13. The Saranda wetlands

Summary

The Butrinti zone is the only transitional natural region at the Ionian coast of Albania with a total wetland area of 24 km^2; 16 km^2 of it belong to the Butrinti lake (Fig. 13-1). The region is highly renowned for the Butrinti archaeological centre, situated close to the lake. It has been nominated 1948 as a cultural monument and later in 1999 internationally recognized as a World Heritage of the UNESCO (29 km^2). Part of the Butrinti lake, the archaeological centre and some nearby terrestrial habitats are protected as national park (25 km^2) (Fig. 13-11'). In 2010 the Pagane-Stillo Cape has been declared as restricted nature marine reserve. Furthermore in 2003, the national park, the Butrinti lake and the Stillo Cape have been included in the checklist of water bird sites of international importance under the Ramsar Convention (135 km^2).

Moreover, the Butrinti zone (about 40 km^2) belongs to the checklist of important plant areas (IPAs) together with other IPAs nearby, like the Gjipe Canyon (12 km^2), Porto Palermo (6 km^2) and Borshi-Lukova (5.5 km^2) (Fig. 13-7), all at the Ionian Riviera, and Bistrica-Muzina (17.6 km^2) and Rrezoma (23.3 km^2), both in Delvina.

Figure 13-1: Butrinti lake (Photo: L. Shuka).

The Butrinti zone encompasses many significant ecosystems, like a brackish water lake, rivers, fresh- and salt-water marshlands, dry pastures, scarcely wooded hills and Mediterranean maquis. All these are very delicate ecosystems and crucial sites for biodiversity.

13.1. How to reach the area

The town of Saranda (Fig. 13-2) is the main inhabited centre in the most Southern part of Albania at the Ionian coast with 35'000 inhabitants. Saranda is linked with most large centers in Albania as well as with Greece by regular bus services. It is connected with the island of Corfu within a distance of only 8 km by regular ferryboats.

Figure 13-2: Saranda town (Photo: L. Kashta)

Figure 13-3: Map of the transitional wetlands of Butrinti (Saranda district) (Google Imagery, 2008, *modified*).

Saranda is a good starting point for visiting the lagoon, the wetlands and the famous archaeological sites. Saranda is also a pleasant place during the whole year, with a lot of sunshine, mild winters and sheltered from strong winds by the surrounding mountains. The town offers excellent possibilities for accommodation and food, and comprises small gravel beaches with clean water for swimming.

13.2. Information about the most important sites

The Butrinti lagoon, the seashore of Ksamili and its islands are best visited from the road of Saranda to Butrinti (Fig. 13-3). The eastern part of the lagoon system and the Rreza Lake are accessed after crossing the Butrinti channel by a raft. Ksamili town, about 17 km far from Saranda, was in the previous century only a small village but developed since 1973 with increasing fruit tree cultivation. Terracing of the slopes in the hilly zone was started during the former regime by "voluntary work" to cultivate citrus and olive. With the political change the agricultural farming nearly collapsed. Today, urbanization is continuously increasing due to the rising tourism.

Besides the different wetland and natural reserve sites around the lagoon, many cultural and historic places in the region are worth to be visited.

About 3000 years of Mediterranean history and architecture meet within the Butrinti archaeological center (Fig. 13-4). It is situated on a hilly peninsula and surrounded by the Butrinti lagoon and its channel to the sea. The archaeological centre is a combination of nature and archaeology, where the values of biodiversity and landscape are mixed with many witnesses of antiquity. An intact Mediterranean forest completely hides the ancient remains.

The archaeological centre represents the remains of the ancient town of Buthrotum (Fig. 13-5), a major coastal portal from the Hellenistic to the Ottoman times. The history of the town starts in the Neolithic as a settlement of the Illyrian Epirus tribe of the Prassaib in the Bronze Age. By the end of the 7th century BC Bouthroton was known as a major center of the local tribe of Chaonia with close contacts to the Corinthian colony on Corfu and other Illyrian tribes in the north. The colonization from Corfu started in the 6th century and at that time the town was dominated by the Corinth and became part of the Epirus alliance.

In 228 BC, Buthrotum became a Roman protectorate and remained from then on under the influence of the Roman Empire until the 7th century AD. The town scaled down, was briefly under the First Bulgarian Empire which was followed by the Byzantine Empire in the 9th century.

Figure 13-4: 1: The hilly peninsula with the Butrinti archaeological center (AC) and the surrounding Butrinti lagoon with its channel; **2:** Butrinti AC with rests of ancient walls (**3**); dense Mediterranean forest hides much of the archaeological sites; **4:** ancient rests and the middle age fortress on the hill top; **5:** Ugolini tower, named in the memory of the Italian archaeologist who excavated in Butrinti during 1928-41 (Photos: L. Shuka and L. Kashta).

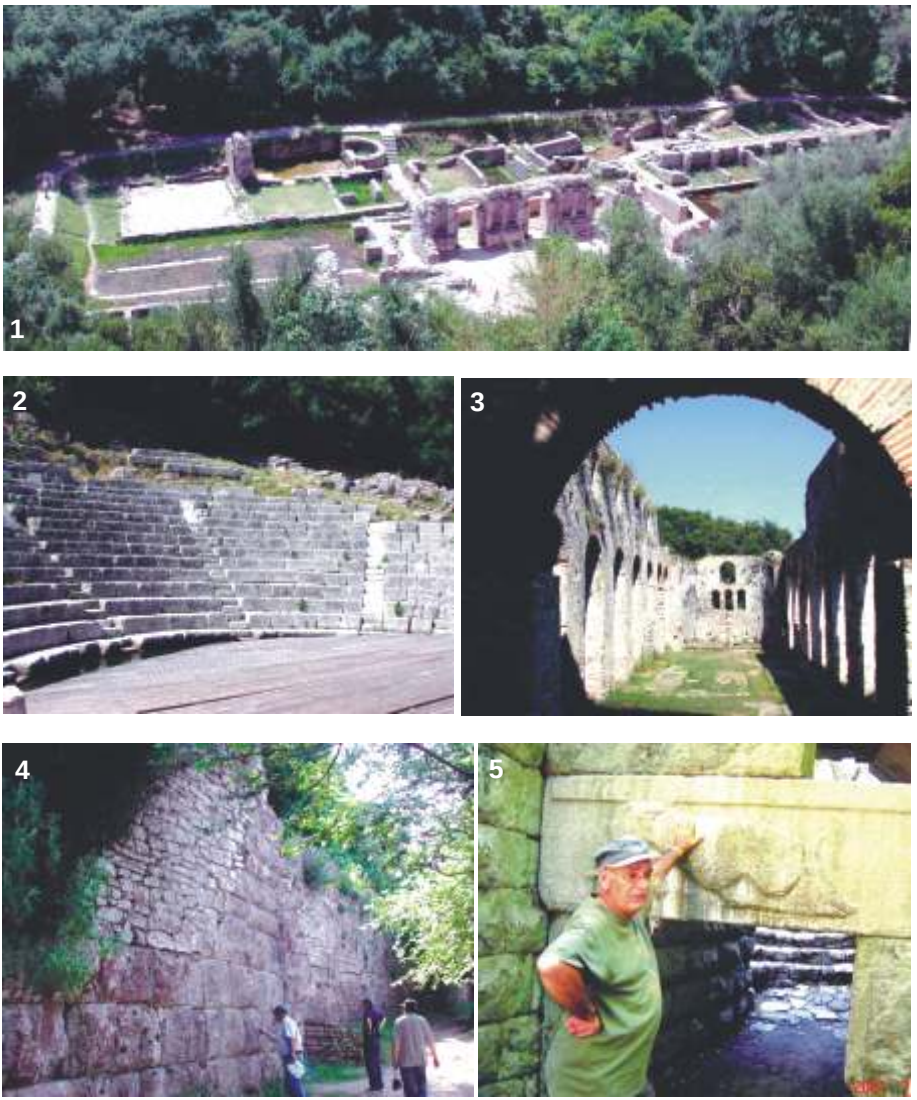

Figure 13-5: Various remains in the archaeological center of Butrinti: **1:** ancient rests around the theatre (middle of 3rd century BC); **2:** Theatre (3rd century BC); **3:** Basilica (4th century); **4:** Illyrian walls (5th to 6th century BC); **5:** Lion Gate (Photos: A. Miho and L. Kashta).

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Figure 13-6: Middle age fortress in front of the Butrinti archaeological center (Photo: A. Miho).

In 1797 Butrinti came under French control, but in 1799 the local Ottoman governor, Ali Pasha Tepelena, conquered the town and Butrinti became part of the Ottoman Empire until the Albanian independence in 1912. The site of the original Butrinti had been abandoned for centuries at the time of the Ottoman Empire as it was surrounded by malarial marshes. Rests of a middle age fortress are found on the other side of the Butrinti channel (Fig. 13-6) and a small fortress constructed for Ali Pasha in 1807 is located on the sea cape at the channel mouth.

Since the 1960s Butrinti AC is recognized as an important educational site, over 5000 children visit it each year. Thanks to the support by UNESCO for an education program the visitors also receive information on environmental or conservation topics.

Saranda, originally named Onhezmi, developed as a harbor of the Phoenicians and became the metropolis of the Epirus Alliance in 213 BC. Its importance increased during the Roman period. In 547 AD the city was captured by Slavic tribes. It continued to be a small harbor during the Byzantine and Ottoman periods but after 1800 under Ali Pasha Tepelena Saranda became a main port for the trade with Ioannina. Fascinating fragments of the Roman period are found near the museum and some ancient Roman foundations from the 5th century AD have been discovered in the city. The surroundings of Saranda offer a sum of particular sites of high natural value to visit (Fig. 13-2). The Lekuresi castle (16th century) at the Gjashta pass (Saranda) allows a perfect overview on the Saranda harbor and the Butrinti region (Fig. 13-7).

Figure 13-7: ***Above:*** Overview from Lekursi tophill (Saranda) on the Ksamili peninsula, that separates the Butrinti lake (*left*) and Ionian sea (*right*); ***right:*** the newly restored Lekuresi castle (16th century) on tophill of Saranda (Photos: F. Bego and L. Kashta).

The Bistrica springs (Fig. 13-16) in Delvina district about 18 km east of Saranda near the road to Gjirokastra are exciting concerning nature, biodiversity and history. On the road we meet the Finiqi village with walls from the ancient city of Phoinike, an early center of the Illyrian tribe of the Chaonia and the capital of the Epirus Kingdom in the 3rd century BC. Rests of the largest theatre in Albania have been discovered there. The Mesopotami church of Saint Nicholas nearby is the oldest church in Albania from the Byzanthine period. In Delvina, a small town with 12'000 inhabitants, the ruins of an ancient Byzantine castle (11th century) are witnesses of the former importance of the city.

Figure 13-8: **1:** Ionian Riviera at Lukova village (Saranda), with terraces cultivated with citrus and olives; **2:** Palasa beach known as White Roads; **3:** distillation of grapes for homemade *raki* (Albanian traditional liquor); **4:** Porto Palermo Bay near Himara and an abandoned tunnel in the bay used formerly as shelter for submarines of the Albanian coastal navy; **5:** castle of Ali Pasha from the 17th century (Photos: A. Miho and L. Kashta). **»»»**


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The Ionian Riviera along the national road to Vlora offers impressive views on the blue sea with attractive beaches and the rocky coast (Fig. 13-8). Many natural, historical, cultural and ethnographic treasures are evidences of the continuos struggle for freedom for centuries, from old churches and monasteries to the hundreds of *bunkers* of the last century. The history of Himara, a small town with about 11'000 inhabitants, goes back to Philip V of Macedonia who attacked it in 214 BC, later in 167 BC it became a Roman base. Today Himara becomes much altered by the rapidly growing tourism activities.

13.4. Physico-geographical characteristics

The Butrinti area belongs to the lowland of Delvina, geographically to the Mountainous Southern Region of Albania and part of the Southern Albanids with the tectonic Ionic zone. It is formed primarily by the carbonatic rocks of the Mesozoic; only small parts are composed of terrigenous and Quaternary materials. The Delvina Lowland is built of old formations of the Permo-Triassic, characterized by evaporites (gypsum, anhydride, rock salt). Carbonate formations, especially limestone of the Jura and Cretaceous form the mayor part of the mountain peaks and the many hills. Limestone of upper Trias and lower Jura are less aboundant, i.e. in Ksamili and Stillo.

Most of the surrounding hills are composed of terrigenous formations of the Paleogene and Neogene, lower parts are filled with alluvial or marshy depositions of the Quaternary. Tectonically the Delvina Lowland represents a graben of the Plio-Quaternary that continues to sink still today; moreover the zone shows seismic activities.

The coastline is often fragmented with peninsulas (Ksamili), islands and small deep bays (such as the Armura bay) with two morphologically different types, a high abrasive coast at Ksamili peninsula and a low accumulating one at Butrinti.

The relief is diverse, but erosive-denuding activities dominate. Due to these processes, glas formations are widespread in the zone, forming an original enormous plain and accumulating relief along the steep mountain slopes. Their materials are of *terra rossa* type (Fig-13-17), strongly susceptible to erosion; the biggest glas is in Muzina, near the Bistrica springs.

The Vurgu plain (Fig-13-3) is the biggest and the most significant plain; it extends from the Butrinti Lake in the south to the Blerimasi village in the north over a distance of 13 km. It is very flat with an altitude between 0 and 1 m above sea level in Butrinti and 10 to 20 m in the north. The plain is formed completely by Quaternary depositions of alluvial origin, mainly from the Kalasa and Bistrica rivers. Several hills rise up erratically to a height of 100 to 150 m, they are built of flyshes or quaternary depositions.

Before the 2nd World War, the Vurgu was marshy and swampy and often flooded by the Bistrica and Kalasa rivers. Between 1957 and 1959 more than 28 km^2 new agricultural lands were created or regenerated and new beds for the rivers have been constructed. The two rivers were combined to the artificial channel of Çuka (Fig. 13-9) in the south of Saranda and the water directed straight into the sea.

The Mursia is another plain bordering the Butrinti Lake; it extends 15 km south-east to Konispoli at the Greek border. The Vrina plain is part of it close to the Butrinti Lake (Fig. 13-10). The Mursia plain was mostly marshy and in part densely covered by shrubs and alluvial forests, with elm, ash, willows. Reclaiming was carried out after building a new bed for the river Pavlla, moving it towards the foot of the southern hills and away from Butrinti Lake. The Mursia reservoir was built upstream of Pavlla river; it is one of the biggest in Albania with a water volume of 4.5 million m^3 and an irrigation capacity of 20 km^2.

Figure 13-9: Bistrica river at the artificial channel of Çuka (Saranda) (Photo: A. Miho).

Figure 13-10: The Butrinti forest, the Vivari channel and the Vrina plain (Photo: F. Bego).

Like the whole Ionian Riviera, the Delvina lowland is the warmest region of Albania with about 343 sunny days or more than 2700 hours per year. The annual mean temperature is the highest in Albania with 16 to 18°C and the mean temperature for January and August are 10°C and 24°C, respectively. The absolute maximum may exceed 40°C; in winter the temperature rarely drops below 0°C. This allows a continuous growth of the vegetation and permanent agricultural activities during the whole year.

The annual mean precipitations vary between 1300 to 1350 mm in the plains and rise to 1650 to 1770 mm in the mountain valleys. Only a small amount of the annual rainfall occurs in summer.

The Delvina lowland is very rich in water. Bistrica springs (Fig. 13-16) with a mean flow of about 18 $m^3 s^{-1}$ combine to the Bistrica river. It is 32 km long, rich in minerals with 427 mg l^{-1}. It has a rather constant flow of 24 $m^3 s^{-1}$ during the whole year. The Kalasa river is mainly fed by the Tatzati spring which delivers 1 $m^3 s^{-1}$. The river is 33 km long and has a mean flow 7.5 $m^3 s^{-1}$, but with large shifts between the wet and the dry season, varying from 3.5 to 14.5 $m^3 s^{-1}$. A maximum flow event of 133 $m^3 s^{-1}$ has been recorded. The Pavlla river is the third major river with about 50 km in length. It originates in the north-western Greece and has a scarce but highly variable water flow of 6.5 $m^3 s^{-1}$ as it lacks the input of subterranean water. The mineral content amounts to 354 mg l^{-1}.

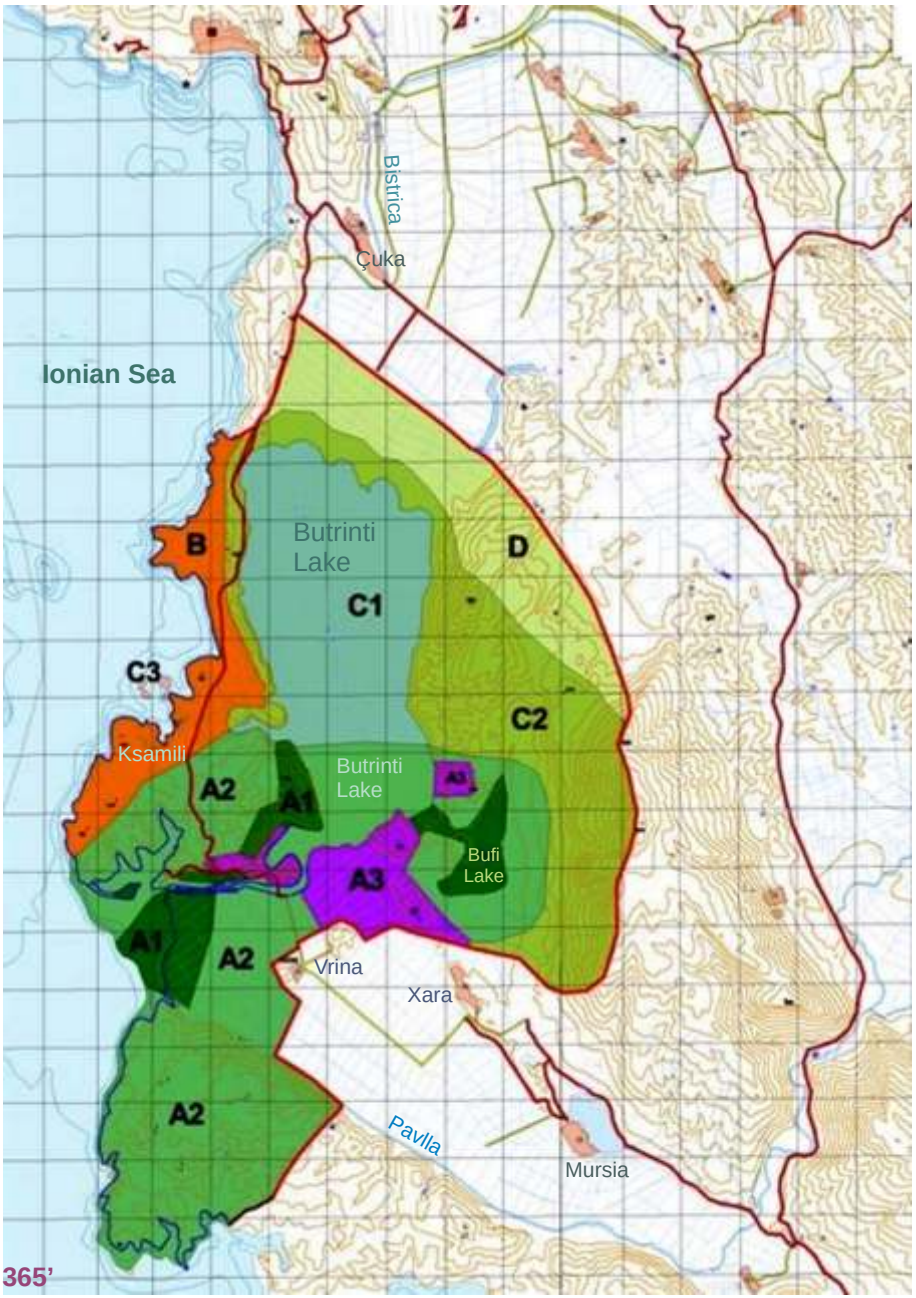
Figure 13-11: Butrinti/Vivari channel, the sea mouth (*right*) and the wetlands in the Vrina plain (*left)* (Photo: F. Bego).

Human impact in Butrinti area seems not negligible. Bushati in her PhD theses (2014) evidences that the water quality in the lake oscillates from mesotrophic to hypertrophic (Tab. 13-14 and Fig. 13-26) showing the presence of high content of nutrients (nitrogen and phosphorous) in water, mostly during summer, probably from surrounding plains of Vurgu and Mursia. Moreover, last years (2010) heavy metal content in bottom waters and in mussels (Cr and Pb) is reported, as well as increase of bacteria (*E. coli*) in mussels. Even the values of pesticide residues in mussels during 2005-2010 (Marku & Nuro, 2011) were reported higher than 0.01 mg kg^{-1} (Fig, 5-6; *see* § 5.5 in Chapter 5), the general EU limit permitted in products of animal and plant origin that are intended for human or animal consumption.

13.5. Description of the most important habitats

The Butrinti wetland zone (Fig. 13-3) is a unique transitional wetland which borders to Greece in the south and to the Ionian Sea in the west. Seven small villages are scattered within the area counting about 3700 inhabitants. The small town of Ksamili with about 4000 inhabitants is located at the coast in the west of the area. The main local activities are agriculture, fruit yards and vineyards, livestock, cultural and recreation tourism, fishing and mussel farming. Many young people migrated to Greece during last decade.

The Butrinti National Park covers a large part of the Vrina plain (Figs. 13-11'; 13-10 and 13-11), including the Ksamili peninsula (Fig. 13-3), the southern part of the Butrinti Lake with its archaeological centre, the lake Bufi/Rreza (Fig. 13-15), the Armura lagoon (Fig. 13-12) and some salt- and fresh- water marshes.


Bistrica
Çuka
Ionian Sea
Butrinti Lake
B
D
C1
C3
C2
Ksamili
A2
A1
Butrinti Lake
A3
Bufi Lake
A1
A2
Vrina
Xara
A2
Pavlla
Mursia
365'

«««« Figure 13-11': Zone map of Butrinti NP; A, strictly protected zone (A1, specially protected subzone; A2, natural subzone; A3, cultural inheritage subzone); B, recreational zone; C, traditional zone (C1, traditional fishing; C2, traditional livestock; traditional recreation); D, sustainable development zone (VKM 693, 2005; *Anonymous,* 2010).

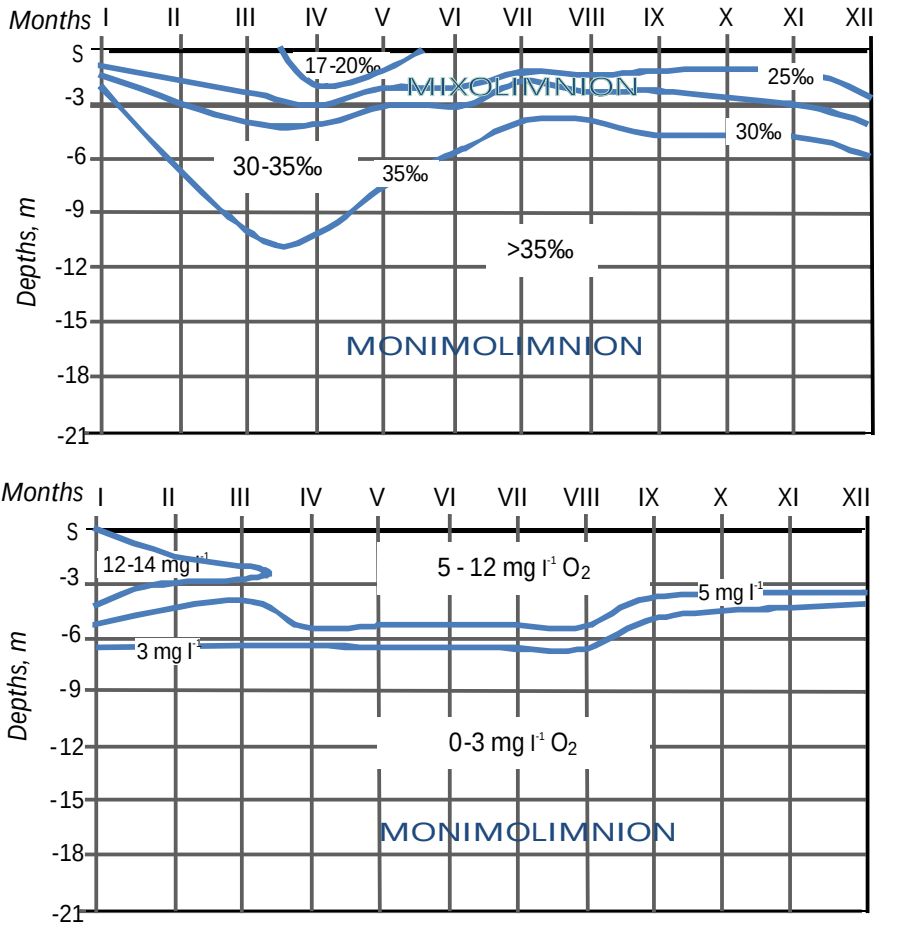


Figure 13-11'': Depth average distribution in depth of salinity, ‰ (*above*) and oxygen, mg l^{-1} (*below*) in Butrinti lake. Data taken from the lab of the former Mussel Enterprise in Butrinti, measured in 1990 in 5 different stations (elaborated after Miho, 1994).

365''

Figure 13-12: Armura lagoon shelters interesting habitats concerning microscopic algae (Photo: A. Miho).

Table 13-1: Some morphometric parameters of Lake Butrinti.	
Total water surface	16 km^2
Watershed surface	128 km^2
Total water volume	211 x 10^6 m^3
Maximal depth	22 m
Mean depth	14 m
North-south dimension	7.1 km
East-west dimension	3.2 km

Butrinti comprises also a high diversity of natural, semi-natural and artificial habitats, most of them with transitional features, such as the brackish water lagoon of Butrinti, freshwater marshes (reed beds), the salt marshes of Armura, the brackish lake of Bufi\Rreza, the outlets of Bistrica and Pavllo, open halophytic lands, Mediterranean forests and maquis, a rocky coast, arable lands, fruit tree terraces and more. All these shelter a rich diversity of flora and fauna, that make the Butrinti zone the most diverse and attractive site in Albania. More than 10 major archaeological sites or monuments are spread within the zone, dating from the middle Palaeolithic.

The core of the wetland is the Butrinti lake (Fig. 13-3), a tectonic lagoon of 16 km^2. Some general morphometric parameters are given in table 13-1. It is surrounded by forested hills and mountains and encompassed by freshwater and saltwater marshlands.

The watershed covers the coastal hilly zone, its northern and southern parts are lowlands formed by rivers and lakes, while the western and eastern parts are at higher altitude with hills broken up by karstic formations.

Despite the tectonic origin, the water regime in Butrinti is the typical one of coastal lagoons. Some physic-chemical data are presented in table 13-2 and figure 13-13 that allow to understand better the remarkable lake ecosystem.

Table 13-2: Depth profiles of physic -chemical parameters in the Butrinti lake in August 1993 (mean of 14 stations, Guelorget & Lefebvre, 1994); S, salinity; TSS, total suspended solids; OM, organic mater; Chl a, chlorophyll a; Phe a, pheophytin a; *nr,* not reported.

Depth, m	pH	O_2 (mg l^{-1})	T (°C)	S (‰)	TSS (mg l^{-1})	OM (mg l^{-1})	OM / TSS (%)	Chl a, (mg m^{-3})	Phe a (mg m^{-3})	Phe / (Chl + Phe) (%)
0	8.3	7.2	26.5	14.5	17.0	2.9	16.9	4.9	2.4	33.2
-1	8.3	6.7	26.4	14.8	12.5	3.3	26.6	0.6	2.3	80.6
-2	8.3	6.8	26.3	14.6	17.3	3.9	22.3	0.9	1.9	67.9
-3	8.3	6.6	26.4	16.1	25.5	3.6	14.3	0.7	2.1	75.5
-4	8.1	6.0	26.0	18.6	23.5	3.5	15.0	1.6	2.8	63.8
-5	8.1	4.9	25.2	19.6	20.8	3.1	14.7	1.0	2.7	74.1
-6	8.2	6.9	25.0	18.7	25.6	5.0	19.4	1.3	2.6	66.9
-7	8.1	5.1	24.3	19.1	36.0	5.3	14.7	2.7	2.1	43.0
-8	8.0	4.4	23.6	18.7	17.4	2.8	16.2	2.2	6.5	74.4
-9	7.8	0.1	20.4	19.0	nr	nr	nr	nr	nr	nr
-10	7.9	1.0	20.4	18.9	20.7	3.7	18.0	0.0	13.2	99.9
-11	7.8	0.6	20.4	20.2	nr	nr	nr	nr	nr	nr
-12	7.8	0.0	18.4	20.2	24.0	2.0	8.3	0.0	7.6	100.0
-13	7.8	0.0	18.4	20.2	nr	nr	nr	nr	nr	nr
-14	7.8	0.0	18.4	20.2	24.0	4.4	18.1	0.1	5.5	98.2
-15	7.8	0.0	18.4	20.2	65.0	11.0	16.9	0.9	6.8	87.8
-16	7.7	0.0	18.4	20.2	nr	nr	nr	nr	nr	nr
-17	7.7	0.0	17.5	20.2	nr	nr	nr	nr	nr	nr
-18	7.7	0.0	17.5	20.2	nr	nr	nr	nr	nr	nr
-19	7.5	0.0	17.5	20.2	nr	nr	nr	nr	nr	nr
-20	7.5	0.0	17.7	20.2	nr	nr	nr	0.0	9.8	100.0
-21	7.7	0.0	17.8	20.3	46.0	6.0	13.0	0.0	5.7	100.0

The deviation of the Bistrica river, the main tributary until 1959, and the reclaiming of the Vurgu plain reduced the surface area of the Butrinti lake and its wetlands massively. It decreased also the freshwater input and resulted in an increase of the salinity.

Due to its relatively great depth (average of 14 m), its water column is permanently stratified, indicating that Butrinti is a typical meromitic lake. The upper layer (epilimnion) is mixed by winds similar to other Mediterranean lagoons, while the hypolimnion (usually below 6 m depth) especially in the central area stays permanently anoxic with a temperature of 16-17°C and salinity of about 20-35‰ (Figs. 13-11'' and 13-13).

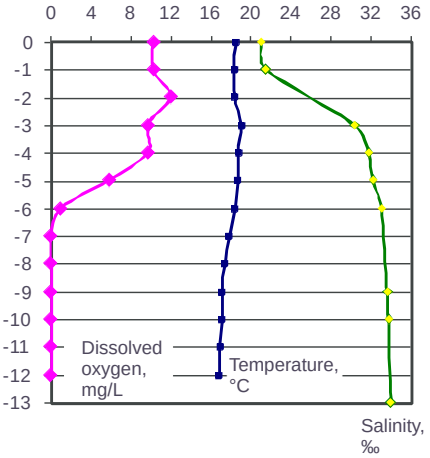


Figure 13-13: Profiles of temperature, oxygen and salinity in the Butrinti lagoon in 17 April 2010. Average of the values measured on three stations: Manastiri, Pallavraqi and Butrintti (*after* Osmani Miri *&* Peja, 2012b).

The mean temperature of the epilimnion follows the seasonal changes, from 9°C in January to 28°C in August. In April and November only minimum temperature differences of a few degrees exist between the epilimnion and the hypolimnion. The salinity in the epilimnion varies between 14 and 35‰ (Figs. 13-11' and 13-13), increasing with depth and with a maximum in late summer and a minimum during winter. In contrast the salinity of the nearby sea water varies from 30.4‰ at the surface to 40.9‰ at 5 m depth. The transparency given as Secchi depth is low ranging between 0.8 m and 4 m with two minimums in late autumn and in spring. In contrast the marine habitats of the Ionian Sea exhibit much higher transparencies, between 3 and 14 m.

The epilimnion is always oxygenated ((Figs. 13-11' and 13-13), with a saturation often above 100% and a maximum during late winter and early spring. Below 4 to 5 m depth the oxygen drops to less than 50% saturation and below 6 to 8 m to values of 0 to 3 mg l^{-1} (Fig. 13-11'). In the sea the mean values of oxygen were normally below saturation, with a maximum in late winter and a minimum in summer. The pH ranged between 7.9 in winter and 8.7 in summer.

Sulfates were recorded with up to 2.86 mg l^{-1}, showing a similar distribution pattern as the salinity with lower concentrations in surface layers. Therefore, the bottom is characterized by anaerobic decomposition processes probably by sulfate-reducing bacteria with the formation of sulfides and hydrogen sulfide detected occasionally below 7 m, especially during hot summers. Sulfides diffuse up to the surface, causing the sessile biota to die, especially the mussels.

Figure 13-14: Habitats at the Butrinti lagoon (Photos: L. Kashta).

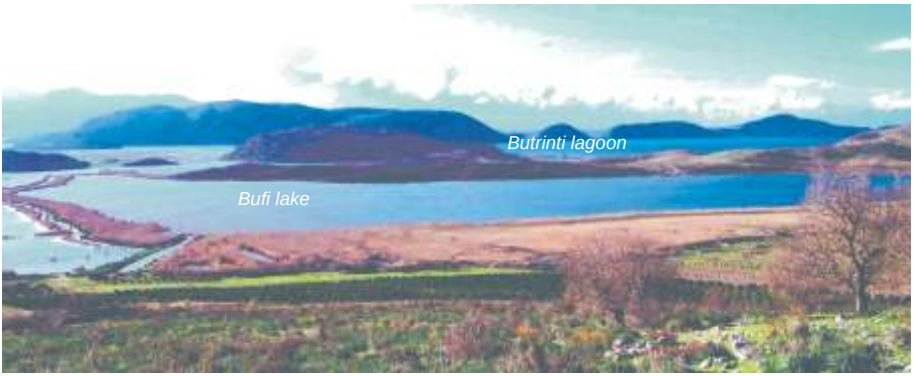


Figure 13-15: ***Above and below right:*** Bufi/Rreza lake; ***below left:*** connecting channel of the Bufi/Rreza lake with Butrinti lagoon (Photos: L. Kashta).

The Butrinti lagoon joins the Ionian Sea through the natural channel of Vivari (Figs. 13-3 and 13-11); it is 3600 m long, 60 to 100 m wide and up to 5 to 6 m deep. The sea water exchange occurs every 6 hours with a small tide of 15 to 20 cm. Small amounts of fresh water from the Bistrica and the Kalasa river enter the lagoon in its northern part.

The Butrinti lagoon and the Pavllo river play important roles in the flood control and sediment trapping, preventing heavy flooding in their upstream areas. Butrinti serves as a retention basin for surplus water from the Vurgu plain. Pavlla in the southern part of the complex plays the role of a drainage channel disposing the surplus water from the Vrina-Mursia area.

In 1990, part of the Bistrica water was returned back into the lagoon in the northern part. The lagoon is also furnished by subterraneous springs in its eastern lakefront. In Manastiri in the northern and in Dajlani in the southern part, two pumping stations (Fig. 13-3) discharge the drainage water from the Vurgu and the Vrina plains.

Another small lake, Bufi or Rreza (Fig. 13-15), extends close to the Butrinti lake with a surface of 1.2 km^2; it is fed by the Rreza springs with a high flow and a high mineral content. Its water is discharged in into the Butrinti lake through a channel of about 1 km length with a flow of 2 to 3 $m^3 s^{-1}$.

More than 17 springs with a mean flow 18 ± 3 $m_3 s^{-1}$ enter from the karstic caves into the Bistrica (Delvina) at the foot of the Muzina pass. The largest one delivers 6 $m^3 s^{-1}$ and is known by local people as *Syri i Kalter* (= Blue Eye) (Fig. 13-16). The water has a constant low temperature of 6 to 12°C. It escapes from a cave of about 45 m depth. The spring hole is surrounded by dense aquatic plants and tall plane trees (*Platanus*) and evergreen hills. About 50 ha of the Bistrica springs and the surrounding Mediterranean forest with different oaks and hygrophilous vegetation are on the checklist of nature monuments of Albania (hydromonuments).

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Figure 13-16: Blue Eye spring in Bistrica (Photo: EU StEMA Project, 2008).

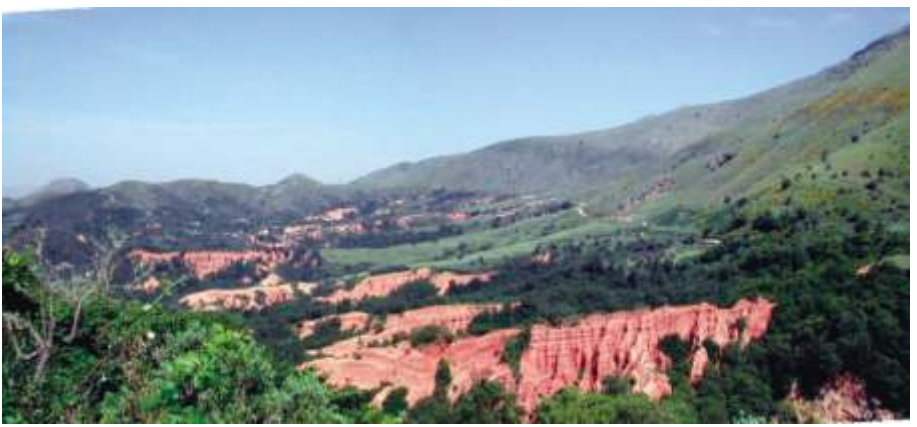

Figure 13-17: Deposition of *terra rossa* around Bistrica near Muzina village (Photo: A. Miho).

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The springs probably originate from a large underground lake, draining the Drino valley. It is thought that this spring and also the Viroi spring (Gjirokastra) are fed by the same underground lake. It can be observed in the Skotini grotto in Vanistra village (Gjirokastra) about 200 m deep. Since 1963 the Bistrica springs feed the artificial Bistrica reservoir (*see* Fig. 3-8) which drives two hydroelectric power stations. The Muzina Pass (570 m a.s.l.) connects the Delvina and Saranda regions with the Drino valley and Gjirokastra.

Limestone dominates in mountains and terrigeneous depositions in hills and plains. Descending from the Muzina village, *terra rossa* depositions form a landscape of some hundred meters width (Fig. 13-17). They are heavily eroded with bare patches of reddish color mixed with evergreen vegetation. The area has been listed as a natural monument (geomonument). Karstic landscapes dominate on mountain peaks with steep slopes, sharp rocks and rocky holes, caves and deep dolines.

The rocky peninsula of Ksamili is situated on a karstic plain, some rocky islands in front of it formed by tectonic uplifting are covered by evergreen shrubs. Three of these islands are in the Albanian water (Fig. 13-18), 60 to 500 m far from the Ksamili bay.

In Saranda visitors are fascinated of the Ionian Rivera or the *Bregu* (Coast) (Figs. 13-8, 13-19 and 13-20), as local people call it. It is an attractive and thrilling physical-geographical entity and a typical ethnographic region with its own original culture, folklore and history. It extends from the western side of the Çika mountain at the Llogora pass to Nivica village near Saranda.

The geological basis is mainly limestone with the typical karstic characteristics of steep slopes, sinkholes and bare rock areas. The shoreline, especially from Palasa to Himara, is the most beautiful part of the Ionian coast, full of contrasts, bays and rocky capes, wave-cutting cliffs and numerous caves.

Figure 13-18: Ksamili islands (Photo: L. Shuka).

Fluvial gravel valleys with wide deposition cones create attractive and beautiful beaches and large fields and orange, lemon and olive plantations, like the one of Borshi or Qeparo. A large beach of about 2 km length and 1 km width (geomonument) is formed from the stony deposits of the Dry Torrent at the foot of the Llogara pass near the Palasa village (Fig. 13-19). It is the largest and most natural Albanian beach. Some springs like in Dhermi, Borshi and Lukova, create challenging relaxing places under plane trees. Eroded glas formations of *terra rossa* type are also found in the zone.

Figure 13-19: Dry Torrent at the foot of the Llogora pass near Palasa village (at the *left*) (Photo: L. Kashta).

13.6. Biodiversity of the Butrinti complex

The most remarkable characteristics of the Butrinti wetlands are their unique natural values which support a large number of globally endangered plants and animals, and offer wide habitats especially for fish as spawning grounds, nursery and migration pathways. In table 13-3 the estimated biological richness (number of species) and % of national numbers, found in the Butrinti protected areas is reported.

Table 13-3: Estimated biological richness (number of species) and % of national numbers, found in the Butrinti protected areas (http://www.ramsar.org/ris/ris_albania_butrint.htm, 2003).

Biological groups	Number of species	% of National
Plants	800-900	27
Insects	1500-2000	12.5
Fish	105	34
Amphibians	10	67
Reptiles	25	69
Birds	246	75
Mammals	39	55
Total	**2725-3325**	**17**

Flora

The phytoplankton of the Butrinti lagoon has been studied from 1987 to 1991 in cooperation with the Mussel Enterprise, Saranda (Miho, 1994). At present the Institute of Food Security and Veterinary (ISUV) in Tirana runs a monitoring program focused on the production of toxic algae and biotoxins (Bushati *et al.*, 2010; 2011; 2012).

Figure 13-20: Ionian Riviera at Lukova village (Saranda), with terraces cultivated with citrus and olives; the Çika mountain is at the horizon (Photo: F. Bego).

Figure 13-21: Dense growth of submersed little Neptune grass (*Cymodocea nodosa*) in the shallow water of Butrinti (Photo: L. Kashta).

As the lagoon is meromictic, phytobenthos grows only on a narrow shoreline zone. Dense growth of *Ulva* (*Enteromorpha*) *prolifera* and of the Dwarf eelgrass (*Zostera noltii; =Zostera* (*Zosterella*) *noltei*) is limited to this shallow littoral belt. In the shallow water near the Butrinti channel the influence of the sea is stronger. Dense growth of submersed little Neptune grass (*Cymodocea nodosa*) is observed (Fig. 13-21).

The bottom part, deeper than 6 to 8 m, is of anoxic mud, consisting of decomposing biomass of sedimented phytoplankton from the epilimnion. The percentage of organic matter was significantly higher in April than in August, showing the high contribution of phytoplankton as the main primary producer during the spring period. Note also the difference between epilimnion and hypolimnion in April (Fig. 13-22).

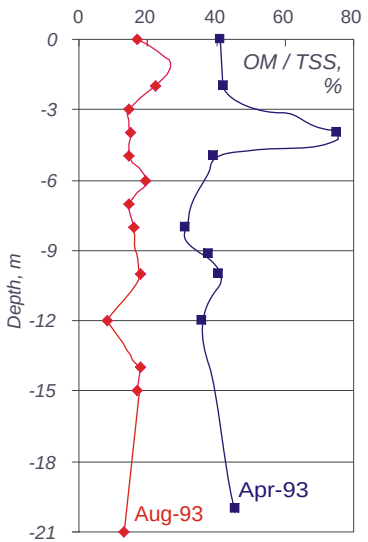

Figure 13-22: The percentage of organic matter of the total suspended solids (OM / TSS, %; mean values) in April and in August indicate the high contribution of biomass during the spring period (calculated after Guelorget and Lefebvre, 1994).

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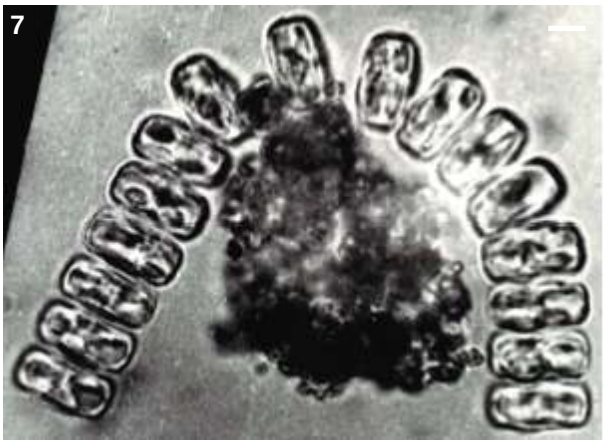
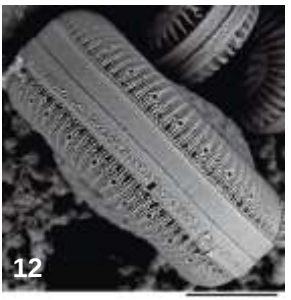
Figs. 1-7*: bar =10 µm (1500x)*





Figs. 8-12*: bar =3 µm (x4000)*

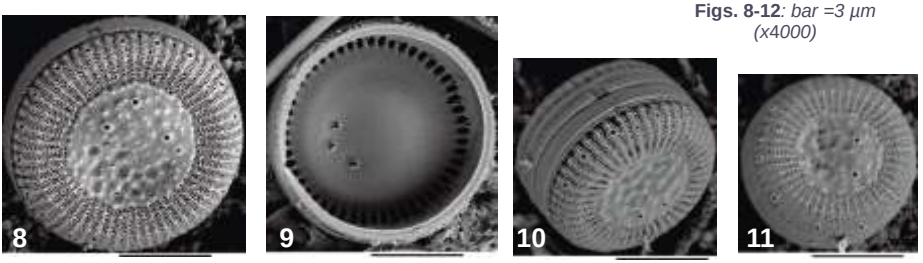
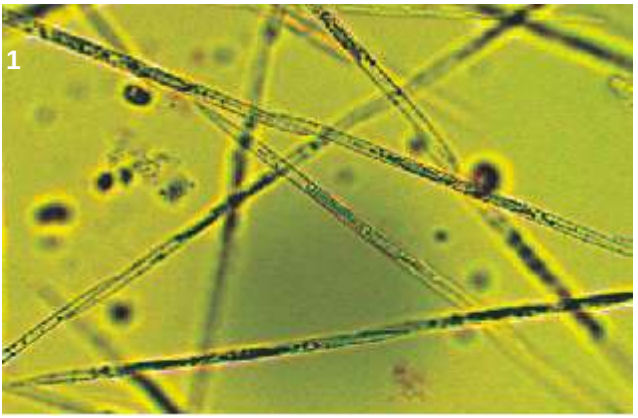
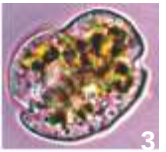
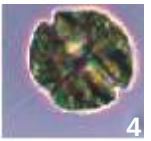


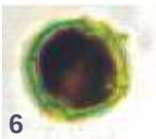
Figure 13-23: *Cyclotella choctawhatcheeana*, an abundant centric diatom in the phytoplankton of Butrinti lagoon, detected also in the Eastern Adriatic (Buric *et al*., 2007) (Photos: A. Miho).

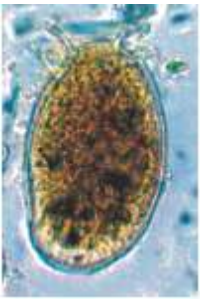
Figure 13-24: Microscopic algae in the phytoplankton of the Butrinti lagoon (most abundant and/or potentially toxic species): **1:** *Pseudo-nitzschia seriata*; **2:** *Amphora coffeaeformis*; **3-4:** *Heterocapsa* spp.; **5-6:** *Alexandrium* spp.; **7:** *Dinophysis sacculus*; **8:** *Dinophysis* spp.; **9:** *Ostreopsis* spp.; **10-11:** *Gyrodinium* sp.1; **12:** *Prorocentrum micans*; **13-14:** *P. minimum*; **15-16:** *Gyrodinium* sp.2; **17-18:** *Karenia* spp.; **19:** *Protoperidinium* sp.1; **20:** *Protoperidinium* sp.2 (Photos: M. Bushati). **»»»**











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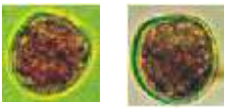
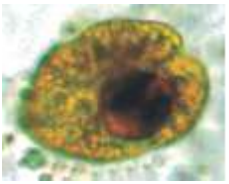
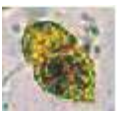
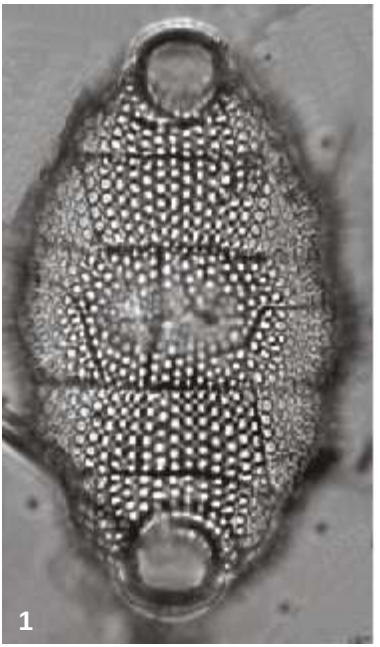
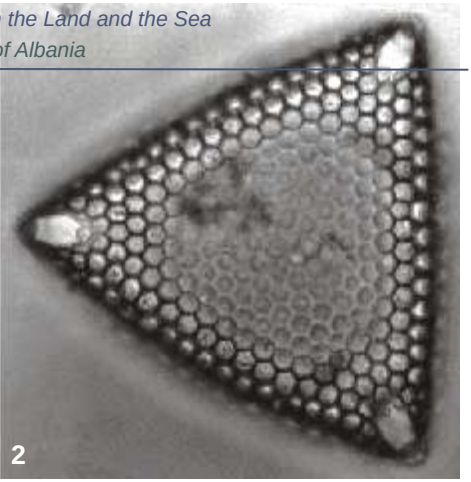
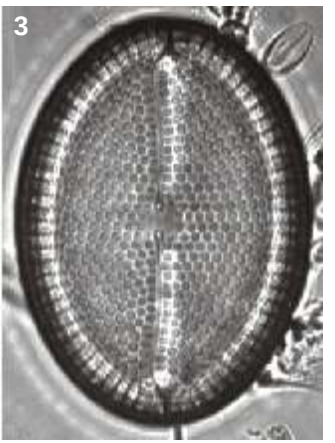








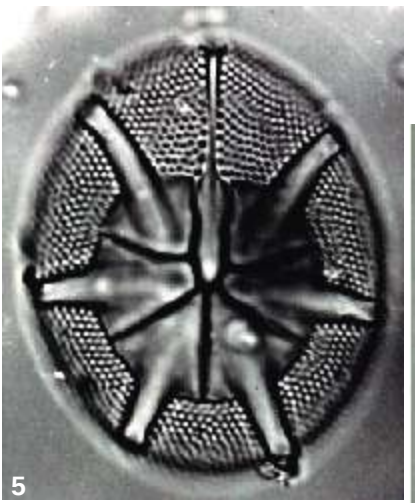




Figs. 1-2*: bar =25 µm (600x)*

Figs. 3*: bar =16.6 µm (900x)*

Figs. 4-6*: bar =10 µm (1500x)*



«««« Figure 13-25: Diatoms from Butrinti wetlands: **1:** *Biddulphia pulchella*; **2:** *Triceratium favus*; **3:** *Mastoglioa splendida*; **4:** *Achnanthes brevipes*; **5:** *Asteromphalus heptactis*; **6:** *Cocconeis pseudomarginata*; **3** and **7:** from Armura, the others from Butrinti (Photos: A. Miho).

In the study during 2006-2010 focused on the phytoplankton and biosecurity, Bushati reported about 460 taxa of microscopic algae, shared on 13 classes. Diatoms (*Bacillariophyceae*) and dinoflagellates (*Dinophyceae*) dominated either in species or abundance. The phytoplankton in mixolimnion (down to 5 m depth) showed a seasonal dynamics, mostly irregular, either with a relatively very high peak during January-February (2006 and 2009), or mostly in May (2007, 2008 and 2010), and a second peak smaller generally in October (Tab. 13-4 and Fig. 13-26). Most abundant species were centric diatoms: *Cyclotella* spp. (*C. choctawhatcheeana;* Fig. 13-23) and *Cerataulina pelagica*, and the pennatae diatoms: *Pseudo-nitzschia* spp. The most abundant dinoflagellates were *Gymnodinium simplex*, *Heterocapsa* spp., *Prorocentrum micans* and *Scrippsiella* spp. (Bushati, 2014). More than 20 taxa algae were known as toxic, where about 5 taxa belong to diatoms and 15 to dinoflagellates, like the dinoflagellates *Karenia* spp., *Alexandrium* spp., *Dinophysis acuminata*, *D. sacculus* or *Gonyaulax spinifera*. From the toxic diatoms, *Pseudo-nitzschia* species (Fig. 13-24) produce the neurotoxin domoic acid (DA), which causes amnesic shellfish poisoning (ASP). In general, they dominate during autumn-winter (maximum in December), probably related to low temperature. They were found abundant during winter 2009 and 2010, but without harmful effects (Bushati, 2014; Bushati *et al*., 2012).

Productivity was considered relatively high (mesotrophic to hypertrophic), favorable to an extensive use (fishing), but also aquaculture (mussel growth). It indicates that the oxygenated layer offers favorable habitats for shellfish reproduction, visible by the vigorous growth of the Mediterranean mussel *Mytilus galloprovincialis* everywhere in the lagoon. But the life conditions and the mussel growth can be disturbed often by the algal blooms of toxic species belonging to *Pseudo-nitzschia* and *C. pelagica* during winter-spring, and from the abundance of toxic dinoflagellates during summer-autumn. The state can be stressed even from climatic, hydrodynamic or meromictic conditions, or human impact.

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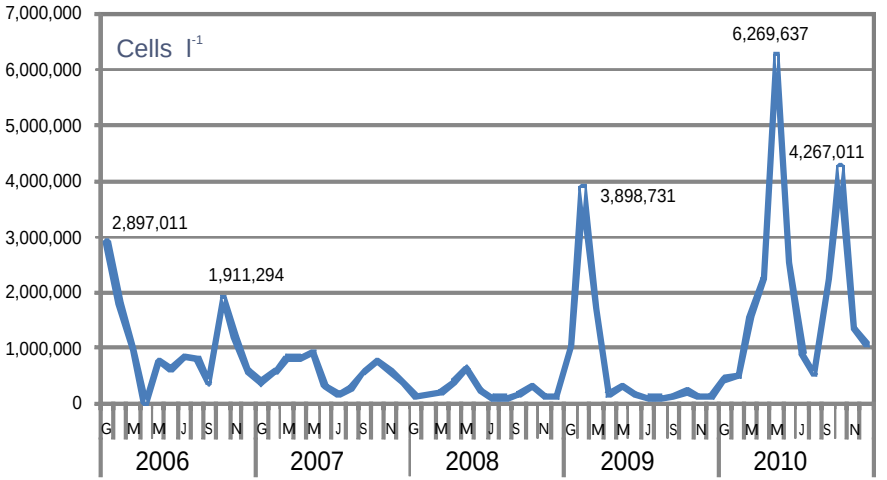

Figure 13-26: Monthly average quantity of the phytoplankton (cells l^{-1}) (depth 1 m) in Butrinti during 2006-2010 (Bushati, 2014).

Table 13-4: Monthly average quantity of the phytoplankton (cells l^{-1}) in Butrinti during 2006-2010 and the related trophic state after Dokulil (2003); Blue - Oligo-mesotrophic (0.01 - 0.1 million cells l^{-1}); Green - Mesotrophic (0.1 - 0.5 million cells l^{-1}); Orange - Meso-eutrophic (0.5 - 1 million cells l^{-1}); Red - Eutrophic (1 - 10 million cells l^{-1}) (*after* Bushati, 2014) .

Period		G	F	M	A	M	J	J	A	S	O	N	D
2006		2,897,011	1,809,062	979,598	-	746,998	621,938	845,882	819,365	376,624	1,911,294	1,190,580	564,929
2007		390,324	565,973	806,917	809,845	923,364	333,328	165,852	280,437	587,185	760,490	556,385	387,633
2008		73,477	136,317	183,645	343,567	525,230	221,603	113,991	73,278	172,683	257,742	126,156	493,972
2009		2,721,395	3,679,481	899,010	160,392	331,111	176,740	109,201	86,664	139,684	257,043	123,750	110,095
2010	1 m	447,020	509,725	1,559,132	2,260,112	6,269,637	2,520,219	915,138	551,317	2,246,653	4,267,011	1,348,849	1,068,253
2010	3 m	503,761	563,530	1,222,557	2,559,578	6,494,920	1,916,107	479,639	531,987	1,846,733	3,997,619	1,440,035	1,343,263
2010	5 m	190,816	246,767	245,253	871,711	2,208,813	480,393	93,623	115,330	674,357	1,728,140	428,274	522,746

Today the Butrinti lagoon is considered mesotrophic with tendency to eutrophy. Dystrophic crises in mussel farming were observed during summers 1979 to 1983, 1987, 1994 and 2012. The eutrophication is probably accelerated by two hydrological impacts, the deviation of the Bistrica and Pavllo rivers leading to a reduced freshwater input and a limited water exchange in the lagoon, enhanced by a frequent blockage of the Vivari channel. During hot summers the hydrodynamic exchange drops to a minimum, decreasing the depth of the oxygenated layer (= epilimnion) occasionally to only two meters. The content of organic matter increases in both sediment and water. Combined with high summer temperatures the rate of decomposition is stimulated in the whole water column, with bacteria consuming the oxygen and sulfate reducing bacteria producing hydrogen sulphide.

However, as the lake is permanently stratified the anoxic water in the hypolimnion represents a potential risk for aquaculture that requires a controlled process and a proper technology. No pollution of domestic or industrial origin in the Butrinti wetland system has been observed so far. However, in summer 2012 some slight urban pollution indicated the negative effect of the heavy and chaotic urbanization on the Ksmili peninsula during the last decade. Other possible sources of pollution arise from agricultural activities from fertilizers and pesticides brought in by the two pumping stations during drainage of the Vurgu and Vrina plains.

The brackish water habitats of the Armura lagoon or the freshwater habitats of the springs of Bistrica or Borshi hide various microscopic algae, most of them oligotrophic forms. In Borshi spring probably a new diatom species has been found, similar to *Navicula jobaudii* (Fig. 13-27).

The macroflora of the Butrinti habitats is rich and diverse with about 800 to 900 plant species (Tab. 13-3). About 32 of them of unfavorable conservation status are presently listed in the Albanian Red Book; of them one is endemic and eleven are sub-endemic (Tab. 13-5). Some plants from the Saranda region and the Ionian Riviera are shown in figure 13-36.

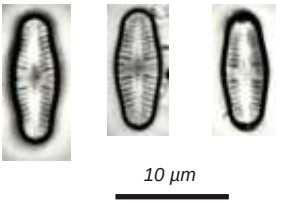

Figure 13-27: ***Left:*** freshwater habitat at Borshi spring; ***right:*** *Navicula* aff. *jobaudii* Germain, probably a new species from the spring (Photos: A. Miho).

Table 13-5: Important plant species from the Butrinti protected areas (http://www.ramsar.org/ris/ris_albania_butrint.htm, 2003; Xhulaj & Mullaj, in Riccardi *et al*., 2001). Al = in Albania, Gr = in Greece, Balkan = in whole Balkan area.

Rare species	**State**		**Endangered species**
Alkanna corcyrensis	Subendemic (Al & Gr)		*Agrimonia eupatoria*
Alyssum smolikanum	Subendemic (Al & Gr)		*Aristolochia sempervirens*
Colchicum cupanii			*Capparis spinosa*
Crocus boryi	Subendemic (Al & Gr)		*Colchicum autumnale*
Daphne gnidium			*Desmazeria marina*
Euphorbia dendroides			*Ephedra distachya*
Galium intricatum	Subendemic (Al & Gr)		*Hypericum perforatum*
Galium procurrens	Subendemic (Balkan)		*Laurus nobilis*
Limonium anfractum	Subendemic (Al & Gr)		*Lotus cytisoides*
Pterocephalus perennis ssp. *bellidifolius*	Subendemic (Al & Gr)		*Mathiola tricuspidata*
Stachys decumbens	Subendemic (Al & Gr)		*Origanum vulgare*
Teucrium fruticans			*Prunus webbii*
Insufficiently known			*Quercus ilex*
Centaurea spruneri ssp. *guiccuiardii*	Subendemic (Al & Gr)		*Salvia officinalis*
Scabiosa epirota	Subendemic (Al & Gr)		*Satureja montana*
Stachys sericophylla	Endemic (Al)		*Viburnum tinus*
Thymus teucrioides	Subendemic (Al & Gr)		

Figure 13-28:
Wetlands at the northern lakeshore of the Butrinti and Vurgu plains (Photo: A. Miho).

Figure 13-29:
Wetlands at the Bufi lake (Photo: O. Nika).

Wetlands are mainly shaped by salt marsh vegetation and reed beds. They border the Butrinti lake in its northern (Figs. 13-14 and 13-28), southeastern and southern parts and are present along the Butrinti / Vivari channel (Fig. 13-30), the coastal area between the Vivari and Pavlla river estuaries and in the western part of the Bufi / Rreza lake (Figs. 13-15 and 13-29). Salt marsh occurs as a narrow fringe along the southern lakeshore and at the mouth of the Vivari channel and the river Pavlla. Such halophyte vegetation is described in table 13-6 (*see* also similar biotopes of brackish water and hydro-hygrophilous vegetation shown in tables 12-7 and 12-8).

Reed beds are widespread in the northern part of Butrinti (Figs. 13-14 and 13-28), in the western part of Bufi (Figs. 13-15 and 13-29) and in the mouth of the Pavlla river. The vegetation is dominated by reed (*Phragmites australis* and *Typha angustifolia*) with sparse trees of Common elm (*Ulmus campestris*), Manna ash (*Fraxinus excelsior*) and willows (*Salix* spp.). Other species adapted to such aquatic habitats are *Scirpus lacustris* and *S. maritimus.* The vegetation shows a wide ecological plasticity, covering freshwater to brackish habitats (Tab. 13-6). These are outstanding habitats for water birds. On the southern part of the Butrinti wetlands especially along the Vrina plain (Figs. 13-10 and 13-11), dry pastures spread with plants adapted to high salt concentrations and permanent presence of water in winter and droughts in summer.

Figure 13-30: Halophyte habitats at the Vivari/Butrinti channel outlet to the Ionian Sea (Photo: L. Kashta).

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Table 13-6: Saltmarsh vegetation in the Butrinti wetlands.

Scientific name	Common name	Albanian name	Remarks
Ammophila arenaria	European marram grass	Amofila e ranishteve	
Artemisia coerulescens	Sagebrush	Pelini i bruzte	
Arthrocnemum fruticosum	Glasswort	Artroknemi shkurror	
Arthrocnemum glaucum	Glaucos glasswort	Artroknemi i rimte	
Arthrocnemum perenne	Glasswort	Artroknemi shumevjeçar	
Cakile maritima	European searocket	Brokra bregdetare	
Crithmum maritimum	Rock samphire	Krithmi bregdetar	Rocky substrate
Echinophora spinosa	Prickly parsnip	Ekinofora gjembake	
Halimione portulacoides	Sea purslane	Halimioni si bordullak	
Inula crithmoides	Golden samphire	Omani kritmoid	
Juncus acutus	Spiny rush, Sharp rush	Kulmaku i mprehte	
Juncus maritimus	Sea rush	Kulmaku bregdetar	
Limonium anfractum	Sea lavender	Fshesa dredhake	Rocky substrate
Limonium vulgare	Sea lavender	Fshesa e rendomte	
Medicago marina	Coastal medick	Jonxha detare	
Salicornia europaea	Common glasswort	Jambruku evropian	
Sporobolus pungens	Coast dropseed	Sporobolusi çpues	
Tamarix dalmatica	Dalmatian tamarisk	Marina dalmate	Most dominant, between Bufi and Butrinti lagoon, along Vivari channel
Tamarix hampeana	Tamarisk	Marina hampeana	
Vitex agnus-castus	Chaste tree	Konopica	
Xanthium strumarium	Rough cocklebur	Rrodhja	

Figure 13-31: Higher fungi from the Butrinti region: ***left:*** *Coprinus atramentarius*; ***right:*** *Pholiota nameko* (Photos: O. Nika).

The Mediterranean forest (Fig. 13-32) inside the archaeological park houses more than 80 species of higher plants and other organisms, stacked in vertical layers. The wood layer is dominated by elm (*Ulmus minor*), ash (*Fraxinus angustifolia*), common oak (*Quercus robur*) and white poplar (*Populus alba*), occasionally, laurel tree (*Laurus nobilis*) and holm (*Quercus ilex*) are frequent. Typical plants of the brushwood layer are listed in table 13-7. The most widespread species in the herbaceous layer are *Asparagus acutifolius, Galium mollugo, Ranunculus ficaria, Campanula rapunculus* and *Lythrum salicaria*.

The brushwood vegetation spreads mainly in the hills in the eastern and southern parts of the Butrinti lagoon and on the Ksamili peninsula and its islands. Due to many factors, especially human influence, the vegetation cover has been transformed and shows different degradation patterns of the former forest with Holm oak (*Quercus ilex*). About 148 species of higher plants are still present. The best preserved associations with *Quercus ilex* and *Fraxinus ornus* are found on the Ksamili islands, more species including various liana are listed in table 13-7.

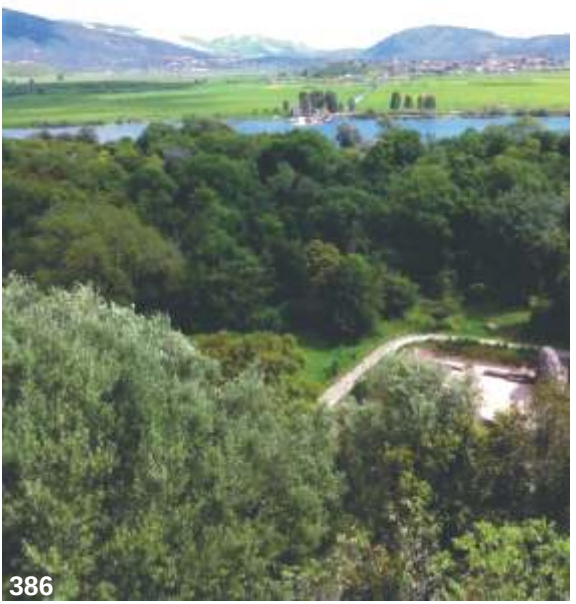

Figure 13-32: Butrinti forest, Vivari channel and Vrina plain (Photo: O. Nika).

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Table 13-7: Brushwood vegetation in Butrinti.
L = liane growth type (*see* also tables 8-6 and 9-4)

Scientific name	Common name	Albanian name	Remarks
Arbutus unedo	Strawberry tree	Mareja	
Cercis siliquastrum	Judas tree	Lofata	
Clematis viticella	Virgin's bower	Kulpra e zeze	L
Crataegus monogyna	Common hawthorn	Murriz njeberthamor	
Hedera helix	Common ivy	Urthi	
Juniperus oxycedrus	Prickly juniper	Dellinja e kuqe	
Juniperus phoenicea	Phoenician juniper	Dellinja fenikase	
Myrtus communis	Myrtle	Mersina	
Olea oleaster	Wild-olive	Ullastra, Ulliri i eger	
Periploca graeca	Silk vine	Shtalpra	L
Phillyrea angustifolia	False olive	Mretja gjethengushte	
Pistacia lentiscus	Mastic	Xina, Bafra, Sqind	
Rosa sempervirens	Evergreen rose	Trendafili i breshkes	
Rubus ulmifolius	Elm leaf blackberry	Manaferra	L
Ruscus aculeatus	False olive	Rrushkulli shpues	
Salix alba	White willow	Plepi i bardhe	
Smilax aspera	Rough bindweed	Morenxa	L

Xerophyte shrubs of *Garrigue* or *Phrygana* vegetation type (xeromorphic shrubs and grasses) grow on limestone on the Ksamili peninsula, widespread but poor in species richness and similar to the vegetation at the Ionian Riviera. Associations with Holly oak (*Quercus coccifera*) are the most degraded ones due to previous interventions by burning or eradicating trees to transform the zone into pastures and then pushed further by overgrazing. The most degraded parts are dominated by *Phlomis fruticosa* and other species resistant to environmental stress. A list of xerophyte shrubs from the *Garrigue* is given in table 13-8.

The xerophyte maquis grows in the northeastern hills of Butrinti, with sparse presence of Vallonea oak (*Quercus macrolepis*), a rare and endangered species of economical value. The association with the Tree spurge (*Euphorbia dendroides*) is most intriguing in some small areas of the Ksamili hills and in the Himara area at the Ionian riviera. It represents a first degradation step of *Q. ilex* communities growing on calcareous formation at high solar radiation.

Table 13-8: Xerophyte shrubs in the Saranda region (G = *Garrigue;* M = *Maquis*).			
Scientific name	**Common name**	**Albanian name**	**Remarks**
Asparagus acutifolius	Wild asparagus	Ferremiu	G, in degraded environments
Arbutus unedo	Strawberry tree	Mareja	M
Brachypodium ramosum	Bunch grass	Rudithi i degezuar, Stupec	G
Cercis siliquastrum	Judas tree	Lofata	M
Chrysopogon gryllus	Bunchgrass	Belizma e zeze, Fengu, Pirra	G, in degraded environments
Cistus spp.	Rockrose	Menishtja	M
Colutea arborescens	Bladder senna	Fshikartha	G
Coridothymus capitatus	Cone head thyme	Zhumbrica me koke konike	M
Cornus mas	Cornelian cherry dogwood	Thana	M
Crepis rubra	Hawksbeard	Shmanga e kuqe	G, in degraded environments
Crithmum maritimum	Rock samphire	Krithmi bregdetar	M, salt resistent
Desmazeria marina	Sea fern-grass	Desmazeria bregdetare	M, salt resistant
Elymus pycnanthus	Sea couch	Elimi	M, salt resistant
Erica arborea	Tree heath	Shqopa	M
Euphorbia dendroides	Tree spurge	Qumeshtore si dru, Flomi	M
Ilex aquifolium	European holly	Ashja	M
Inula crithmoides	Golden samphire	Omani kritmoid	M, salt resistent
Juniperus oxycedrus	Prickly juniper	Dellinja e kuqe	M
Laurus nobilis	Bay laurel	Dafina	M
Limonium anfractum	Sea lavender	Fshesa dredhake	M, salt resistant
Lotus cytisoides	Bird's-foot trefoils	Thuapule si vjexhes	M, salt resistant
Malcolmia maritima	Virginia stock	Malkolmia bregdetare	G, in degraded environments
Myrtus communis	True myrtle	Mersina	M
Nerium oleander	Oleander	Leandri	M
Olea europaea var. *sylvestris*	Wild olive	Ulliri	M

Table 13-8: Xerophyte shrubs in Saranda region (G = *Garrigue*; M = *Maquis*) (continued ...).			
Scientific name	**Common name**	**Albanian name**	**Remarks**
Olea oleaster	Wild-olive	Ullastra, Ulliri i eger	M
Paliurus spina-christi	Jerusalem thorn	Driza	G, in degraded environments
Phillyrea angusitifolia	False olive	Mretja gjethengushte	M
Phillyrea media	Mock privet	Mretja	G
Phlomis fruticosa	Jerusalem sage	Cfaka, Bexga	G, in degraded environments
Pistacia lentiscus	Mastic, Lentic	Xina, Sqindi, Bafra	M, G, in degraded environments
Prasium majus	Mediterranean prasium	Piperi i eger	M
Pyrus amygdaliformis	Almond-leafed pear	Gorrica	G, in degraded environments
Quercus coccifera	Holly oak	Prralli	G, >50% of area, in degraded environments
Quercus macrolepis	Valonia oak	Valanidhi	M, rare and endangered species of economical value
Salvia officinalis	Common sage	Sherbela	M
Salvia fruticosa (=Salvia triloba)	Greek sage	Millocfaka	M
Saponaria c alabrica	Calabrian soapworts	Shkumeza kalabreze	G, in degraded environments
Spartium junceum	Spanish broom		M
Drimia maritima (=Urginea maritima)	Sea squill, Sea onion	Boçka, Qepa e detit	G, in degraded environments
Vitex agnus-castus	Chaste tree	Konopica	M

Euphorbia is accompanied by *Pistacia lentiscus, Phillyrea angustifolia, Olea oleaster, Prasium majus, Salvia officinalis* and *Salvia fruticosa* (=*S. triloba*). The narrow rocky belt along the seashore from the Stillo cape to Çuka at about 2 to 3 m a.s.l. is inhabited by a salt- and wave-resistant flora (Tab. 13-8).

The Italian cypress with the perennial Sea onion (*Drimia maritima*) and *Andropogon* spp. prosper on the seaside slopes from Saranda to Ksamili. Along the narrow road Saranda-Ksamili many natural xerophytes, olives and citruses thrive, in September the white flowers of the sea onion are exciting.

Figure 13-33: The agave in coastal slopes of Himara (Photo: A. Miho.

Natural tropical plants like the Indian fig opuntia (*Opuntia ficus-indica*) (Fig. 13-36) and the agave (*Agave americana*) create an unusual scenery (Fig. 13-33). The agave was originally cultivated for industrial purposes. Due to overgrazing, it has completely replaced the native vegetation.

The mild climate tries to blur the vegetation cycles around the Bistrica springs (Fig. 13-34). Oriental planes, willows, horn beans (*Carpinus betulus, C. orientalis*), heathers (*Erica arborea*), evergreen shrubs and various hygrophilous vegetation cover the spring habitats, the lake shore as well as the whole Bistrica bed down to the seacoast.

Figure 13-34: Oriental planes of great age (*Platanus orientalis*) around the Bistrica springs (Photos: F. Bego and O. Nika).

Mediterranean forests grow densely in the surroundings of the Muzina village (between 800 and 1300 m a.s.l.). They house many oak species (*Quercus cerris, Q. troiana, Q. frainetto, Q. ilex* and *Q. pubescens*), mixed with trees like Sweet chestnut (*Castanea sativa*) and evergreen shrubs such as lentic (*Pistacia lentiscus*), strawberry tree (*Arbutus unedo*), laurel tree (*Laurus nobilis*), cone head thyme (*Corydothymus capitatus*) and prickly juniper (*Juniperus oxycedrus*). Other shrubs occur between 600 to 1000 m, examples are the Stinking bean trefoil (*Anagyris foetida*), Judas tree (*Cercis siliquastrum*), Chaste tree (*Vitex agnus-castus*), European cornel (*Cornus mas*), Jerusalem thorn (*Paliurus spina-christi*), together with Kermes oak (*Quercus coccifera*), Spanish broom (*Spartium junceum*) and *Phillyrea* spp.

Valonia oak forms sparse forests, even at altitudes up to some 100 m on the surrounding mountain slopes. It is often accompanied by Holm oak and Manna ash. Mediterranean fir communities grow in isolated valleys, mixed with maple (*Acer* spp.), ashes (*Fraxinus ornus, F. exelsior*) and hornbean (*Carpinus betulus, C. orientalis*). Pines (*Pinus heldreichii, =P. leucodermis*) form rare forests on limestone slopes of the Pylloi mountain (Delvina), Heckle rose (*Rosa heckeliana*), Buckthorn (*Rhamnus rupestris*) and Olive-like spurge laurel (*Daphne oleoides*) grow in sub-alpine pastures.

Figure 13-35: Spring time in the Butrinti archeological center with blooming *Leucanthemum vulgare* (Photo: F. Bego).

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Dry stony pastures are found along the mountain slopes, mainly on brown-grey soils of the Ionian riviera. They are dominated by *maquis* of *Garrigue* or *Phrygana* with Kermes oak (*Quercus coccifera*) and accompanied by various plants, listed in table 13-8.

On hills and humid mountain slopes between Borshi and Nivica where terracing was not possible, different types of Mediterranean *maquis* are mixed (Tab. 13-8). Special associations with Oleander grow in the Borshi valley and Tree spurge (*Euphorbia dendroides*) is found in Porto Palermo, Qeparo and Ksamili (Fig. 13-36). Valonia oak occasionally forms small forests near Borshi, Piqerasi and Himara.

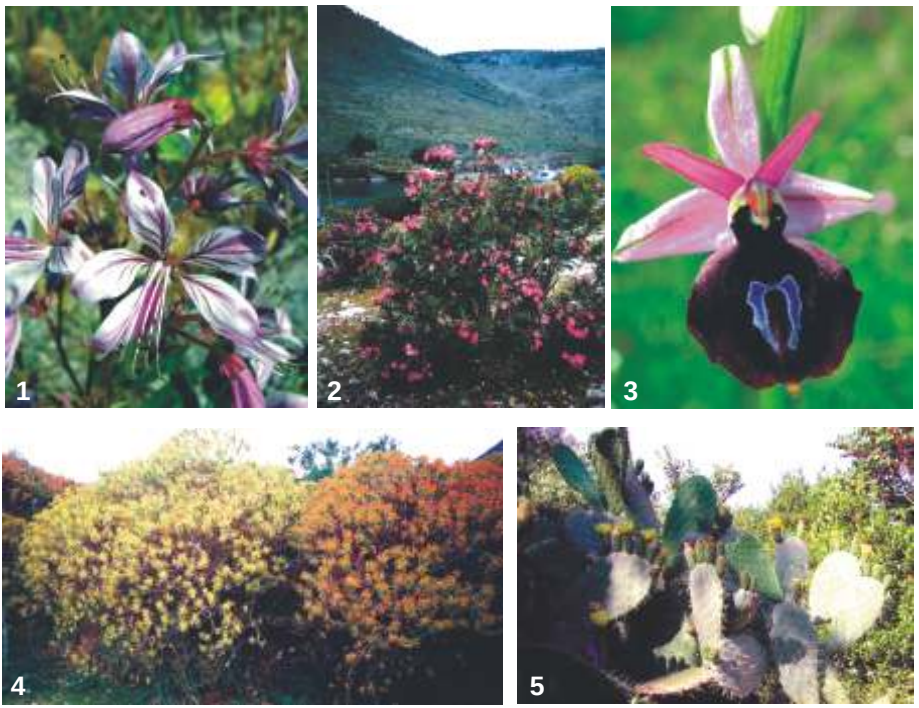

Figure 13-36: Plants from the Saranda region and the Ionian Riviera: **1:** Burning-bush (*Dictamnus albus*) (Ksamili); **2:** Oleander (*Nerium oleander*) (Himara); **3:** Horseshoe ophrys (*Ophrys ferrum-equinum*) (Butrinti); **4:** Tree spurge (*Euphorbia dendroides*) (Himara); **5:** Indian fig opuntia (*Opuntia ficus-indica*) (Butrinti) (Photos: L. Shuka and A. Miho).

Trees rarely mentioned for the Ionian Riviera are Carob tree (*Ceratonia siliqua*) and Milkweed (*Gomphocarpus fruticosus*), the latter is only found in Qeparoi and in the Borshi plains. In valleys the streams and other shaded areas, Holm oak grows, while in the shrubby areas, Italian cypress is found. Grassland species like Sea onion and Beard grasses (*Andropogon* spp.) are very common. Tropical plants are also present like the Tree of heaven (*Ailanthus glandulosa*) in Borshi. The Indian fig opuntia is widespread, agave is found in the Palermo bay and even fruiting bananas (*Musa* sp.) have been reported.

For many decades citrus, olives and vine were planted in the green terrigenous hills and valleys between Borshi and Nivica, and in Ksamili. The enormous work of terracing (Figs. 13-8 and 13-20) was forced by the former regime. Mediterranean shrubs were cleaned up and more than 650'000 trees had been planted in Lukova and the surrounding hilly area. The voluntary work of terracing and the maintenance of the fruit yards were practiced by the youth. An irrigation system was operating at that time using the water of the Tatzati springs brought to the Ionian Riviera by a tunnel. After the change of the political system the agricultural industry collapsed and the fruit yards rapidly degraded. Today the local community is making strong efforts to restore the fruit yards. The terracing at the Riviera was an experience that was later transferred to other hilly zones of Albania. Unfortunately, it often had negative effects on the vegetation cover and resulted in a loss of biodiversity and enhanced erosion.

Fauna

The Butrinti region shelters a range of particular animal species (Tab. 13-3), a few of them threatened or of biogeographical and economic value. About 33 species are listed of global conservation concern, 14 of these are globally endangered. Of national conservation concern are 109 species and of European conservation concern 136 species (Tab. 13-9). Some important globally endangered species are listed in table 13-10, while the checklist of species included in the IUCN Red List of Threatened Animals is given in table 13-11.

Table 13-9: Number of species grouped as of national (NCC) and global conservation concern (GCC) in the Butrinti area (http://www.ramsar.org/ris/ris_albania_butrint.htm, 2003).

Fauna groups	NCC	GCC
Amphibians	3	2
Birds	56	9
Fish	1	-
Insects	20	2
Mammals	15	15
Reptiles	14	5
Total	**109**	**33**

Figure 13-37: Clouded yellow butterfly (*Colias*) visiting a thistle flower (*Cirsium*) in the Butrinti region (Photo: O. Nika).

The Butrinti region registers the highest number of bird species ever recorded in Albania. It is an essential resting place for migratory birds between the Mediterranean-Adriatic-Ionian Sea and the Sahara desert. It is nationwide important for wintering of at least 9 species of water birds and shelters more than 11% of the national bird population. Recorded in the lake area are species of gulls (*Larus cachinnans, L. argentatus*), and sparrows (*Passer hispaniolensis, P. montanus*). Marsh harriers (*Circus aeruginosus, Acrocephalus scirpaceus*) are reported in the marshlands and the estuary mudflats.

Table 13-10: Most important globally endangered vertebrate species in the Butrinti region.

Scientific name	Common name	Albanian name
Canis lupus	Wolf	Ujku
Caretta caretta	Loggerhead turtle	Breshka detare
Dermochelys coriacea	Leatherback turtle	Breshka e detit lekurore
Falco naumanni	Lesser kestrel	Skifteri kthetraverdhe
Haliaetus albicilla	White-tailed eagle	Shqiponja e detit
Myotis capaccinii	Long-fingered bat	Lakuriqi i nates gishtgjate
Rhinolophus euryale	Mediterranean horseshoe bat	Lakuriqi hundepatkua i Mesdheut
Testudo hermanni	Hermann's tortoise	Breshka e zakonshme
Testudo marginata	Marginated tortoise	Breshka e maleve

Table 13-11: Checklist of species included in the IUCN Red List of Threatened Animals; CR, Critically Endangered; DD, Data Deficient; EN, Endangered; LRcd, Lesser Risk conservation dependent; LRlc, Lesser Risk less concern; LRnt, Lesser Risk nearly threatened; VU, Vulnerable; (http://www.ramsar.org/ris/ris_albania_butrint.htm, 2003).

Amphibians	**Status**	***Mammals***	**Status**
Triturus cristatus	LRcd	*Rhinolophus blasii*	LRnt
Hyla arborea	LRnt	*Rhinolophus euryale*	VU
Reptiles		*Rhinolophus ferrumequinum*	LRcd
Caretta caretta	EN	*Miniopterus schreibersi*	LRnt
Dermochelys coriacea	EN	*Myotis capaccinii*	VU
Testudo marginata	LRlc	*Myotis emarginatus*	VU
Testudo hermani	LRnt	*Myotis myotis*	LRnt
Emys orbicularis	LRnt	*Sciurus vulgaris*	LRnt
Elaphe situla	DD	*Glis glis*	LRnt
Birds		*Microtus (Pitymys) felteni*	LRnt
Phalacrocorax pygmeus	LRnt	*Microtus thomasi*	LRnt
Pelecanus crispus	VU	*Mus spicilegus*	LRnt
Aythya nyroca	VU	*Canis lupus*	VU
Oxyura leucocephala	VU	*Monachus monachus*	CR
Haliaetus albicilla	VU	*Stenella coeruleoalba*	LRcd
Aquila clanga	VU	***Insects***	
Falco naumanni	VU	*Cerambyx cerdo*	VU
Gallinago media	LRnt	*Lycaena dispar*	LRnt
Numenius tenuirostris	CR		

Figure 13-38: Two nests of the White stork (*Ciconia ciconia*) on the bell tower of churches in the Vurgu plain area, Saranda (Photos: F. Bego).

Most of the migratory bird species are observed during autumn and winter. In the coldest months waders have been detected in mudflats and the channel estuaries, while anatids, ducks geese and swans, assemble in large colonies on the lake. Pairs of White stork (*Ciconia ciconia*) were often observed to build large stick nests on bell towers of the churches in Vurgu plain area (Fig. 13-38). Noteworthy the White stork has been rated as least concerned by the IUCN.

The zone is also the richest of Albania concerning amphibians and reptiles (Fig. 13-39). About two thirds of amphibians and reptiles of the whole Albanian territory are recorded here. Butrinti is the unique site in Albania where the Epirote frog (*Rana epirotica*), the Marginated tortoise (*Testudo marginata*), the Sand boa (*Eryx jaculus*) and the Balkan wall lizard (*Podarcis taurica* ssp. *jonica*) live. The brackish ponds and channels in the Butrinti archeological center host large populations of the European terrapin (*Emys orbicularis*) and the Striped-neck terrapin (*Mauremys caspica*) (Fig. 13-40).

The diversity in aquatic habitats with freshwater, brackish, saline and marine water results in a high diversity of fish species. About 105 species of fish are known here which equals to about a third of the Albanian fish-fauna. Some species, such as the Flathead grey mullet (*Mugil cephalus*) and the Sea bream (*Sparus aurata*) find in the lake optimal spawning grounds. Fishing is practiced in the lakes as well as in the littoral. Fish traps (*dajlani*) are permanently installed in the Vivari channel catching about 60% of the annual yield of the lake which amounts for 60 to 120 t per year. Economically important are species of Mugilidae and Sparidae and European eel (Tab. 13-12).

The benthic fauna of the Butrinti lagoon has not been examined yet. Based on sporadic information and due to the anoxic conditions of the bottom layer it is probably very poor.

Figure 13-39: Animals from Butrinti and Bistrica: **1:** Greek marsh frog (*Rana balcanica; =Pelophylax kurtmuelleri*) (Bistrica); **2:** European ratsnake (*Zamenis situla; = Elaphe situla*) (Muzina); **3:** Crab spider (*Thomisus albus*) (Bistrica); **4:** the beetle (*Epicometis (Tropinota) hirta*) (Butrinti); **5:** Beautiful demoiselle (*Calopteryx virgo*) (Bistrica) (Photos: A. Miho, I. Haxhiu, L. Shuka and L. Kashta). **»»»**

Figure 13-40: The European pond terrapin (*Emys orbicularis*) (***top and below left***) and the Striped-neck terrapin (*Mauremys caspica*) (***below right***) from the Butrinti archaeological centre (Photos: O. Nika and F. Bego).

Table 13-12: Fishery and important fish species from Butrinti; E, *economically important.*			
Scientific name	**Common name**	**Albanian name**	**Remarks**
Anguilla anguilla	European eel	Ngjala	E
Aphanius fasciatus	Mediterranean killfish	Çeliku me rripa	
Arnoglossus laterna	Caldfish	Gjuheza goje madhe	
Chelon labrosus	Thicklip grey mullet	Qefulli i dimrit	E
Dicentrarchus labrax	European seabass	Levreku	
Lichia amia	Leerfish	Lojba, Lica, Glica	
Mugil cephalus	Flathead grey mullet	Qefulli i veres	E
Pagrus caeruleostictus (=Sparus caeruleostictus)	Seabream	Spalca e eger, Pagri pikablu	E
Pagrus pagrus (=Sparus pagrus)		Pagri, Gjansa	E
Sparus aurata	Gilt-head (sea) bream	Kocja	E

About 18 species of mollusks have been reported from the Vivari channel, with 10 gastropods and 8 bivalves. The gastropods *Bittium reticulatum* and *Pirenella conica* and the bivalve *Cerastoderma glaucum* are the most frequent. Barnacles (*Balanus* and *Chthamalus*), serpulids and oligochaetes are fairly present among the macroinvertebrates, often seen as epibionts on the Mediterranien mussel.

About 47 mollusk species have been recorded at the coastal areas of Butrinti, including 26 gastropods and 21 bivalves. Of these about 27 species have a national threatened status (Tab. 13-13), 4 gastropods and 3 bivalves are vulnerable as a consequence of the intense harvesting and trade for food or ornamental objects. The highest impact was observed for Date mussel (*Lithophaga lithophaga*) and Warty venus (*Venus verrucosa*), especially in the Ksamili area.

Sporadic and/or organized harvesting is also known for limpets (*Patella*) and the bivalves *Tellina, Donax* and *Venerupis*. Due to mussel farming in Butrinti, Albania is the 4th largest European producer of Mediterranean mussel (*Mytilus galloprovincialis*) after Italy, Greece and France, having a production of about 1400 tonnes (data of 2010) after the FAO - Fishstat Plus statistics.

Table 13-13: Mollusks from the Vivari channel and the coastal area of Butrinti – Ksamili noted on the Red List of Albanian fauna (2007): C, coastal zones Butrinti-Ksamili; V, Vivari; DD, data deficient; LRlc, lesser risk, less concern; VU, Vulnerable (after Beqiraj 2003).

Gastropods	Place/Status	Bivalves	Place/Status
Alvania lineata	V / DD	*Abra alba*	V / DD
Aporrhais pespelecani	C / VU	*Acanthocardia tuberculata*	V&C / LRlc
Fusinus rostratus	C / LRnt	*Arca noae*	C / LRnt
Galeoda echinophora	C / LRnt	*Dosinia lupinus*	V / LRnt
Gibbula ardens	C / LRnt	*Ensis minor*	C / LRnt
Gibbula divaricata	C / LRnt	*Lithophaga lithophaga*	C / VU
Hexaplex trunculus	V&C / LRnt	*Loripes lacteus*	C / DD
Jujubinus exasperatus	C / LRlc	*Lucinella divaricata*	C / DD
Monodonta turbinata	C / VU	*Macoma cumana*	C / LRnt
Murex brandaris	C / LRnt	*Solen marginatus*	V / LRcd
Nassarius reticulatus	V&C / LRnt	*Tapes decussatus*	V / VU
Naticarius stercusmuscarius	C / LRnt	*Venerupis aurea*	V / VU
Neverita josephinia	C / LRlc	*Venus verrucosa*	C / VU
Ocinebrina edwardsii	C / LRnt		
Patella caerulea	C / VU		
Pirenella conica	V / LRlc		
Pusillina marginata	V / LRcd		
Rissoa labiosa	V / LRcd		
Rissoa ventricosa	V&C / LRcd		
Sphaeronassa mutabilis	C / VU		
Vexillum ebenus	C / LRnt		

Approximately 80 concrete mussel rafts were constructed in the 1980s (Fig. 13-41), which increased the production up to 5000 tons in 1990 (Figs. 13-42). The activity was abandoned after the political change, due to the export ban forced in October 1994 by the EC for sanitary reasons for all live products from the fish sector. Efforts were made on the re-establishment of the existing farming facilities in the Butrinti lagoon (Fig. 13-41); until now about 60 fixed mussel rafts are under production, yielding up to 1200 t per year.

Figure 13-41: Concrete mussel rafts in the Butrinti lagoon. ***Below right:*** center for mussle collecting and depuration in Butrinti (Photos: L. Kashta, A. Miho and F. Bego).

Besides these, the newly established floating rafts of 32 ha will produce up to 2000 t of mussels per year. Therefore, the production rised continuously to 1500 t in 2012 mainly for the local market (Fig. 13-42). Meanwhile, attempts on shrimp farming in Butrinti were made, aiming to grow the Deep-water rose shrimp *Parapenaeus longirostris*.

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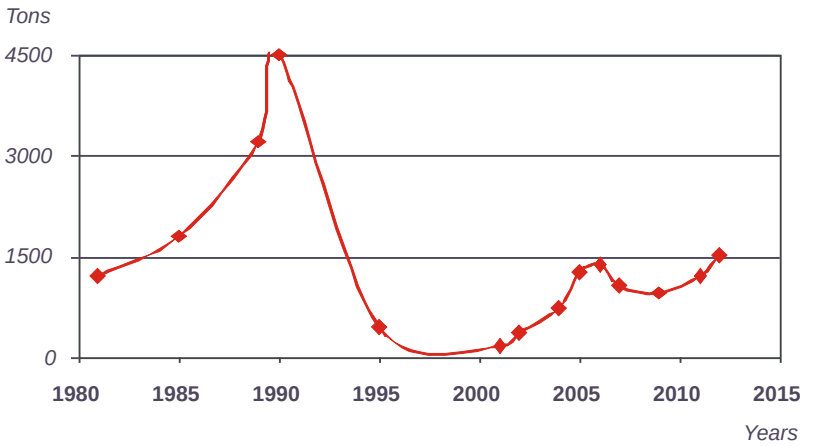

Figure 13-42: Mussel harvests in Butrinti between 1984-2012 *(http://www.dfishery.gov.al/SQ/pdf/PMP.pdf; http://www.eurofish.dk; http://151.1.154.86/GfcmWebSite/CAQ/WGSC/2010/SHoCMed_AZA/ppt/Albania.pdf; http://www.gjirokastraime.com).*

Nevertheless, as mentioned in chapter 13.5, in Butrinti the risks of dystrophic crises in mussel farming always remains, especially during summer, with high water temperatures, scarce circulation and marginal water exchange with the sea through the Butrinti\Vivari channel. This leads to an enormous decrease of the oxygenated layers (epilimnion), an increase of the activity of sulfobacteria and furthermore to an increase of toxic algae like the blooming of toxic species of *Pseudo-nitzschia* spp. Even *marteiliosis*, a mollusk disease caused by the protist parasite *Marteilia* spp., has been detected (Telo *et al*., 2011).

In summer 2011 a high content of coliforms has been verified in mussels, probably caused by the massive urbanization in the Ksamili and Vurgu zone parallel to the influx of untreated wastewater into the lagoon. All this has been observed since starting with farming and causing big losses in the mussel production. Therefore shellfish control and related depuration must be mandatory in Butrinti for aquaculture activity (Fig. 13-41). Moreover, waste water treatment in the Ksamili and Vurgu villages would reduce the risk of contamination.

The zooplankton in Butrinti is poorely known. Miglietta *et al.* (1997) reported data about 42 morphotypes of resting stages (benthic cysts and eggs of pelagic organisms), of which 27 were considered as cysts of protists and 15 eggs of metazoans (8 Copepoda; 3 Rotifera). The survey on the zooplankton community is going on recently within a PhD study (Osmani and Peja, 2012a; 2012b). In February and April, 2010 the average quantity of zooplankton was up to 9800 individuals m^{-3}, with more than 90% as Tintinnids; they appear to be the most dominant in spring with an average number of 9000 organisms m^{-3}, and a clear peak during March (39´500 individuals m^{-3}). *Favella ehrenbergii* was the key species, forming 75% of the total zooplankton and more than 80% of Tintinnids. *Oithona nana* was the most abundant copepod (Fig. 13-43). Other copepod species were *Acartia clause, Euterpina acutifrons, Calanus* spp. (copepodites).

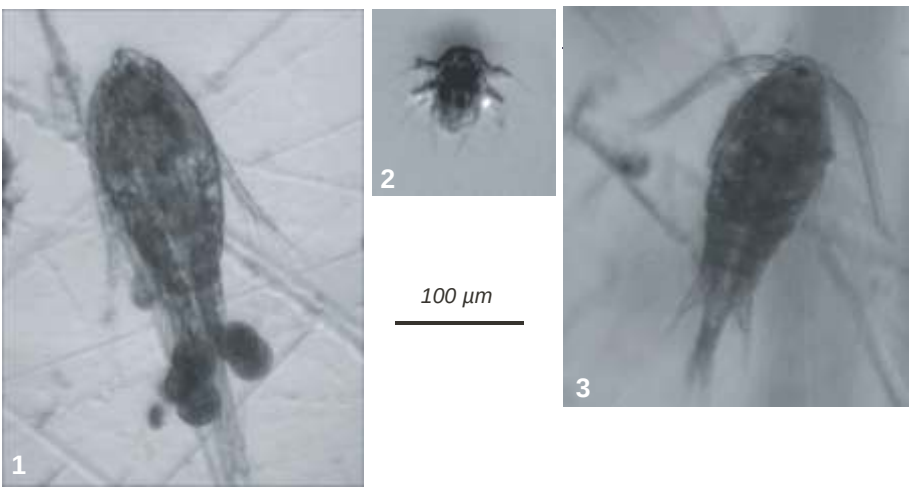

Figure 13-43: Develoment stages of *Oithona nana* from the Butrinti lagoon: **1:** adult female with eggs; **2:** nauplii; **3:** copepodit (Osmani Miri and Peja, 2012a).

The Butrinti region includes also the most diverse sites for mammals, covering 55% of the mammals in Albania. The European otter (*Lutra lutra*) has been recorded in the lagoon. The Bechstein's bat (*Myotis bechsteinii*) is found only in the Bistrica spring area. The mountains still shelter important mammals, like the wild boar (*Sus scrofa*), the hare (*Lepus europaeus*), the badger (*Meles meles*), the jackal (*Canis aureus*), the wolf (*Canis lupus*) and the fox (*Vulpes vulpes*). In the mountains it is still possible to face a roebuck (*Capreolus capreolus*) and a wild goat (*Rupicarpa rupicarpa*), although they may be locally extinct.

Figure 13-44: Monitoring training at the Butrinti lagoon in July 2007 with students from the universities of Lecce and Tirana in the project the Adriatic Meridional and Ionic Wetland System (Photo: L. Kashta).