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Costal vegetation of the Lalzi bay (Albania)

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ABSTRACT: The paper presents results of a vegetation survey of Lalzi bay, a specific Albanian costal habitat. Lalzi Bay, due to the geographic position, geology and hidrology, specific clime, offers a very rich vegetation. This is reflected in the big number of sintaxa. Plants assosiations are classified based on principless of Zurich–Montpellier school that made the base of classification in Europe sites. In this study, there 19 associations were analyzed, included in 16 alliances, that belong to 10 orders and 9 classes, with high plant diversity.

Key words: sandy dunes, phytosociology, vegetation dynamics

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INTRODUCTION

About 2 million people, half of the population of the Albania, live in the coastal region. Economic activities in the coastal areas are constantly expanding. Permanently increasing tourism and pollution has already resulted in disruption of or highly negative impacts on fragile ecosystems, impacts on quality of life of resident populations and loss of habitats and species. The resulting impacts on the Albanian coastal and marine biodiversity might be considered as dramatic. Present and future trends concerning adverse global phenomena, climate change in particular, are expected to worsen the situation.

Lalzi Bay has a longitude of 18 km, on Adriatic coast and it is bordered from the Erzen river waterway on the south, up to the north of the Rodon Cape.

The Lalzi Bay area is considered as one of the most important areas in Albania based on the high biodiversity values and the number of habitat found there. The value of Lalzi Bay area for wildlife conservation has been recognized for many years, particularly in terms of the wide variety of plants and animals associated with them. The Lalzi bay is a wetland complex composed by many different habitats, where the most important are: Bishtaraka Lagoons, Erzeni delta, salt marshes, sand dunes, Mediterranean pine forests and riparian forests.

During the 20th century, starting from the 1950s, and especially the mid 1960s, approximately 2/3 of the wetland area of Lalzi Bay area was drained. At the time, drainage had been deemed necessary to confront the important problems of malaria, flooding, and the supply of irrigation water and the acquisition of more areas for cultivation. In addition to drainage, other interventions were made (e.g. confinement of riverbeds, clearing of natural vegetation, construction of dams). Currently it is established that a lot of drainage and other interventions were mistaken because they did not yield the expected economic and social benefits and they led to the loss of values that at the time were unknown.

Currently, Lalzi Bay area continue to be threatened by alteration of their functions which means degradation of their values, despite the fact that certain positive step in the direction of their sustainable management have started.

The aim of this study was to describe the basic types of vegetation in this area, and to show global importance of area of Lalzi Bay and needs for their effective protection.

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MATERIAL AND METHODS

The vegetation of the Lalzi Bay area analyzed based on relevés follow the phytosociological method of Zurich-Montpellier school (Braun-Blanquet, 1932, 1964) This analysis conducted with the support of Flora of Albania (Paparisto *et al.*,1984-2000) and Flora Europaea (Tutin *et al.*, 1964-1980). The nomenclature followed is Paparisto *et al.*,1984-2000.

Number, size, distribution pattern of the stations and transects depend on the size and heterogeneity or diversity of habitats situated in the area of Lalzi Bay, as well as on the bio-ecological characteristics of the species or group of species. The GPS used to tell the exact location of stations or transects.

The relevés were stored into the TURBOVEG database program (Hennekens & Schaminée 2001). Diagnostic species were determined in the JUICE 6.3 program (Tichý 2002) on the presence/absence basis by calculating the fidelity of each species to each cluster, using the phi coefficient of the association (Chytrý *et al.* 2002). The results of the classification were given in a vegetation table. (Tables are available on line)

RESULTS AND DISCUSSION

Sintaxonomical review of vegetation of Lalzy Bay. Our phytosociological research in the area Lalzy Bay has recorded 19 associations classified in 9 classes, 10 orders and 10 alliances. Sintaxonomical review is presented in following list.

CAKILETEA MARITIMAE Tüxen & Preising ex Br.-Bl. & Tüxen 1952
Euphorbietalia peplis Tx.ex Oberd. 1949
Euphorbion peplis Tx. ex Oberd. 1952
Cakilo - Xanthietum strumarii (Beg. 1941) Pign. 1958

AMMOPHILETEA Br.-Bl. & Tüxen ex Westhoff, Dijk & Passchier 1946.
Ammophiletalia Br.-Bl. 1933
Agropyrion juncei Pignatti 1953
Eryngio-Sporoboletum virginici Gehu et Uslu 1989 (Tab. 1)
Euphorbio paraliae-Agropyretum junceiformis Tüxen in Br.-Bl. & Tüxen 1952 corr. Darimont, Duvigneaud & Lambinon 1962 (Tab. 2)
Ammophilion australis Br.-Bl. 1921 corr. Rivas-Martínez, Costa & Izco in Rivas-Martínez, Lousã, T.E. Díaz, Fernández-González & J.C. Costa 1990
Medicagini marinae-Ammophiletum australis Br.-Bl. 1921 corr. F. Prieto & T.E. Díaz 1991 (Tab. 3)

ARTHROCNEMETEA Br.- Bl. et Tx. 1943 corr. Bol. 1957
Arthrocnemetalia fruticosi Br.-Bl. 1931 corr. Bol. 1957
Arthrocnemion fruticosi Br.-Bl. 1931 em. Riv. Mart. et al. 1980
Puccinellio festuciformis-Arthrocnemetum fruticosi (Br.-Bl. 1928) Géhu 1976
(= *Salicornietum fruticosae* Br.-Bl. 1928) (Tab. 4)
Limonietalia Br.-Bl. & O. Bolòs 1957
Limonion angustifolii Br.-Bl. (1933) 1934
Limonio-Artemisietum coerulescentis Horvatić (1933) 1934 (Tab. 5)

JUNCETEA MARITIMI Br.-Bl. 1952 em. Beeftink 1965
Juncetalia maritimi Br.-Bl. 1931
Juncion maritimi Br.-Bl. 1931
Juncetum maritimo-acuti Horvatic 1934 (Tab. 6)
Plantaginion crassifoliae Br.-Bl. in Br.-Bl., Roussine & Nègre 1952
Eriantho-Schoenetum nigricantis (Pignatti 1953) Géhu in Géhu et al. 1984 (Tab. 7)
Holoschoenetum romani Tchou 1948 (Tab. 8)

LEMNETEA Tüxen *ex* O.Bolòs & Masclans 1955
Lemnetalia minoris Tüxen ex O. Bolòs & Masclans 1955
Lemnion minoris Tüxen ex O. Bolòs & Masclans 1955
Lemnetum minoris Oberdorfer ex Müller & Görs 1960 (Tab. 9)

POTAMETEA Klika in Klika & Novák 1941
Potametalia Koch 1926
Potamion (Koch 1926) Libbert 1931
Potamo pectinati-Myriophylletum spicati Rivas Goday 1964 corr. Conesa 1990
Ranunculion aquatilis Passarge 1964 (Tab. 10)
Callitricho-Ranunculetum aquatilis O. Bolòs, Molinier & P. Montserrat 1970 (Tab. 11)

PHRAGMITO-MAGNOCARICETEA Klika in Klika & Novák 1941
Phragmitetalia Koch 1926
Phragmition communis Koch 1926
Phragmitetum communis (Allorge, 1921) Pign. 1953 (Tab. 12)
Typhetum angustifoliae Soo 1927 (Tab. 13)
Scirpenion maritimi Rivas-Martínez in Rivas-Martínez, Costa, Castroviejo & E. Valdés 1980
Bolboschoenetum maritimi Eggler 1933 (Tab. 14)

SALICI PURPUREAE-POPULETEA NIGRAE (Rivas-Martínez & Cantó ex Rivas-Martínez, Báscones, T.E. Díaz, Fernández-González & Loidi 1991) classis nova

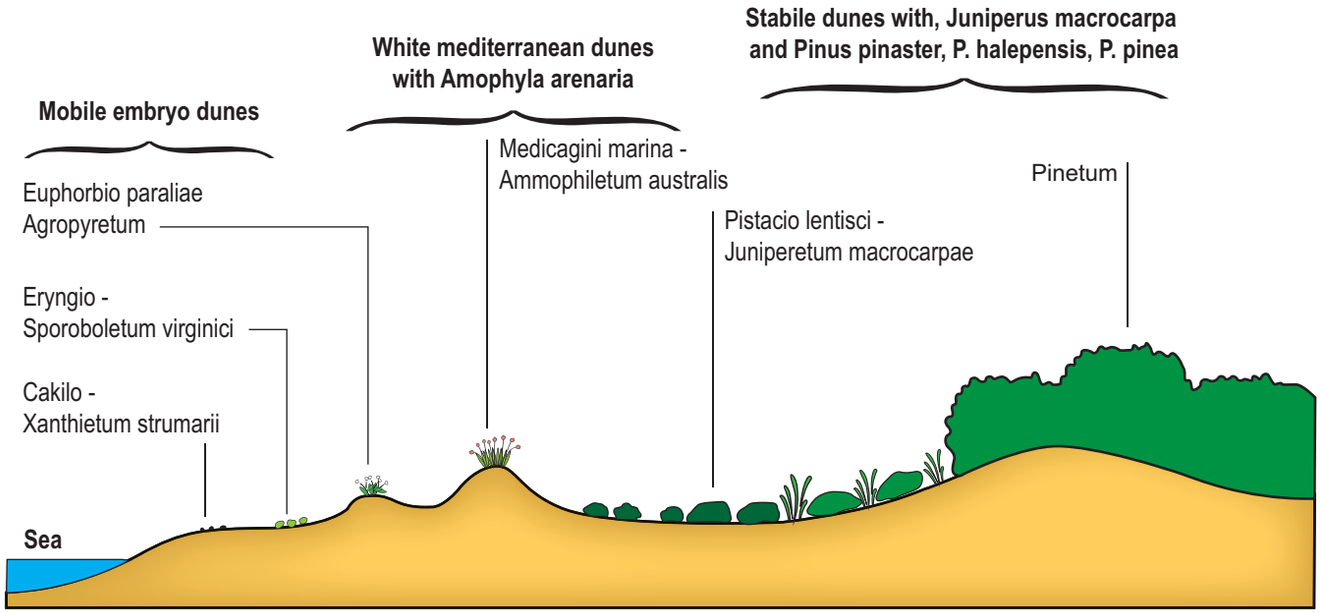

Fig. 1. Vegetation profile of the Albanian costal habitat Lalzi Bay.

Populetalia albae Br.-Bl. ex Tchou 1948
Populion albae (Br. Bl. 1931) Tchou 1948
Populetum albae (Br. Bl. 1931) Tchou 1948 (Tab. 15)
Fraxinion angustifoliae Pedrotti 1970
Alno glutinosae–Fraxinetum oxycarpae (Br. Bl. 1915) Tchou 1946. (Tab. 16)

QUERCETEA ILICIS Br. Bl. 1947
Pistacio lentisci – Rhamnetalia alaterni Rivas – Martinez 1975
Juniperion turbinatae Rivas – Martinez 1975 corr. 1987
Pistacio lentisci-Juniperetum macrocarpae Caneva, De Marco e Mossa (1981)
Quercion ilicis (Br. Bl. 1936) Riv. Martinez 1975 (Tab. 17)
Pinetum halepensis-pineae prov. (Tab. 18)

Sandy dunes vegetation. The dunes in Lalzi Bay area develop on about 10 kilometers of coast, with a variable width that ranges from 10 to 100 meters and reach a maximum height of 1-2 meters (Fig. 1). The presence of a dune system is result of factors, which determine the morphology of a sandy coast: abundant detritus depositing of fluvial or marine origin and presence of strong dominant winds. Moreover, the vegetation present in the area have to be considered as determining factor, since it has, due to its radical apparatus, a fundamental role in the consolidation and in the growth of the dune's height.

The floristic complex of the Lalzi Bay area dunes includes more than 70 taxa of higher plants. Part of these are typical psammophytes such as *Eryngium maritimum, Cakile maritima*, *Echinophora spinosa, Euphorbia paralias* and *Ammophila arenaria.* They form almost the entire vegetation of the beaches and the shifting dunes. Perennial plants as a biological type dominate in floristic complexes, though in some cases (mainly on the beaches) the dominants are pioneer annual plants (*Cakile maritima, Salsola kali* or *Euphorbia peplis*).

Analyzing the transversal profile of a dune (Uslu & Géhu 1990), starting from the shoreline, where the waves break, and continuing towards the inner part of the shore, one can observe a sequence of vegetation clusters which determine various habitats and various stages of growth of the dune's sandbar.

In accordance with the specified definition of psammophytic vegetation succession dynamics and stages of dune formation, the following parts of the dune complexes have been evidenced:

- The higher parts of the beaches with pioneer vegetation
- Embryonic dunes
- Shifting dunes

Pioneer vegetation on the higher parts of the beaches. The first vegetation clusters, found along the shore, find location at a distance from the sea, which safeguards them from the action of the wave-motion, and where sea storms may reach them only in rare cases.

This association represents the first stages of development of littoral psammophytic vegetation in the higher beach places. Despite the poor floristic composition, the total abundance of the species is often very low.

Pioneer plants are so called because they are the first plants capable of colonizing this type of hostile environment. The hostility is caused by strong thermal

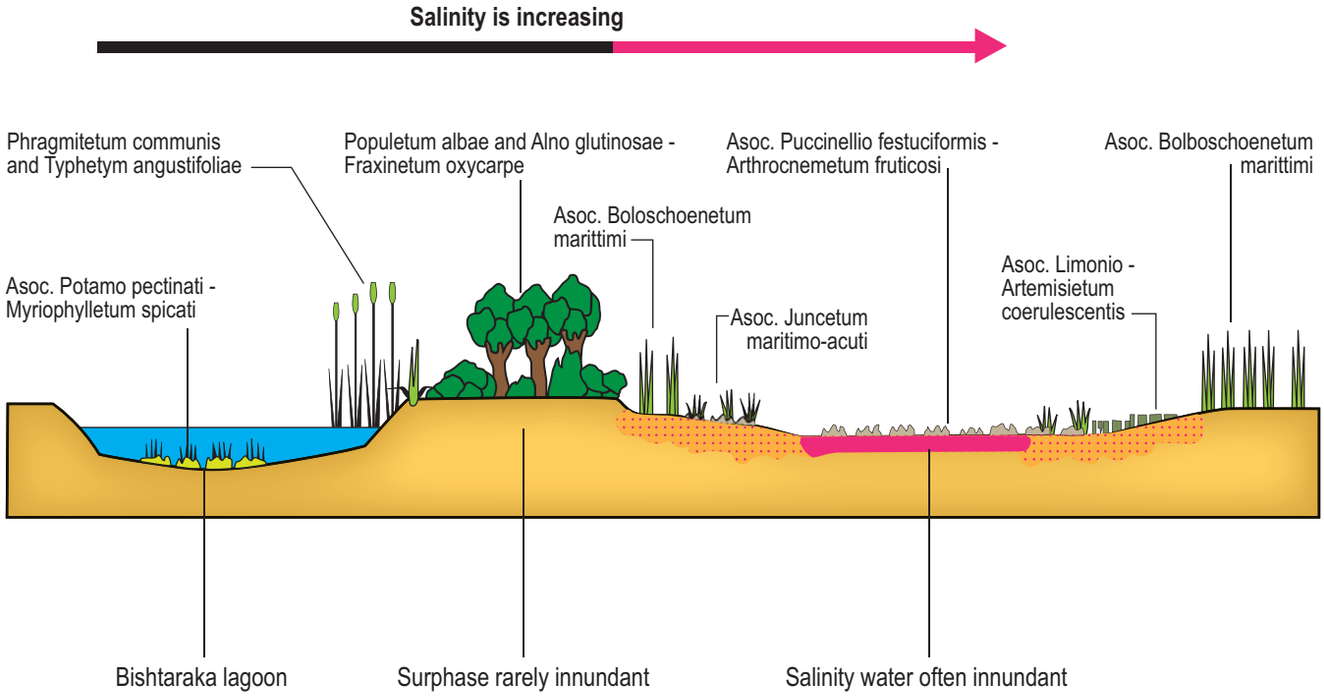

Fig. 2. The changes in coastal vegetation types in Lalzi bay with the increase of salinity.

changes, poorness of water and finally, because of the variable saline content. The most representative plants among them are *Cakile maritima, Salsola kali, Inula crithmoides* and *Xanthium strumarium.*

Embryonic dunes. Gradually going away from the coast line and as the height of sandy dunes is increased, the physiognomy of vegetation is imparted by the species *Eryngium maritimum, Euphorbia paralias, Echinophora spinosa, Elymus farctus, Cyperus capitatus, Sporobolus pungens,* that pertain to a more evolved phase of psammophytic vegetation and from the beaches to the embryonic dunes. This type of vegetation represents a stable "potential" of the sandy banks. The discussed vegetation, in most of the cases, is under human impact determined by the developing tourism, intensive usage and intensive erosion. An obvious result of human impact is the expansive distribution of *Xanthium strumarium* subsp. *italicum* in the highest beach places and the embryonic dunes. The species was introduced from America and is perfectly adapted in these areas.

Shifting dune vegetation. The increase of dune height is accompanied as well with the gradual change of the physiognomy of this vegetation. The highest dunes are colonized by the big tufts of *Ammophila arenaria* which grow especially on the crest of the dunes. This species is the real builder of the dunes. The presence of this species is an important factor in impeding the movement of sand quantities pushed away by the sea winds towards the continent. This type of vegetation extended only on some parts of the DMRD area, mostly in the northern part of Mati delta and Kune islet.

From this type of vegetation there are noticed two evaluative lines:

Retro dune or degradation of sandy dunes and the formation of depressions. The end of depressions is closer to the level of salted ground waters. The ground becomes wetter and different vegetation grows from that of dunes, dominated by *Erianthus ravennae, Scirpus holoschoenus*, *Schoenus nigricans* and *Plantago coronopus*.

Mediterranean pine forest: These forests occupy a considerable part of the DMRD area distributed mainly on sandy dunes. In generally, they represent relatively young forests, cultivated recently in order to stabilize the sandy dunes and protect the agricultural lands. The physiognomy of this formation is imparted by the species *Pinus halepensis* and *Pinus pinea*. The shrubby layer is represented by typical Mediterranean species. The most spread shrubs in this formation are *Myrtus communis*, *Juniperus oxycedrus* subsp. *macrocarpa*, *Erica manipuliflora* and *Pistacia lentiscus*.. These forests constitute the last most evolved phase of the vegetation of sandy dunes.

Salt-marsh vegetation. On the Lalzi Bay area, salt marshes are one of the most prevalent habitats around the coastline of Bishtaraka Lagoons, in both sides of the Erzeni river (mostly near the delta of this river) and also in depressions behinds the sand dunes and low-being alluvial plain (Fig. 2).

Plant species diversity is low, since the flora must be tolerant of salt and anoxic mud substrate. The most common salt marsh plants in Lalzi area is glasswort (*Salicornia europaea*), which have worldwide distribution. Glasswort is often the first plants to take hold in a mudflat and begin its ecological succession into a salt marsh. Their shoots lift the main flow of the tide above the mud surface while their roots spread into the substrate and stabilize the sticky mud and carry oxygen into it so that other plants can establish themselves as well. Plants such as sea lavender (*Limonium vulgare*), Spiny rush (*Juncus acutus*) and Sea rush (*Juncus maritimus)* grow once the mud has been vegetated by the pioneer species.

The *Salicornia europaea* (pioneer marsh communities) takes place in the space of just a few months between summer and early autumn. Following this layer is a wetland of sea-lavenders (*Limonium vulgare),* saltmarsh-grass (*Puccinellia festuciformis*), perennial glasswort (*Arthrocnemum fruticosum*) and *Halimione portulacoides*. These plants are tolerant of being covered by salt water for long periods.

The development of the lower marsh communities is marked by the increasing diversity which follows the arrival of a range of new species. The next stage is the development of the plant communities dominated by Spiny rush (*Juncus acutus*) and Sea rush (*Juncus maritimus*) that cover a large surface in this area. In lagoon stretches enjoying similar conditions, a dense population of sea club-rush (*Bolboschoenus maritimus*) settles instead of the plant communities dominated by Spiny rush. The sea club-rush often grows together with the common reed (*Phragmites australis*).

As the saltmarsh develops, the accumulation of new material raises the surface level of the new marsh in relation to the sea and this reduces the frequency and duration of tidal inundation. This enables species less tolerant of inundation to colonize, and more complex plant communities gradually develop. Development of salt marsh depends on sediment supply and the rate of sedimentation.

The next stage is the development of the middle marsh with the establishment of such species as *Saccharum ravennae, Scirpus holoschoenus, Plantago crassifolia and Triglochin maritima.* These are mostly rosette perennials, long-lived species but with relative low seed production and thus slow rates of spread.

Most of the species characteristic of the pioneer and lower marsh can also survive, usually as scattered small individuals, in the middle marsh.

The transition to high marsh communities is not found everywhere. In much of South and East Bishtaraka Lagoon the presence of a sea wall impedes the development of high marsh communities. High marsh communities are generally found only where there is a natural and gradual slope from middle marsh through to non-saline areas. The species composition of high marsh is rather variable depending on the nature of the soil. In wet areas the development of high marsh is characterized by the arrival of species such as *Juncus gerardii* and the subsequent assemblage of damp-loving species in contrast to the drier upper marsh species of *Elymus pycnanthus*. In the high marsh, with the intense competition, and in the dense stands, the survival of the species characteristic of the pioneer and lower marsh is very restricted. In the upper parts of the high marsh non- or marginally-saline species, such *Lotus corniculatus* can also be found, but this indicates the development of transition communities.

The development of the saltmarshes in terms of plant species and communities is also accompanied by developments in the soil structure and micro-flora. These developments involve the establishment of populations of bacteria and fungi which are involved in biogeochemical processes controlling the breakdown of organic matter and the cycling of plant nutrients.

Fresh waters vegetation. The Lalzi Bay area is well known for its rich and complex hydrographic network composed of the Erzeni and Tarini rivers. The ecosystems of the fresh waters and their surroundings are characterized by a very rich and interesting flora and fauna. The most important floristic groupings that we can mention for these ecosystems are floating and water-fringe vegetation, as well as riparian forests.

Floating vegetation. This is floristically very poor community where the dominant recorded species were only *Lemna minor, Callitriche stagnalis, Ranunculus aquatilis* and *Potamogeton pectinatus*. In addition to these communities were recorded submerse species like *Myriophyllum spicatum*, and emerse species like *Alimsa plantago-aquatica*.

Water-fringe vegetation. Communities of the margins of lagoons, rivers and brooks, eutrophic marshes and swamps, based on associations of tall helophyte reed, reedmace, horsetails or forbs, are usually species-poor and often dominated by one species, growing in stagnant or slowly flowing water of fluctuating depths, and sometimes on waterlogged ground. They are classified according to dominant species which give them a distinctive appearance.

Reed beds. - The most widely diffused swampy formation in the whole of the Lalzi Bay area is the common reed thicket (*Phragmites australis*). The thicket is rather ubiquitous, in the sense that it can be found in slightly salty waters (together with halophilic species- i.e. species that prefer salty environments like the *Puccinellia festuciformis*), in fresh waters (together with fresh water species like the *Lythrum salicaria*), and even in earthy

environments (on the shores of embankments). Generally speaking, as the saltiness increases the thicket tends to become monospecific, in other words to be completely dominated by the common reed. When the level of saltiness becomes excessive, the reed is taken over by decidedly more halophilic species like the sea-lavenders (*Limonium* spp.) and the saltmarsh-grass (*Puccinellia festuciformis*).

Reedmace beds. - These are communities of the margins of lagoons, rivers and brooks, eutrophic marshes and swamps dominated by *Typha latifolia, Typha angustifolia,* usually extremely species-poor, tolerant of extended periods of dryness, varying conditions of salinity, and pollution.

Bolboschoenetum maritimi beds. - This community develops in the areas where fresh and salt water mix and therefore shows the intermediate character between fresh-waters and salt-marsh communities. These beds are occupied by the species typical of fresh-waters communities (*Scirpus lacustris, Phragmites australis, Juncus effusus* and *Lythrum salicaria*) and species characteristic for salt-marsh communities (*Juncus acutus, Juncus maritimus, Halimione portulacoides* and *Aster tripolium*). In this community, the presence of species *Tamarix parviflora* and T. *hampeana* was noted and they indicate their transient character toward tamarisk thickets vegetation.

Riparian forests. The riparian forests, or alluvial forests, generally are those wooded areas suited to moist soils that cover both the river banks and the areas which are periodically submerged by flooding. These forests occupy a considerable part of the Lalzi Bay area.

The dominant species of this wood are: the bay-oak (*Quercus robur*), common alder (*Alnus glutinosa*), ash (*Fraxinus angustifolia*), the white poplar (*Populus alba*), the elm (*Ulmus minor*), white willow (*Salix alba*) and the privet (*Ligustrum vulgare*).

The area of riparian forests (typical for the region) is declining. The large surfaces of riparian forest areas just beyond the Erzeni Delta are destroyed. Riparian forest dominated by *Quercus robur* that 50 years ago was widely distributed is rarely seen nowadays in the Lalzi Bay. The other riparian forests dominated by species such as *Alnus glutinosa, Fraxinus angustifolia, Quercus ilex* and *Populus alba* can be found fragmentally.

The relatively modest density of the vegetation is due to human pressure exerted on the area; cementing, building embankments, and poplar fields have greatly changed the original landscape. Extremely common along the embankments is the false indigo (*Amorpha fruticosa*), a species native to North America and currently an alien plant of the Lalzi Bay area.

In more elevated areas the furthest from the water table is a presence of Mediterranean thermophile species, whose main species are sclerophyllous evergreens such as: the Mock Privet (*Phillyrea angustifolia*), the juniper (*Juniperus oxycedrus*) and the butcher's broom (*Ruscus aculeatus*).

This riparian forests includes several types:

Riparian mixed forests. - Mixed forests of *Quercus robur, Ulmus minor, Alnus glutinosa, Fraxinus angustifolia* are most distributed on recent alluvial deposits of the Lalzi Bay Forests. The soil may be well drained between inundations or remain wet liable to flooding during regular rising of water level. The undergrowth is well developed.

Riparian common alder forests. - Alnus glutinosa type of riparian forest which require constant soil moisture throughout the year is common in the Erzeni river banks. Tree layer is dominated by *Alnus glutinosa* and rarely accompanied by *Populus nigra, Salix alba and* herb layer by *Angelica sylvestris, Carex acutiformis, C. pendula, Cirsium oleraceum, Equisetum telmateia, Filipendula ulmaria, Lycopus europaeus, Rumex sanguineus, Ranunculus ficaria* and *Urtica dioica.*

Riparian willow formations. - The various species of willows, especially white willow (*Salix alba)* are particularly well represented along the Erzeni and Tarini rivers.

White Poplar galleries. - Another interesting association developed with high vitality in humidity and inundate environments in this belt is the one with White Poplar (*Populus alba)*. Forest physiognomy is determined by White Poplar and is spread following the Erzeni and Tarini rivers flows. In low humidity environment White Poplar are presented by weak development and very often can not upper the shrubs level.

Chaste tree thickets. - Vitex agnus-castus formations of temporary water courses and other humid sites within, mostly situated in the thermo-Mediterranean zone. They are frequent in Lalzi Bay area, particularly along the Erzeni river and other humid sites, where they can constitute dense thickets.

Tamarisk thickets. - Formations of *Tamarix* spp., including *Tamarix parviflora, Tamarix dalmatica, Tamarix hampeana,* associated with the Erzeni river banks, wet areas of fresh water and saline habitats of the Lalzi Bay area. In the Bishtaraka lagoon they are localized on the external margin of the salt-marshes. The relatively modest density of the vegetation is due to human pressure exerted on the area.

All types occur on heavy soils (generally rich in alluvial deposits) periodically inundated by the annual rise of the river level, but otherwise well-drained and aerated during low-water.

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REZIME

Priobalna vegetacija zaliva Lalzi (Albania)

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U radu su prikazani rezultati istraživanja specifičnog priobalnog staništa u Labaniji, zaliva Lazli. Zaliv Lazli zahvaljujući geografskoj poziciji, geologiji, hidrologiji, specifičnoj klimi ima veoma bogatu vegetaciju. Bogatstvo se ogleda velikim brojem sintaksona. Biljne zajednice klasifikovane su po principima Braun-Blanquet-a. U ovom radu analizirano je 19 asocijacija, uključenih u 16 sveza, koje spadaju u 10 redova i 9 klasa sa velikim specijskim diverzitetom.

Ključne reči: peščane dine, fitosociologija, dinamika vegetacije