveniles of these species living in shallow water, shelter bays as well. To be developed fishery management strategies within the institutional legal framework and patrolling is a must.



* Distribution of biodiversity according to the sections in Kas region.



* Distribution of biodiversity according to the sections in Kekova region.


WWF
KAŞ
Bottom Types
Rocky
Sand
Stone-Sand
Rocky-Sand
N
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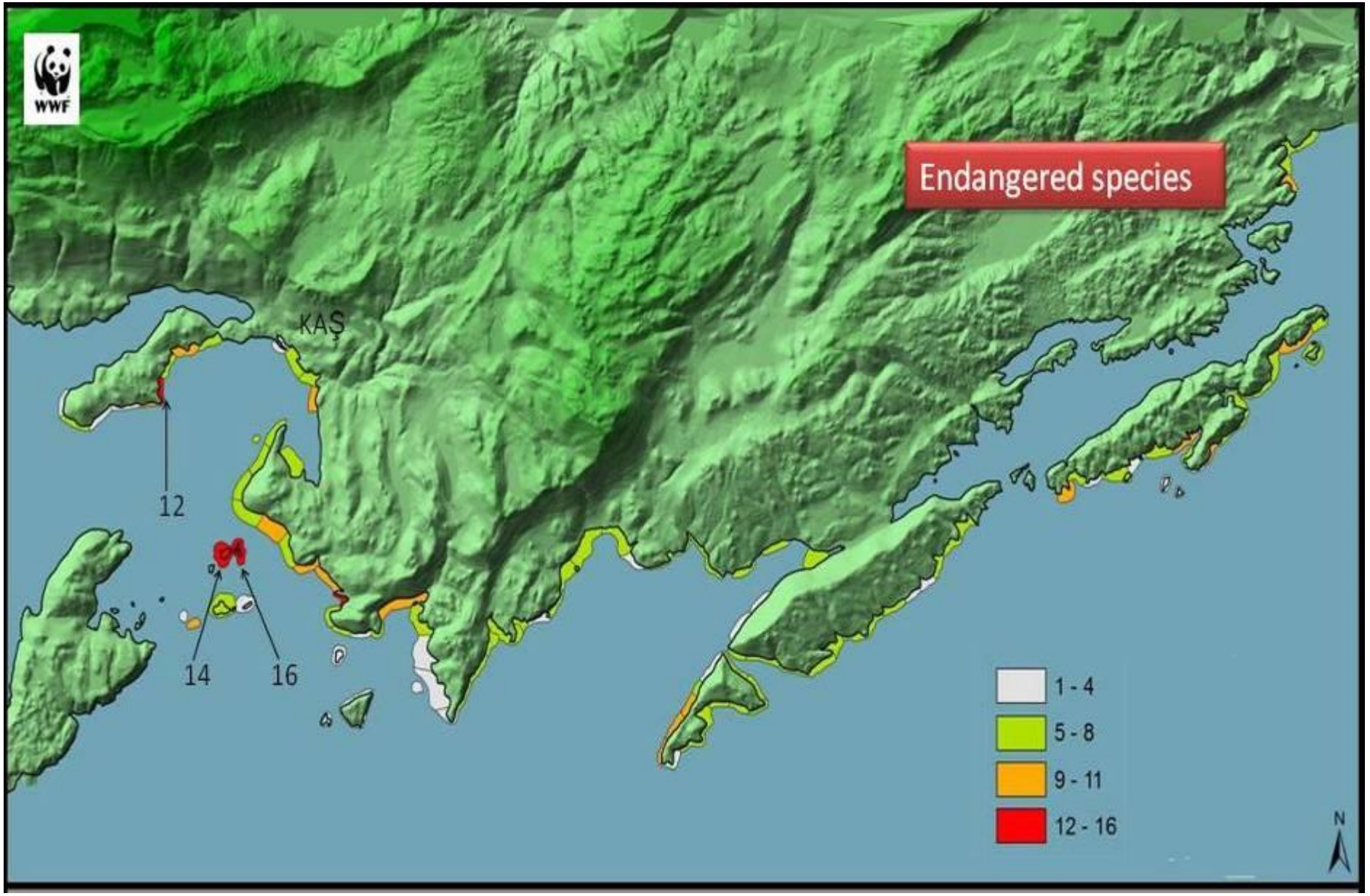
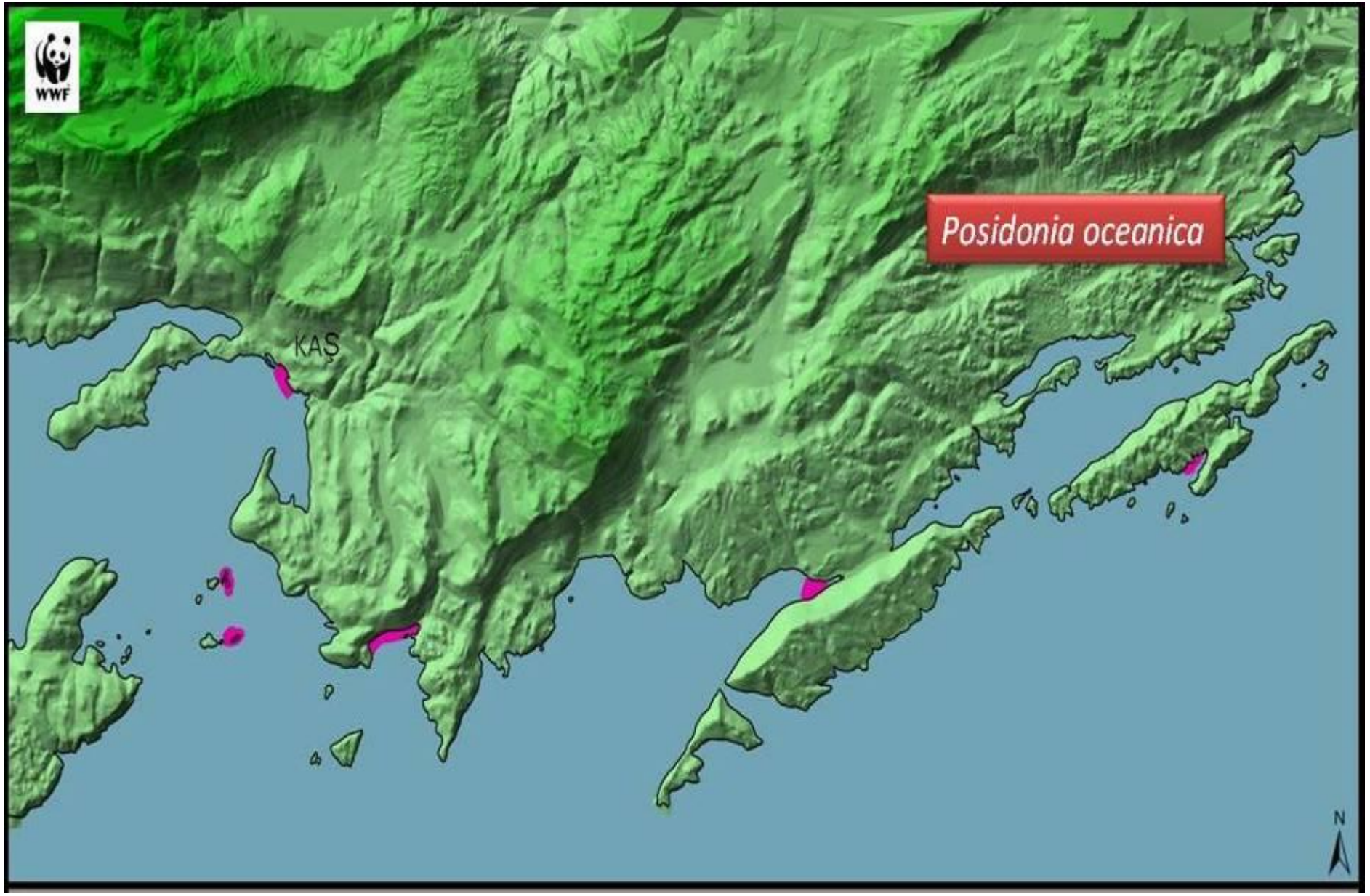
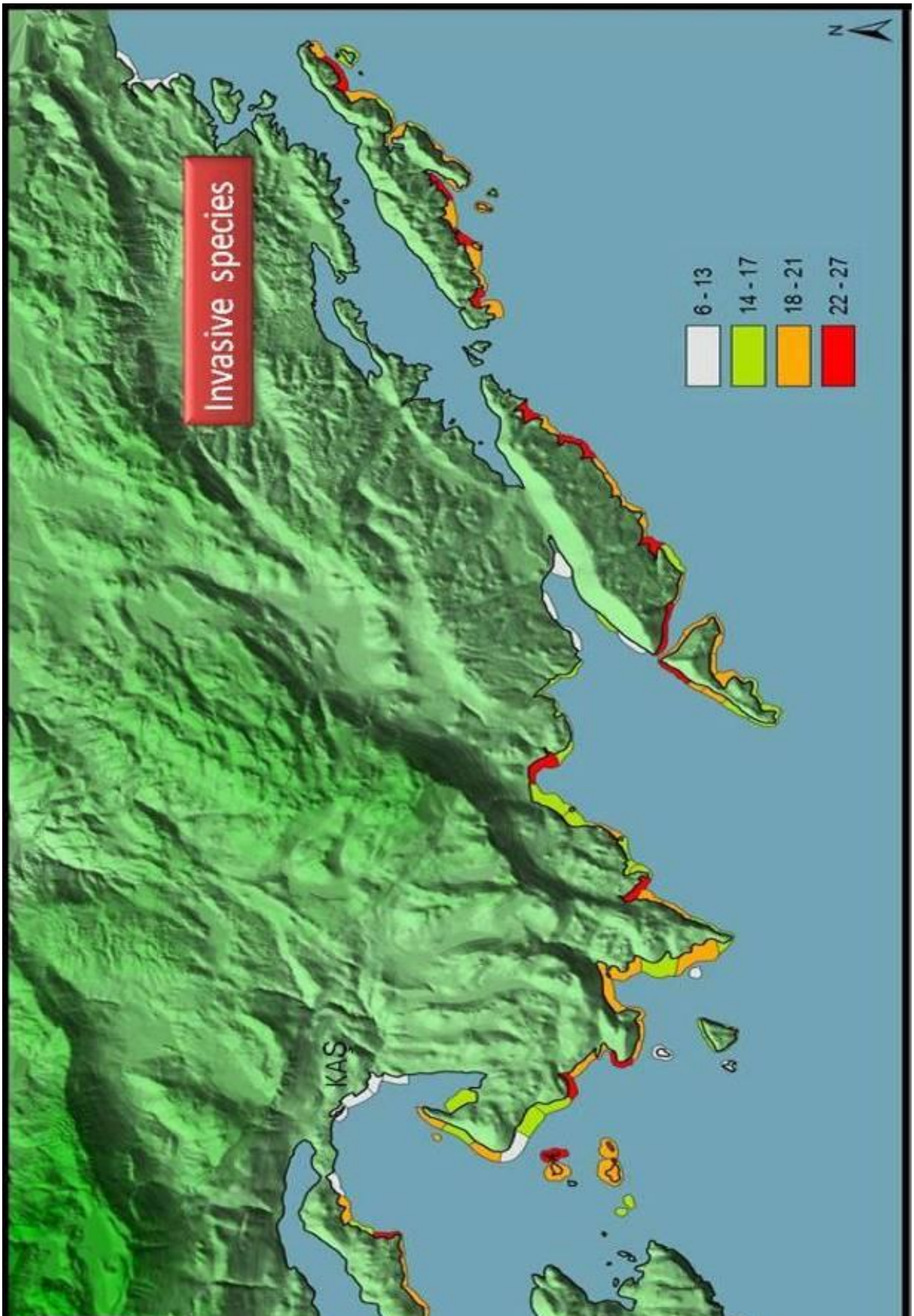

WWF
Endangered species
KAŞ
12
14
16
1 - 4
5 - 8
9 - 11
12 - 16
N


WWF
Posidonia oceanica
KAŞ
N


Invasive species
6 - 13
14 - 17
18 - 21
22 - 27
KAŞ
N
WWF

GENERAL DISCUSSION

SEAGRASS MEADOWS

Seagrass meadows are the oxygen sources of the marine ecosystems, but also constitute an important food source for herbivore species. Besides, this dense canopy forms a shelter for larvae of many species. Sea meadows, which grow in confined places such as bays and lagoons, are very vital to most of the species for mating and for the protection of the offspring. Because of this, sea meadows found in confined waters contain a much more diverse biota compared to the ones found in open sea conditions. The degree and the composition of this diversity depends on the species of the seagrass. It has been shown by research that the canopies of *Posidonia oceanica* and *Cymodocea nodosa* could support different kinds of species.

Another known function of the sea meadows is to regulate some physical conditions of the habitat. It was previously shown that currents are directed over the sea meadows due to the structure of the canopy, and this resulted in an increase in the magnitude of the current, on the other hand, the magnitude of the current effectively decreased inside the seagrass community. Terrados and Duarte have shown that *P. oceanica* meadows increase the rate of the particle precipitation by decreasing the suspension of particles, which indicates that the sea meadows stabilize the sediment.

Because of their low growth rate, seagrass species are vulnerable to environmental disturbances. They are crushed or torn apart by the anchors and chains of boats. Because of their low density they float if pulled out from the sediment, and lose their chance to be fixed on the ground. In the last 20 years, the seagrass meadows worldwide declined because of changing environmental conditions. Being very vulnerable against anthropogenic disturbances they are widely accepted as suitable biological indicators to monitor the quality of marine conditions.

The characteristics and the distribution patterns of current seagrass species were analysed from the coast to 30m depth. The first findings had shown that, the seagrass meadows in this area did not cover the area as a whole, rather they appeared scattered.

Cymodoce nodosa and *Halophila stipulacea* are the two dominant seagrass species at the project area. *C.nodosa* meadows shelter many different species, thus play an important role in maintaining the biodiversity of the region. *Coscinasterias tenuispina*, a juvenile *Trigloporus lastoviza*, a half burried *Trachinus draco*, a juvenile *Octopus vulgaris*, in a seagrass meadow, each Pen Shell individual constitue a habitat by itself, on which many different species inhabit. The carnivore seaslug *Aglaja depicta* feeds on other seaslug species found in seagrass meadows.

Posidonia oceanica communities that are known to be more reproductive than these two species were rarely observed in the project area. Touristic activities which are planned to happen in the near future should be organized in the way that they should not damage the largest *P.oceanica* population observed on the Lycian coast. *P. oceanica* meadows observed in Kas and Kekova have been damaged because of extensive anchoring of the daily boats. To maintain a healthy seagrass population, anchoring should be prevented in these areas.

P.oceanica community found in Kas-Suluada, has yet undamaged since diving had been prohibited for 12 years in that area. But today, it is threatened because of the intense usage of the area by diving boats after the prohibition was abolished. This community should definitely be taken under protection before it is spoiled.

The most important threats for *Cymodocea nodosa* and *Posidonia oceanica* in the Mediterranean are the harmfull effect of invasive exotic algae of Caulerpa species. Caulerpa species are dangerous for the ecosystem because of the chemicals they secrete for defense or to get rid of their competitors. By destroying the seagrass communities they cause a change in the habitat or sometimes even total loss of the habitat. In a research from southern Cyprus (Limassol, Moni Bay) it was reported that a *Caulerpa racemosa* community has changed the benthic structure in six years after it was first discovered. It was shown that *C. racemosa* have become dominant to *P.oceanica* and changed the benthic invertebrate fauna, a decrease in gastropods and crustaceans was followed by an increase in polychaetes, bivalves and echinoderms. Dense *P.oceanica* meadows compared to the sparse ones, were found to be more resistant to *C.taxifolia* invasion. *C. taxifolia* communities reproduce not sexually, but by budding or by regeneration of the fragments. Because of this asexual reproduction fishing activities enhance the spread of this species.

The seagrass species get the essential minerals mainly from the sediment via their roots. But *C. taxifolia* can obtain minerals from water as well as from the sediment. This extraordinary ability enables *C. taxifolia* to be superior to its competitors. It is possible that organic pollutants, dumped into the medium may accelerate the development of *C. taxifolia*. Even though there is not enough data on *C. racemosa*, its more successful spreading compared to *C. taxifolia* indicates that it also has similar characteristics.

In order to biologically control the spread of *C. taxifolia* in the Mediterranean, two seaslugs *Lobiger serradifalci* (Calcara, 1840) and *Oxynoe olivacea* (Rafinesque, 1814) that feed on Caulerpa species have been tested. But in the laboratory experiments it was found that the larvae of both species are pelagic, and they should be artificially reproduced and released to the field to be able to maintain a stable control on *C. taxifolia* communities. On the other hand, in a field research on Hvar Island (Crotia), it was observed that, 11 *L. serradifalci* individuals left on *C. taxifolia* unexpectedly broke the stems into many living parts, of which %65.5 regenerated new leaves and produced new individuals. It is evident that *L. serradifalci* accelerates the spreading of *C. taxifolia* instead of preventing it.

A similar experiment has been done on the Indo-Pacific originated species *Elysia subornata*. This species also feeds on Caulerpa, and it was found to be very effective on *C. taxifolia* and *C. racemosa*, but it could not form a stable and sufficient population since it could not survive the winter conditions in the Mediterranean. The observance of the two lessepsian seaslug species, *Elysia cf tomentosa* and *Oxynoe viridis*, at various locations, indicates that these species have been adapted to the Mediterranean and have established around Uc Adalar. The existence of these two species along our coasts is very promising for the struggle to control the spread of exotic Caulerpa species, which threaten the Mediterranean ecosystem. To have a better understanding about their biology and to be able to estimate their future position in the Mediterranean ecosystem, more detailed research has to be done as soon as possible.

Zostera marina and *Zostera noltii* were not observed in any section examined.

INVASIVE SPECIES

When the Suez Canal was opened in 1869 the waters of the Mediterranean and the Red Sea, which had been separated for millions of years had the chance to come into direct contact. This interaction created an opportunity for species, which had been differentiated separate from each other, to disperse into new regions. The Suez Canal covers a total length of 165km and its mean depth is 14.5m. Because the level of Red Sea is 1.2m higher than the Mediterranean, a continuous flow towards the Mediterranean is observed in the Suez Canal. This may suggest that it will be easier for the Red Sea species to cross the canal, but the enormously thick salt bed on the bottom of the canal increases the salinity to very high levels fatal for species. Despite this fact, each year 5-10 lessepsian species are recorded in the Mediterranean. Washing of these salt lakes by the seawater passing through for more than 100 years results in a gradual decline in the salinity inside the canal. It is assumed that more species will be introduced to the Mediterranean as the salinity gets closer to the normal levels.

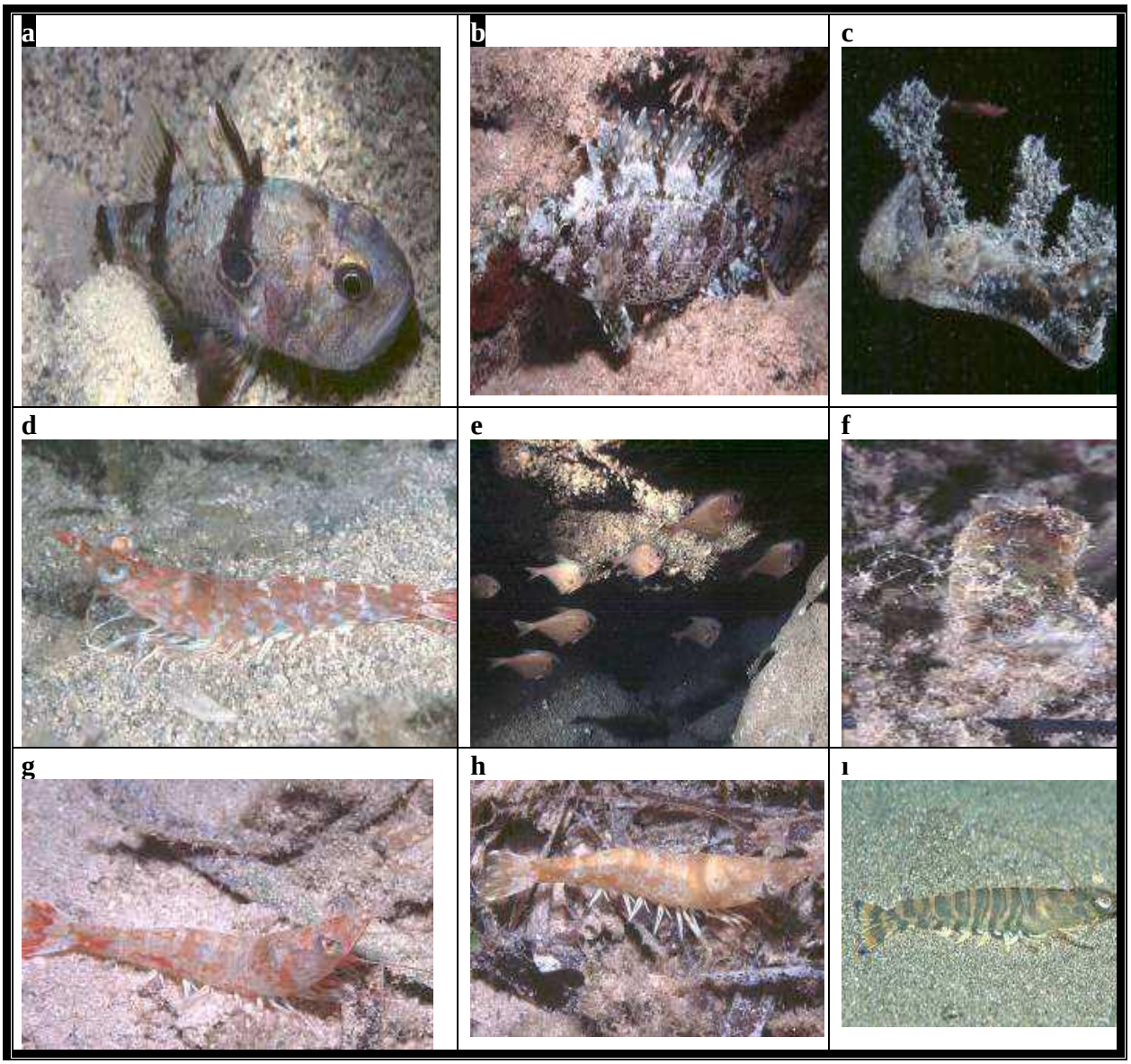
Linking the Mediterranean with a lively, tropical sea, like the Red Sea, may suggests that it will increase the diversity of the Mediterranean biota. But these kind of introductions usually have tragic consequences for the native species. Most of the exotic species adapted to the Mediterranean are found almost everywhere in the Indian Ocean and nearby seas. Their success in adaptation to almost any environment makes them more advantageous when they are introduced to a new ecosystem, which has a vulnerable stability.

*** The Soldier Fish** *Sargocentron rubrum* is very common on the Mediterranean coast of Turkey.

The native species cannot manage to compete for food and gradually decrease in number, which results in the incline of the exotic species. A very good example of this is a cornetfish (*Fistularia commersonii*), which was first reported in the Mediterranean in 2000, and became very common on the coastline between Iskenderun Gulf and Bodrum (Mugla) just in a two-years time. This species was observed frequently in all the regions during this project. Some of the lessepsian species had been very successful in adaptation, hence they are considered as native species. Species which had established long ago in Turkish waters, such as Tiger Prawns (*Paeneus semisilcatus, Paeneus japonicus*), Soldier Fish (*Sargocentron rubrum*) and Rabbit Fishes (*Siganus luridus, Siganus rivulatus*) can be given as examples. Today, majority of the economical species in the eastern Mediterranean is Red Sea originated.

The exotic species are introduced by anthropogenic activities and remove the local species by invading the habitat. Even though new examples of invasions are noticed each day, no lessepsian species have yet been reported as a threat for the Mediterranean ecosystem. But this does not prove that it will never happen. Replacement of native species by the exotic ones may take a very

long time, meaning that the invasion may happen so slowly, and may not even be recognised. In the Mediterranean, environmental pollution is getting more evident everyday, disturbing the balance of the ecosystem in favour of the opportunistic invaders.



Some examples to the lessepsian species that are frequently observed in the research area; a) Black Spotted Cardinal Fish, *Apogon nigripinnis*, b) Rabbit Fish *Siganus luridus*, one of the most frequently seen lessepsian fish on the Aeagean and Mediterranean coast of Turkey, c) A swimming seaslug, *Melibe viridis*, d) A nocturnal shrimp species observed on shallow sandy bottoms *Metapenaeus aegyptica*, e) Sweeper, *Pempheris vanikolensis*, is found in caves, usually in schools, f) This mussel species, *Malleus regulus* frequently observed in Uc Adalar, g) A nocturnal shrimp species *Metapenaeus monoceros* (male), that inhabit seagrass meadows, h) A female *Metapenaeus monoceros* specimen, i) The valuable Tiger Prawn *Penaeus kerathurus*.

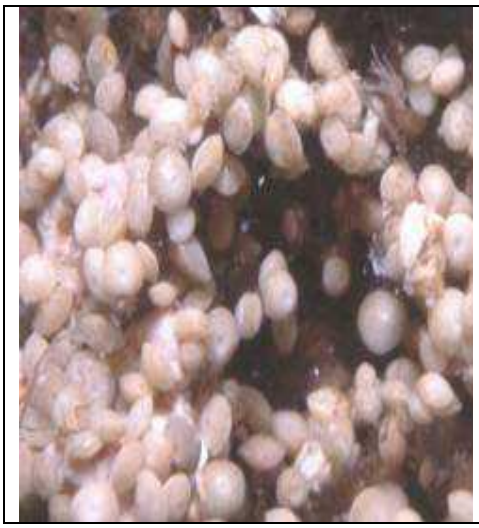
(Photos © Baki Yokeş, Adnan Büyük)

The data obtained in the framework of this project reveal that the distribution patterns of some lessepsian species are wider than it was thought before. The large populations of the exotic species and their dominance over the native ones indicate that the ecosystem has been negatively affected. There are several reports showing that some of the economical species has been replaced by the exotic ones in the eastern Mediterranean part of Turkey. The lessepsian species which were

novel records for the Mediterranean fauna were found to be well established and observed in plenty, indicating that the Red Sea immigrants inhabiting Turkey have not been studied well enough, and there might be still many undiscovered ones. It is impossible either to prevent lessepsian introduction or to control the already introduced ones, yet to predict their positive and negative effects on the ecosystem one must always keep an eye on the exotic species.

Foraminiferans

The incline in populations of exotic species is not only specific for the economical ones. It was recently reported that the lessepsian foraminiferan *Amphistegina lobifera* was found in many different localities throughout Turkey. But, in Uc Adalar (Tekirova) and Bes Adalar (Kas), the populations were so large that such a density has never been observed elsewhere in the world, confirming the Lycian coast should have some unique ecological and environmental characteristics. The sediment samples show that *Amphistegina lobifera* is plenty in every section analyzed. The populations are so large that the aggregated tests cover the rocky sea bottom, forming wide sandy areas. This extensive abundance results in the disappearance of the rocky habitat, while enhancing the growth of sand dwelling species such as *Halophila stipulacea* and *Pinna nobilis*. In some regions the thickness of foraminiferan sediment reaches 40cm. There is no natural beach in the sections analyzed, except the Patara Beach. As a result of the geological formation of the region, the coasts are either rocky or gravel, but not sandy. However, the foraminiferan tests are carried to the shore by waves. Precipitation of the tests in small bays causes these gravel shores to change into small sandy beaches.

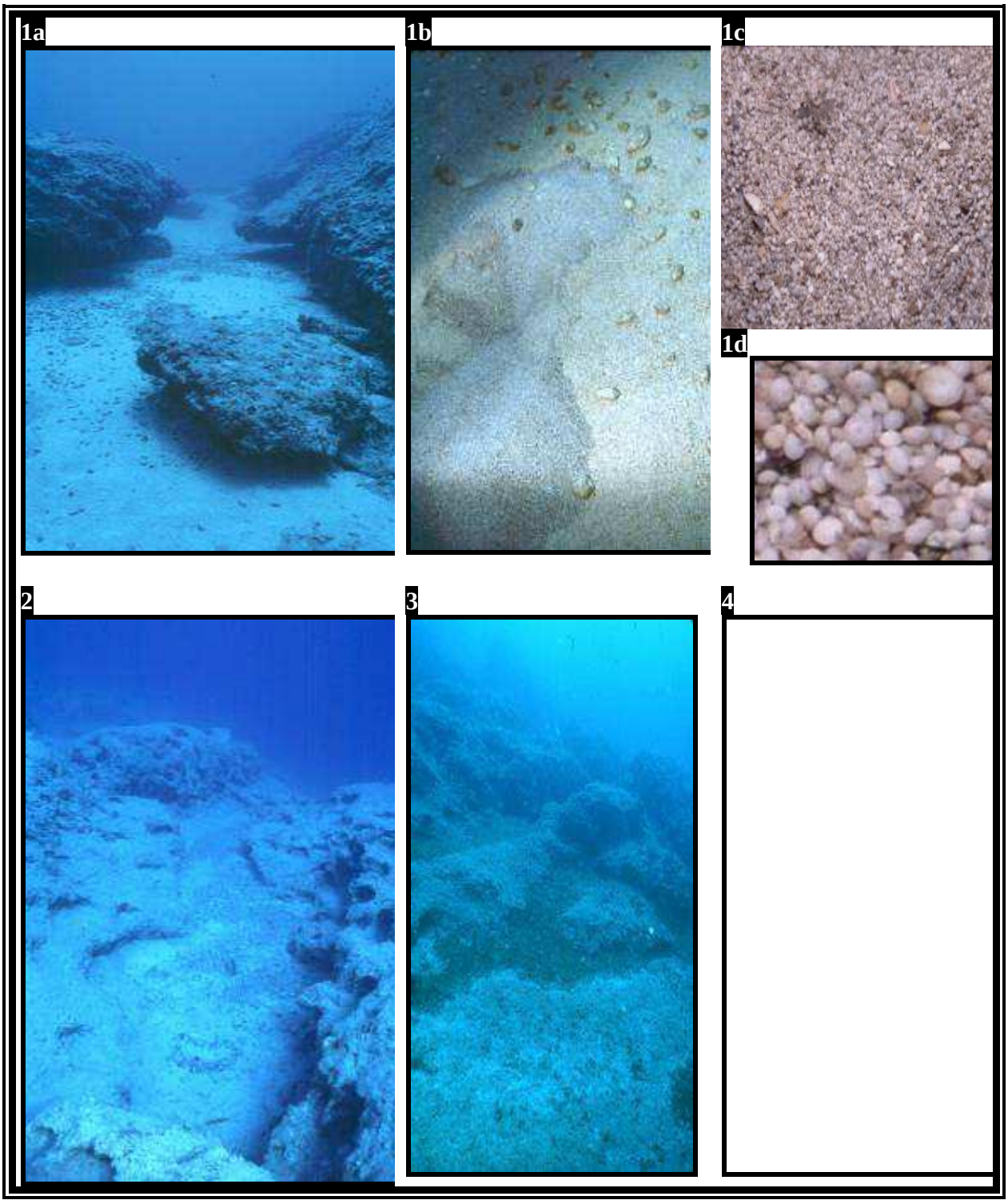


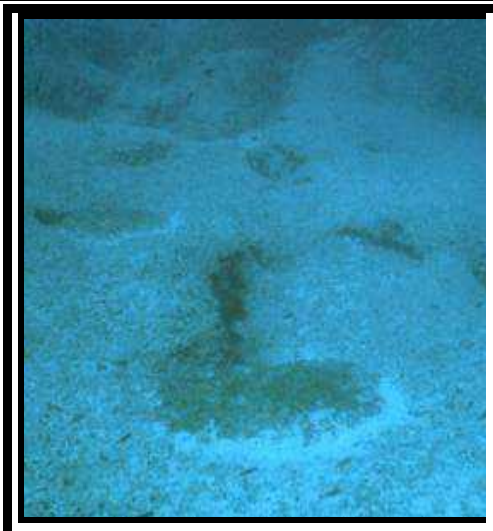
Foraminiferans worldwide play an important role in the formation of the sediment and the sand. Many species need specific physical and chemical conditions for their development. The identification of the species in a sediment sample enables to understand the physical and chemical past of that region. Since different geological areas show different species compositions, foraminiferans are also used to detect the age of a sedimentary rock, as well as the environmental conditions it had had.

The foraminiferan composition of the sediment found offshore Key Largo, Florida was found to be changed between 60's and 90's. The sediment samples collected in 1959-61 had been composed of 50-80% big, algae-symbiotic members of the Soritidae, whereas the samples collected in 1991-92 had contained 65-90% heterotroph species of the Miliolidae and Rataliidae.

The reasons of this change in foraminiferan fauna have not yet been understood, but it was suggested that the continuous increase in nutrient influx in these waters might have an impact.

Analysis of foraminiferan aggregates give important clues about the changes in environmental conditions and structure of ecosystems within the past 30-40 years.

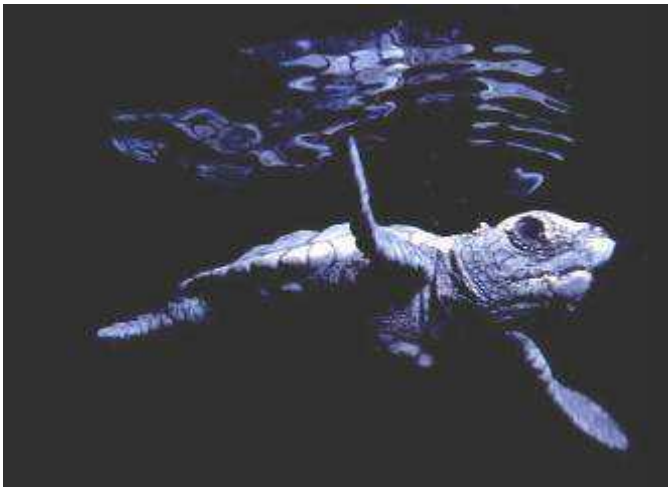




5 1a-d) The rocky bottoms between 0-30m are covered with *Amphistegina lobifera* tests. The thickness of this precipitate may reach to 30-40cm in some locations, if dug, rocky base but no sand is found below this precipitate. When the sediment material analysed in detail, it is seen that almost all the particles are foraminiferans. Sand and gastropod fragments are very rare. 2) The original benthic structure of these regions is rocky, the pits and crevices are filled with small stones of about 1-5cm. The natural sandy bottoms between 0-30m of depth, are very rare in the whole project area. 3-5) The foraminiferans fill in the crevices and the pits, forming a sandy sturcture on the bottom which enhances the growth of the seagrass species, such as *Halophila stipulacea* & *Cymodocea nodosa*, as well as the sand dwelling Pen Shell *Pinna nobilis* (Photos © Baki Yokes).

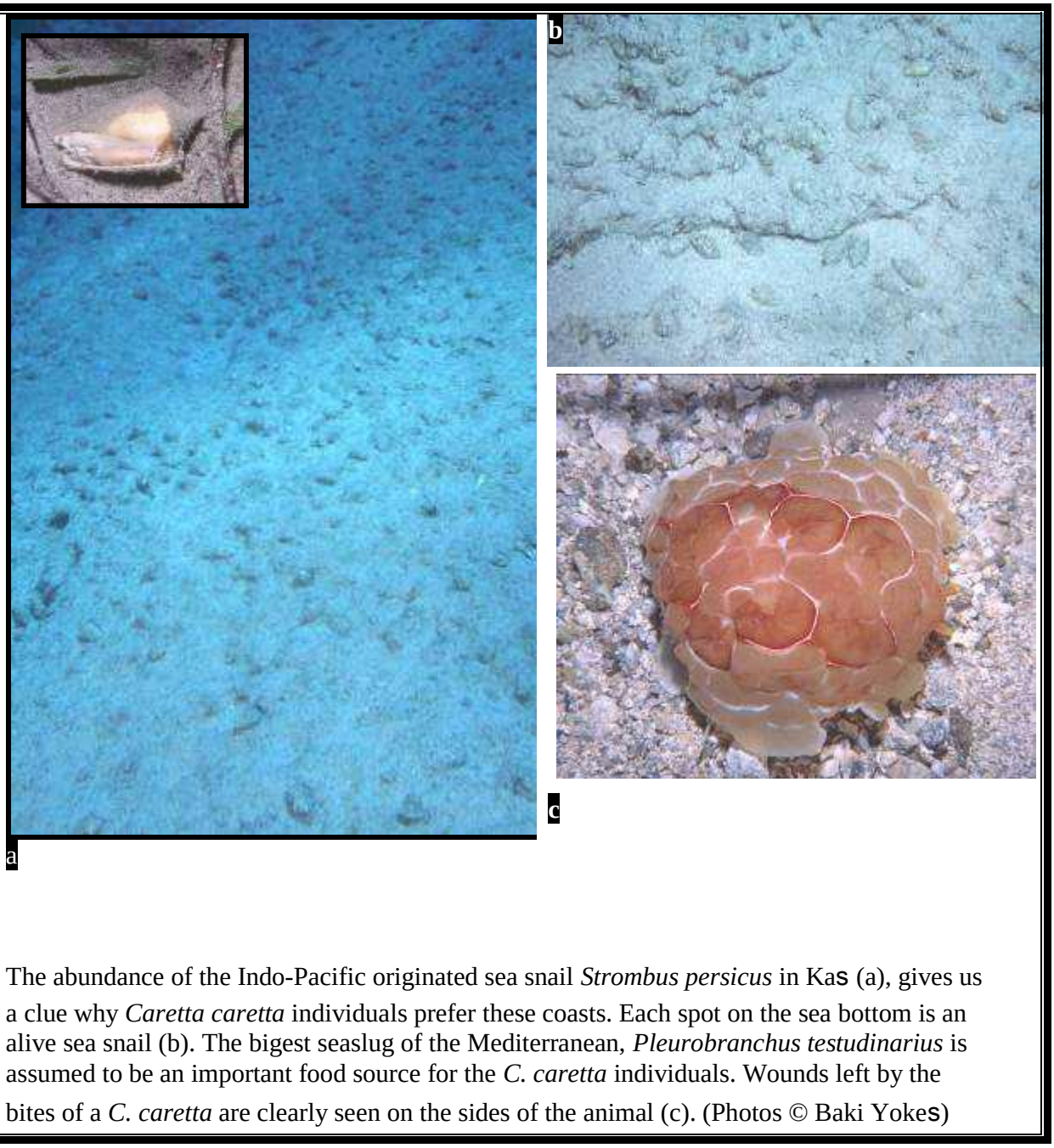
The cause of *Amphistegina lobifera* expansion is yet unknown, but apart from that, another lessepsian species (Amphisorus sp.) was also found almost in every sediment sample collected from the Lycian coast. Yet, it cannot be answered why the lessepisan foraminferans are found in large quantities everywhere in the project area, and the native ones are so rare. However, it is clear that this exotic species change the benthic structure and affect the ecology of the region. In order to foresee the future situation of this region, it is essential to figure out the factors leading to this excessive foraminiferan aggregation.

Sea Turtles



The Mediterranean coasts of Turkey, contains the most important mating and ovulating areas for two sea turtle species. Many beaches are protected by law and looked after by both local and national environmentalist organisations. Reportedly, these two rare species were frequently observed at some locations within the research area. Local diving centers in Kaş indicate Kovan Adası and Suluada as the hotspot for both of these species. It was also informed that around the coasts of Uc Adalar and Tekirova both species were frequently seen and photographed. Both of the species are frequently seen in the project area even though there is no major ovulating site, except Patara Beach, which suggests that these regions are regularly visited for feeding purposes. *Caretta caretta*, being a carnivore, includes a broad range of molluscs on its feeding menu. Pen Shell fields, especially the ones observed in Kaş and also *Strombus persicus* populations found in extreme amounts everywhere probably attracts *Caretta caretta* to these regions.

Besides, the seaslug *Pleurobranchus* species, which is also listed on the *Caretta caretta*'s menu, is plenty around the seagrass meadows of the Uc Adalar, making the region a valuable food resource. Unlike *C. caretta* mature individuals of *Chelonia mydas* are herbivore. The region between Kovan Adası and Suluada, as well as the shores of Uc Adalar and Tekirova are rich in marine vegetation, that causes both of the species share the same regions as food resources. The coasts of Uc Adalar and the region circumscribed by Kovan Adasi and Suluada are thought to contain the most important food resources for sea turtles. Thus, legal measures must be taken to protect the marine fauna and flora of these regions, and human activities threatening the sea turtles should definitely be prevented.



The abundance of the Indo-Pacific originated sea snail *Strombus persicus* in Kas (a), gives us a clue why *Caretta caretta* individuals prefer these coasts. Each spot on the sea bottom is an alive sea snail (b). The bigest seaslug of the Mediterranean, *Pleurobranchus testudinarius* is assumed to be an important food source for the *C. caretta* individuals. Wounds left by the bites of a *C. caretta* are clearly seen on the sides of the animal (c). (Photos © Baki Yokes)

Mediterranean Monk Seal

Turkish coasts, sheltering a major portion of the Mediterranean Monk Seal population, plays an important role on the fate of this species in the Mediterranean. Seals prefer to live in desolate places away from humans. But today, they are extremely affected by anthropogenic factors such as noise, pollution or habitat loss due to extensive tourism and fishing. Seals were often seen by fishermen and divers within the whole research area, but they were mostly encountered on the coastline between Bes Adalar and Uc Adalar. This coastline is made up from steep rocky walls and contains many caves used by seals. It is said that divers frequently observe seals especially in the caves around Cavus Cape and Uc Adalar.

During this project, monk seals were observed, one of which was located in Section 9,10, 108, and the other outside the research area but close to it. Because the locations of these two observations were close to each other and the seals were observed on different days, it is possible that these seals might in fact be the same animals. But in the meetings with the local diving centers, it was understood that the area was being used by more than one seal. Even though there are caves and cavities on the coasts of Bes Adalar, none of them has the suitable structure for a seal to inhabit. For this reason, it is suggested that five islands (Kas) are used as a feeding and hunting area by the seal population. Although seals were observed in Kekova islands (according to Coast Guard reports) and the aired cave of Uc Adalar many times, the fact that this area is frequently used by diving centers and daily boats prevents it from being permanently occupied by the seals. On the other hand, these recurrent observations suggest that this area too might be used for feeding purposes. It is assumed that the caves found on the coastline between Uc Adalar and Bes Adalar, relatively far away from human activities, inhabit the local seal population.

It is evident that the coastline between Gelindonia Cape and Uc Adalar has an importance for the seal population in the Mediterranean. In 1986, the European Council has announced the Gelidonya Cape as one of the unique sites that the Mediterranean Monk Seal inhabit and has recommended that this region should be taken under protection. However, even scuba diving to seal inhabited caves is legally prohibited, the location of any possible seal cave is not mentioned in the law. Due to this uncertainty, no measures have yet been taken by the diving sector or by the authorities. On top of this, some diving centers offer special “seal diving” trips to these caves. A more detailed research to locate the specific caves used by seals must be done in this area. The coordinates of these caves has to be specified in the law and all sort of human activities such as diving, fishing and touristic trips should be prohibited around these caves. Moreover, local people, especially the fishermen, staff of diving centers and local authorities must be made conscious of this fragile species.