The Albanian sea-coast: problems and perspectives

by

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The Albanian sea-coast borders the easternmost and southernmost part of the Adriatic sea, and the north-eastern part of the Ionian sea (Fig. 1). From a geographical point of view, it is located between 39° 40' and 41°53'-S. It represents a rather linear configuration, with few capes and bays and the sole principal island-Sazan. The Albanian coastal zone is limited to the North by the estuary of Buna river, and to the South by Stillo Cape, in front of Corfu Channel. It has a general length of 450 km of which 284 km belong to the Adriatic Sea, 12 km to Sazani Island and 154 km to the Ionian Sea.

The main capes are: Rodon, Bishti i Palles and Karaburun ; the main bays are: Drimi, Lalzi, Durresi, Vlora and Saranda (Fig. 2). Among the main lagoons, Lezha, Karavasta, Narta and Butrinti stand out. The main rivers are rivers, Buna, Drini, Mati, Ishmi, Erzeni, Shkumbini, Semani and Vjosa. The littoral – in particular on the Ionian sea – is densely populated. The principal coastal cities are Durresi, Vlora and Saranda, with a population not greater than 100 000 inhabitants each. They represent also the principal ports of the country.

GEO-MORPHOLOGICAL DATA

From a geo-morphological point of view, the Albanian coast is divided in two principal types (Fig. 3): the low coastal zone, chiefly depository, to the north from Buna estuary to Vlara beach, and an erosive zone to Stillo Cape to the south (see KABO *et al.*, 1990).

The Albanian Adriatic coast is marked by the presence of sandy beaches, sandy arcs and arrows, river deltas, rocky capes, silts, lagoons, submarine bars, and sandy coastal dunes. These features are tied chiefly with the synclinal structure which forms our coastal lowland.

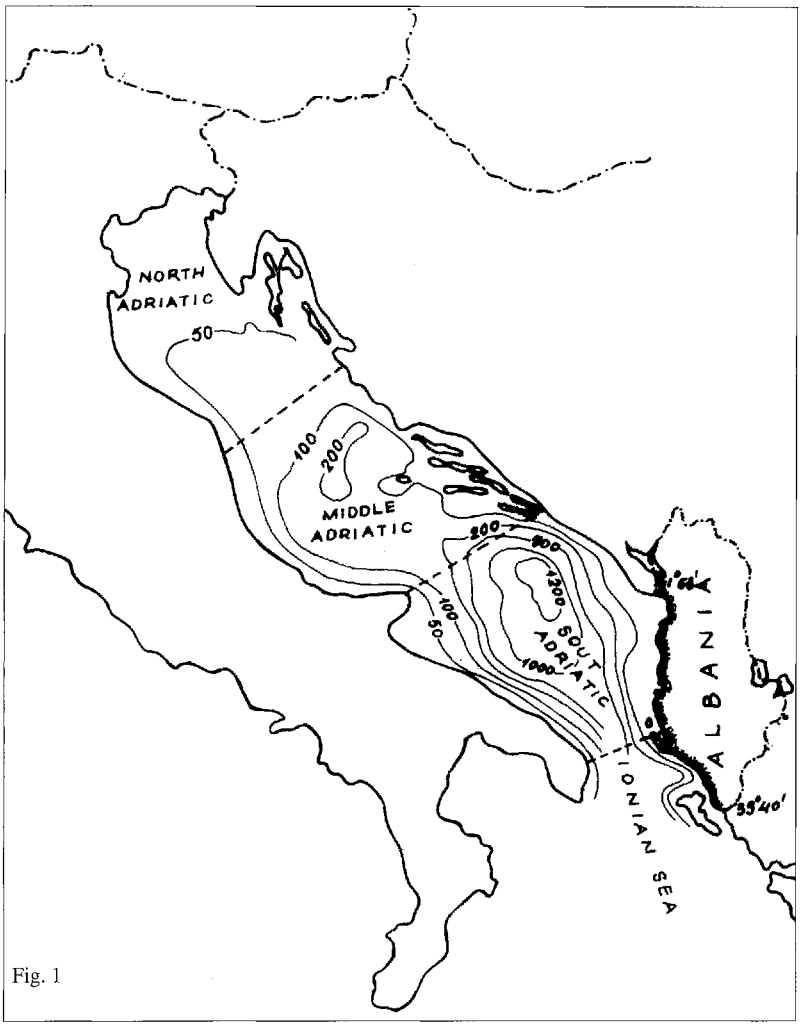
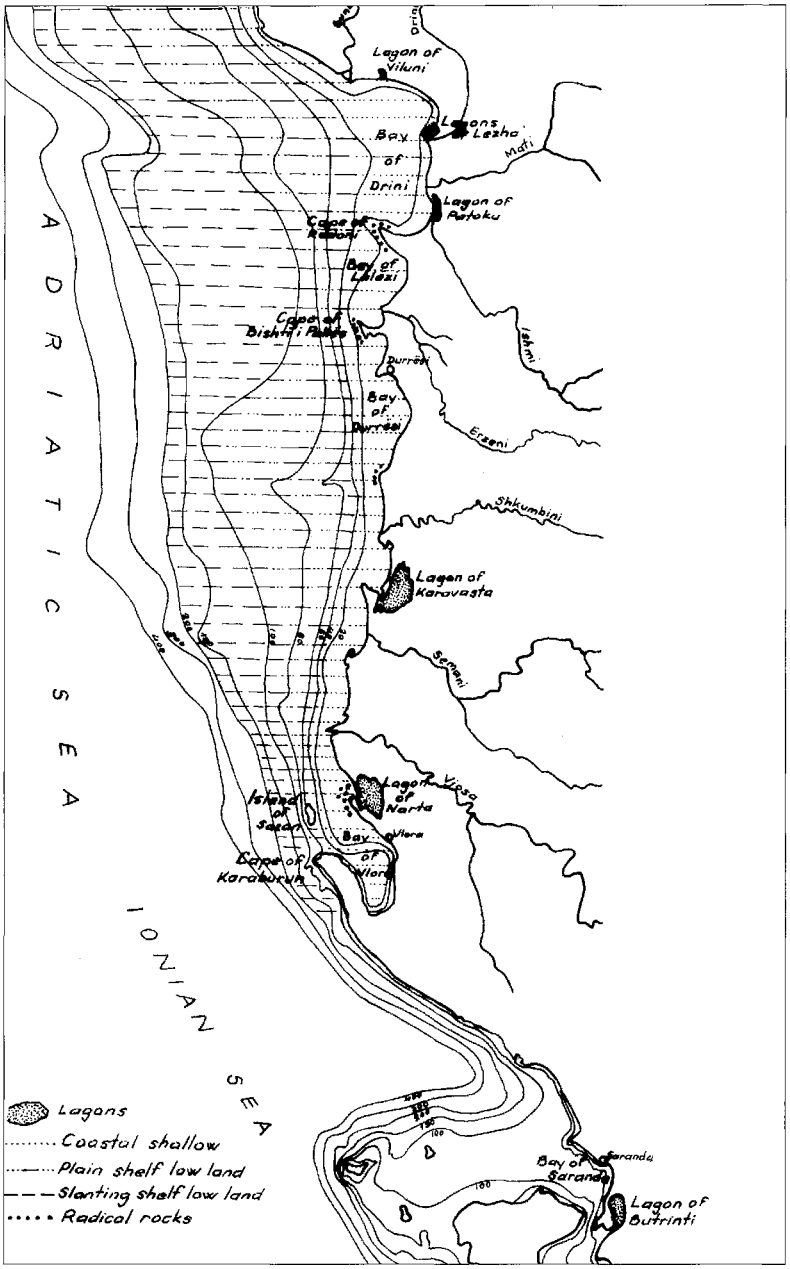


Fig. 1

The main features of the Albanian Ionian coast are the presence of cliffs, abysses, rocky capes and gravel beaches. These are linked with anticlinal structures, chiefly calcareous formations, and poor water flows.

The Low Adriatic coastal zone is distinguished also by a very powerful dynamics, with erosion in some sectors and accumulation in others. These two contradictory processes cause rapid changes on a large scale on the coastal line configuration, which are perceptible even within one generation. Curently, the ratio between accumulations and erosions is 2 : 1, but it tends to diminish as a result of constructing barriers in some rivers for hydro-energetic purposes or for hindering the erosion.

The above-mentioned phenomena are related to the activity of rivers, which are numerous along the littoral. They carry large quantities of water,



with an annual mean value of 1174 m^3/s and an annual volume of 37 022 km^3. They are characterized by a large annual amplitude of water flow (5.1 times in Drini and 13.7 times in Semani) (Table I) ; by water catchment

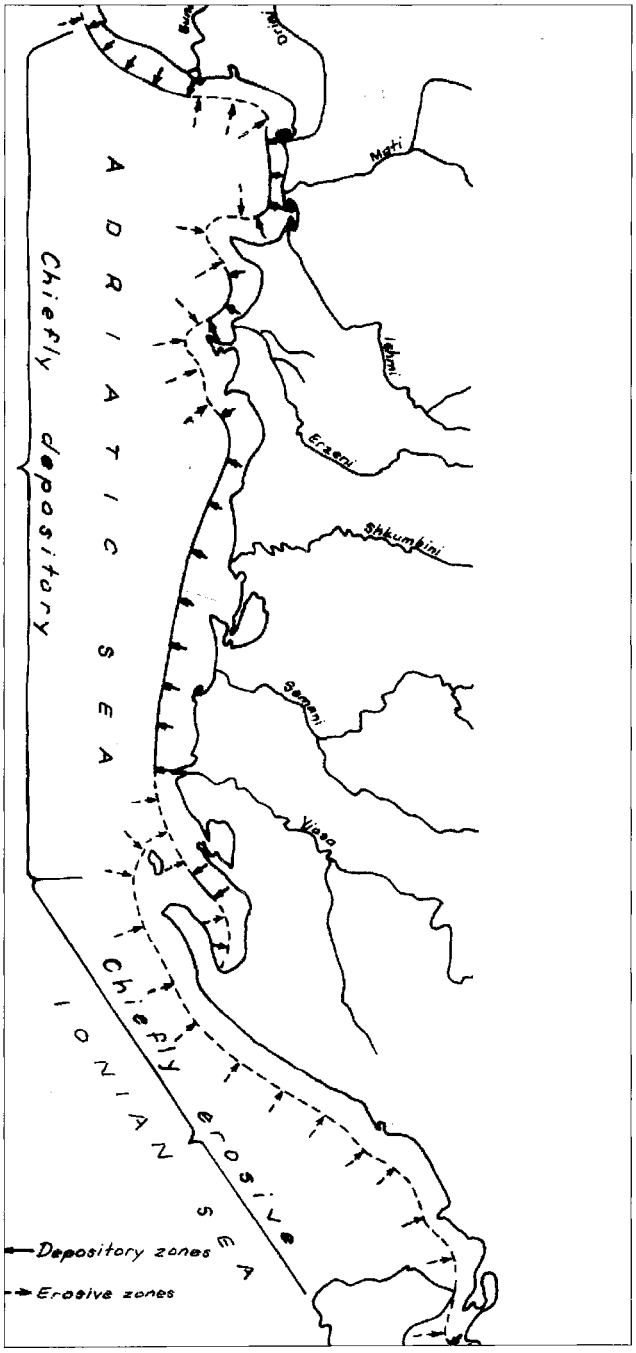


Fig. 3

basins located also outside the state border ; by very large amounts of solid unloadings (perennial mean value is 1462 kg/s, equal to a volume of 46 100 000 tons), and from time to time by change of river beds and outfalls (KABO *et al.*, 1990).

TABLE I.

Nr	*Rivers*	*Surface of water catchment basin (km²)*	*Average Flow m³/s*	*Volume km³*	*Ratio between maxi. & mini. values*	*Average solid kg/s*	*alluvial volume l'₀ /t*
1	BUNA	5187	320	10092	5,3		
2	DRINI	14173	352	11100	5,1	438	13825
3	MATI	2441	103	3248	9,3	60	2021
4	ISHMI	673	20,9	659	5,9	45,3	2020
5	ERZENI	760	18,1	571	11,2	102	3180
6	SHKUMBINI	2444	61,5	1940	13,2	187	5800
7	SEMANI	5649	95,7	3010	13,7	418	13200
8	VJOSA	6706	195	6150	7,2	212	6710
9	TOTAL	38033	1174	37022	-	1462	46756

Albanian rivers are characterized by an average mineralization which ranges from 162 to 461 mg/liter, and is mainly composed of bicarbonate ions. Water temperatures are the highest during July-August (13-25°C), and the lowest during January-February (0-4° C).

The presence of lagoons and loops is another characteristic element of the coastal morphology. The main lagoons have a relatively small depth (1-1,5 m) and a continuous communication with the sea through one or more connective channels. Their main morphometric, physical and chemical characteristics are given in Table II.

TABLE II

Nr	*Name*	*District*	*Geographical position*		*Surface (ha)*	*Maximal Depth (m)*	*Water exchange m³/s*	*Temp. (°c)*		*Salinity*		*O₂*		*pH*	
			North	*East*				*min.*	*max.*	*min.*	*max.*	*min.*	*max.*	*min.*	*max.*
1	MERXHANI	LEZHE	41°47'	19°35'	77	1.5	-	-	-	-	-	-	-	-	-
2	CEKA	LEZHE	41°47'	19°35'	235	1.5	-	-	-	-	-	-	-	-	-
3	KARAVASTA	LUSHNJE	40°55'	19°32'	4,330	1.5	36	3	28	18.4	576.0	5.9	12.75	7.8	9.1
4	NARTA	VLORE	40°32'	19°28'	4,180	0.8	5	1	35	20.0	78.5	24.0	13.90	8.9	8.5

The formation and the evolution of lagoons is connected with the great amount of solid unloadings of rivers and with the dynamic processes of the sea.

Arrows, stripes and arcs of sand are very extended elements of our Adriatic sea-coast. As they extend more and more into the sea, they gradually transform into loops and later into lagoons. All lagoons of the Albanian Adriatic coast are believed to form in this way. The process of lagoons' formation is very active in present days.

Another characteristic element of the littoral is the presence in some sectors of the Adriatic coast of sandy dunes, 1-5 meters in height. At a certain distance, parallel to them, one finds old dunes covered by a dense vegetation and sometimes by forests.

Beach erosion is another characteristic feature of coastal dynamics: it is tied with the general rising of the Mediterranean sea level, with changes of river outfalls, with the decrease of solid unloadings from rivers, with the exploitation of underground waters, etc.

The Ionian coastal zone has a limited dynamics. Abrasive and tectonic processes play the principal role in the formation of the coast, accounting for the presence of cliffs which fall vertically into sea. Erosion rate is usually less than a few mm a year. The steadiness of the coast is due to the presence of firm calcareous rocks and to the absence of large rivers. In some places, such as Jonufra (Vlora Bay) and Piqeras-Lukove, firm, calcareous formations alternate with terrigenous ones. On rocky calcareous shores, one finds also phenomena of sea karst, with the active formation of cavities, holes and karstic-abrasive caves.

Dynamic processes on the Ionian shore are weak and limited. One finds in places (particularly in the south of Karaburuni Peninsula) gravel beaches in the form of long and narrow stripes, and little bays, formed at the outfall of mountainous streamlets.

The morphology of the Ionian coast presents evidence of an old abrasive activity, linked with sea level oscillations during the quaternary, in the form of sea-terraces, located at various heights above sea level, as is observed in Uji i Ftohet, Vlora, Vuno-Iljaz zone, Borsh and Lukove-Qefal.

The coastal zone south of Saranda is thought to be of immersion origin, as a consequence of sinking. The presence of some little islands between Corfu and the Continent, among them the little island of Ksamil ; the absence of sea-coast terraces and the almost complete absence of cliffs, support this hypothesis. This opinion is also confirmed by archaeological data: many ancient objects of the cities of Butrinti and Saranda are dipped today deeply in the sea (KADO *et al.*, 1990).

The southernmost part on the Ionian Sea, known by the name of Butrinti Bay, is typically accumulative ; it is formed by solid unloadings of the rivers Pavlla, Bistrica and Kalasa. One finds nearby Butrinti lagoon which was transformed into a lagoon after the year 1959, with the deviation of Bistrica river, is found nearby. Morphological, physical and chemical characteristics of this lagoon are given in Table III.

TABLE III

Nr	*Name*	*District*	*Geographical position*		*Surface (ha)*	*Maximal Depth (m)*	*Water exchange m³/s*	*Temp. (°c)*		*Salinity*		*O₂*		*pH*	
			North	*East*				*min.*	*max.*	*min.*	*max.*	*min.*	*max.*	*min.*	*max.*
1	BUTRINTI	SARANDE	39°47'	20°2'	1630	21.7	62-74	11.9	27*	13.0	26.0*	7.2	10.2*	7.8	8.7*
								15.5	16.0	13.0	36.0				

GEOLOGICAL AND PEDOLOGICAL CONSIDERATIONS

The geological division of the Albanian shore corresponds to the geomorphological one.

- On the Adriatic are found characteristic zones, as swamp leavings, coastal sands and radical rocks (KONOMI N., 1991).

Swamp leavings are located mainly between the river outfalls of Seman

and Shkumbini, in Lalzi bay, and near the mouth of Mati and Drini rivers. They are represented by silts, sapropelic coal and turfs, saturated with water.

Zones of coastal sands are located in Velipoja, Shengjin, Lalzi bay, Dajlami bridge, Karpen, near the outfalls of Shkumbini, Seman, Vjosa rivers and from Zvernec to Vlora. The thickness of these sands reaches 1.50 m. The level of underground waters is very near the surface.

Zones of radical rocks are of various types. To the north one finds calcareous rocks of the upper Cretaceous, further south sandy clay from the Pliocene and Miocene.

On the Ionian sea are found zones of carbonate, brittle and friable rocks (KONOMI N., 1991).

Refering to the pedological chart of Albania (Fig. 4), one notices that grey-brown lands and grey-brown meadow lands predominate on the coast. Along river beds and their outfalls are located alluvial lands, while lands reclaimed by the draining of old swamps are turfy.

One finds also, particularly on the Adriatic, some zones with salty lands.

CONSIDERATIONS ON COASTAL VEGETATION

Coastal vegetation in Albania is regulated by climatic, pedological, historic-evolutive and anthropogenic factors. The climate is sub-tropical mediterranean, while the geological-pedological composition is diverse. Influences of human activity are evident: deforestations of entire areas, reclamations in marshes and swamps, artificial afforestations and planting of cultivated plants and trees. Natural vegetation is represented by grassy plants, mediterranean bush cover and various forests.

On sandy coasts and dunes, the vegetation belongs to the Ammophilatea and is dominated by the species *Ammophilia arenaria* and *Agropyron junceum*. In zones subjected to human interventions (beaches, constructions, sand taking etc...), they have disapeared or been replaced by other species.

On sandy lands a halophylic vegetation predominates, composed of succulent species belonging to the Salicorniaes class.

On rocky shores, particularly on the Ionian Sea, species of *Limonium* and *Crithmum genus*, are dominant along a narrow strip.

Mediterranean bush species belong to the class Quercetea and are dominated by two alliances: *Quercion ilicis* and *Oleo ceratonion*. The vegetation associated with *Quercion ilicis* is is located on calcereous and brittle rocks, particularly in zones protected from the wind, while *Oleo ceratonion* is is located on dry rocky places, exposed to sea winds (Fig. 5).

In dry rocky coasts, particularly on the Ionian side, one finds *Quercus coccifera*, association which represents a degradation phase of the holm-oak *Quercus ilex* forest. The vegetation of *Quercetea pubescentis* oak forest in Ishmi, Durres forms a forest of great economical importance.

On the Albanian coast are cultivated exotic species, such as *Eucaliptus*, *Cupressus*, *Robinia,* etc., but the principal component of the vegetation landscape is formed by mediterranean coniferous forests, where *Pinus halepensis* predominates. Artificial afforestation currently covers 4770 hectares. There are some old forests among them (as in Divjaka) but are also some recent ones that are developing in Velipoja, Golem, Vlora etc...

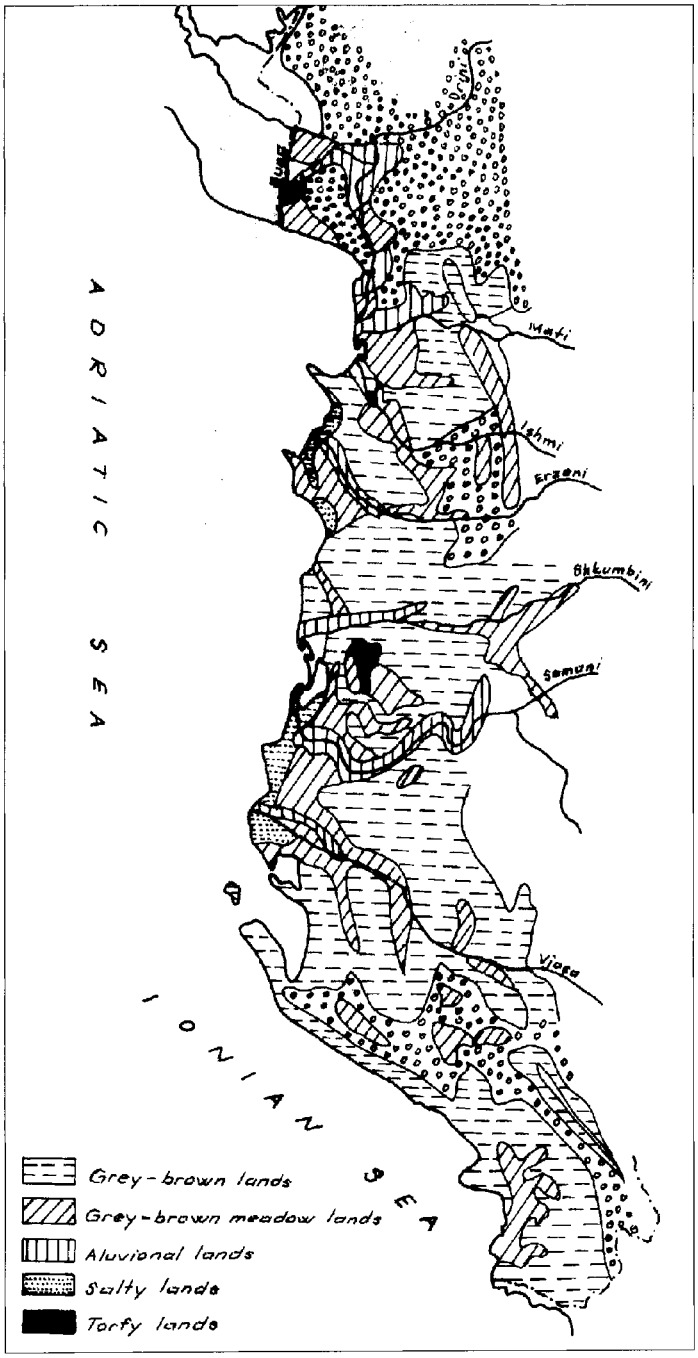
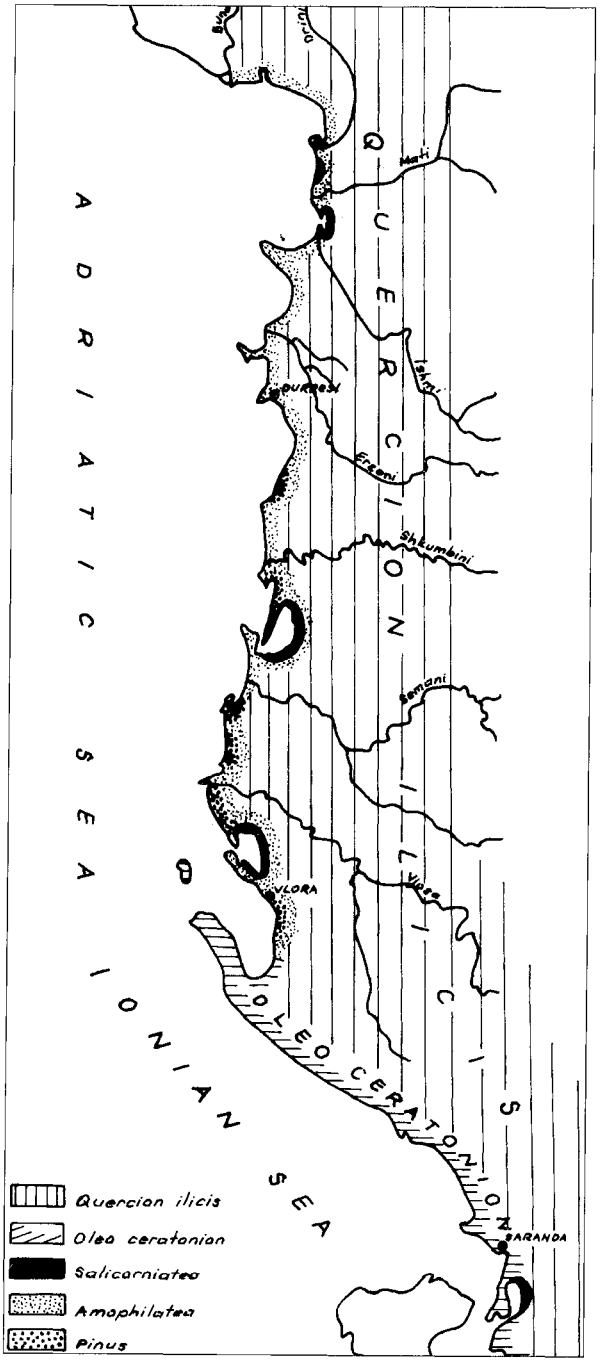


Fig. 4

Fig. 5


Mati
Ishmi
Erzeni
Shkumbini
Semani
Vjose
VLORA
SARANDA
ADRIATIC SEA
IONIAN SEA
QUERCETALIA ILICIS
OLEO CERATONION
Quercion ilicis
Oleo ceratonion
Salicarniatea
Amophilatea
Pinus

On the Ionian coast fruit trees, olives, agrumes are cultivated, forming real plantation in certain areas.

CONSIDERATIONS ON SEA-BOTTOM

The submarine topography is related of course to the external geo-morphology of the coast (see Fig. 2). Thus, isobaths in the Adriatic zone are located away from the coastal line, but are closer to it on the Ionian side. In the Adriatic shelf, three stripes are generally differentiated (PAPA, 1985):

a) Coastal shallow low land, with an accumulation of sandy and sandy-aleuristic sediments from the pleistocene, extending to 50 m in depth.

b) Plain shelf low land, where sediments are accumulated as in coastal shallow from the activity of waves, with a predominance of aleuristic elements, extending to 100 m in depth,

c) Slanting shelf low land, with aleuristic and clay-aleuristic sediments, extending from 100 m to 200 m in depth.

HYDROLOGICAL CONSIDERATIONS

The hydrological regime in the vicinity of Albanian shores is rather complex, dominated by the influence of water exchange through Otranto Channel (Fig. 6). On the surface warm streams enter the Adriatic from the Ionian Sea, with cold currents to the east flowing south along the Appenine Peninsula. This explains why water temperature along our coast is higher than that on the Eastern coast of Italy.

Deeper and cold water exit the Adriatic through Otranto Channel, with a velocity ranging from 0.30 m/s to 1.1 m/s. Tides in our coasts have a small amplitude, averaging 30-40 cm. The highest levels are observed during November-December, the lowest during July-August. These levels are influenced by the intensity, direction and velocity of the winds. The highest waves observed in our bays are about 3.5 m high, compared to 7 to 8 m in the open sea, where their maximal length is about 55 m (KABO M., PANO N. *et al.*, 1990).

The mean surface temperature of coastal waters is 19.2°C in Saranda, 19°C in Vlora, 17.8°C in Durres and 17.7°C in Shengjin ; the maximal observed temperature is 29.6°C, while the minimal is 7.7°C. The salinity is nearly the same as that of the Mediterranean, rangimg from 30‰ to 39.1‰ with an average of 38‰.

BIOLOGICAL CONSIDERATIONS

The Albanian littoral presents a particular interest from a bio-geographical point of view, as it is located near or on the boundaries of three bio-geographical subdivisions: Eastern Mediterranean, Western Mediterranean and Adriatic. Table IV shows the biogeographic diversity of three groups of macrobenthos (algae, echinoderms and crustacean decapoda), on the littoral of Albania.

Macro-algae are found mostly on hard substrata. There, in the mediolittoral, one finds *Bangia fuscopurpurea*, *Porphyra leucosticta*, *Lithophyllum tortuosum*, *Fucus virsoides*, *Nemalion helminthoides*; in the infralittoral pre-

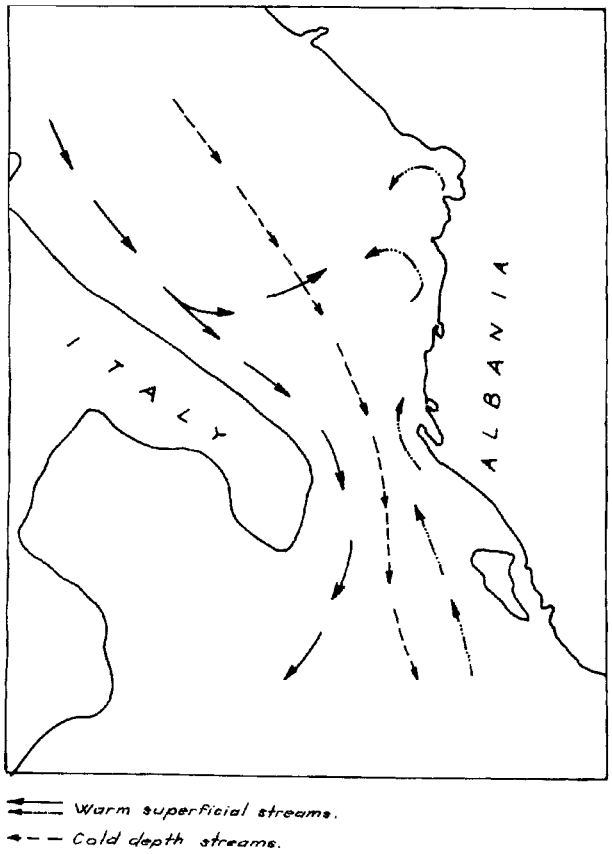


Fig. 6

dominate species of the genus *Cystoseira, Lithophyllum incrustans* and *Tenarea undulosa*. On soft substrata, in the infralittoral predominate the phanerogams *Posidonia oceanica* (particularly in the Adriatic) and *Cymodocea nodosa*, associated with *Cladophora prolifera* (Ionian sea). In certain zones, protected from wave action, one observes near ports and urban centers (Durres, Shengjin, Vlore, Saranda etc...) an algal development dominated by *Ulva rigida* and species of *Enteromorpha* (GJIKNURI, KHASTA and VASO, 1991).

The discovery of boreal species on the Adriatic side, as for example *Fucus virsoides*, represents the southern boundary of their known extension. By contrast thermophylic species such as the red alga *Tenarea undulosa* (*Rhodophycae*) and the phanerogam *Halophila stipulacea* reach their northern limit on our shores. The latter species, along with *Acetabularia parvula,* originate from the Indian Ocean, and entered the eastern Mediterranean Basin via the Suez Canal.

From a faunistic point of view, the thermophylic species *Ophidiaster ophidianus* (Asteroidea), *Holothuria helleri* (Holothuroidea) and *Charonia seguenzae* (Gastropoda) find also their northern boundary in the Ionian sea.

TABLE IV

Nr	Biographic elements	Algae	Echinoderms	Crustacea Decapoda
1	ATLANTIC-MEDITERRANEAN	54%	65%	62%
2	ENDEMIC-MEDITERRANEAN	22%	13%	12%
3	TERMOPHYLES	8%	13%	12%
4	COSMOPOLITES	10%	2%	4%
5	BOREAL	2%	7%	9%

Up to 251 species of fish have been identified so far in albanian coastal waters. The recorded presence of *Lavarus imperialis, Ranzania laevis, Coelorhinchus coelorhinchus, Lebistes reticulatus*, etc., (RAKA N. *et al.*, 1991) completes their known extension in the Mediterranean.

Annual fish catches along the Albanian coast amount to approximately 6000 tons. The main species of fish caught in our waters are given in Table V (the data refer to the year 1989):

TABLE V

Nr	Kinds of fish	Production in t	%
1	*Mullus*	124.1	2.0
2	*M. merluccius*	104.9	1.7
3	*T. trachurus*	151.8	2.5
4	Clupeidae	2532.2	42.0
5	*B. boops*	583.2	9.6
6	Sparidae	71.5	1.2
7	*Spicara*	114.0	1.9
8	Rajidae	42.0	0.6
9	Others	2438.2	40.7

Coastal and lagunar phytoplankton is composed mainly of diatoms and peridinians. The dominant species belong to the genera *Chaetoceros, Nitzschia, Cyclotella, Thalassionema, Rizosolenia*, (diatoms) and *Prorocentrum, Ceratium, Peridinium*, (peridinians). From a quantitative point of view, the phytoplancton is relatively abundant, particularly in lagoons, with a marked seasonal dynamics (MIHO A., 1992).

PERSPECTIVES

Overall, the Albanian littoral is relatively free of degradation. For instance, up to the present, there has been no record of algal bloom. There are, however, some problems related to anthropogenic activity on the coast. Thus technological residues are discharged into the sea in Vlora Bay, Drini Bay, and into Semani and Shkrumbini outfalls. In these two rivers one observes high values of nitrite, ammonia, nitrates, oil, other organics, pesticides, etc... Vlora Bay receives technological residues such as PVCs. Drini Bay is a discharge for the paper mill industry, the mouth of Shkumbini river for the residues of Elbasan Metallurgical Combinate, and Semani river estuary for the residues of a nitrogen fertilizers factory and of an oil basin. In the vicinity of ports and coastal cities, pollution of urban character is also apparent. In addition to land-based coastal pollution, other zones of the Mediterranean and the Adriatic with dense maritime traffic – especially oil tankers – contribute to the pollution of albanian waters.

During decades, massive volumes of sand were taken along the coast for construction purposes, as in Vlora, Durresi, Shengjini, Semani beaches, causing the flattening of entire coastal dunes ecosystems.

The ecological equilibrium of the Albanian littoral also suffered from forced reclamations, often carried out without any scientific criteria at all. This caused the disappearance of some swamps and marshes, and damaged coastal lagoons, by changing their limnological regime.

Other negative factors observed along the coast include the massive use of dynamite for seismological research, its illegal use for fishing, the non-respect of fishing regulations, the exploitation of bivalve molluscs without scientific criteria and, lastly, the use of motor-boats from neighbour countries for fishing. All these factors are certainly the cause for the diminution of valuable fish and crustaceans such as *Paeneus kerathurus*.

Of particular ecological and economical interest for Albania are the coastal lagoons, which cover 15 000 hectares, and constitute important centers for fishing. Their annual production reaches about 800 tons, as shown in Table VI.

TABLE VI

Nr	*Main lagoons*	*SPECIES (q)*													
		Annual production (t)	*Mugilidae*	*Anguilla anguilla*	*Dicentrachus labrax*	*Gobius bucchichi*	*Sparus aurata*	*Cyprinus carpi*	*Pagellus erithrinus*	*Atherina hepsetus*	*Aphanius fasciatus*	*Solea sp.*	*Lythognatus mormyru*	*Umbrina cirrosa*	*Carcinus aestuarii*
1	KARAVASTA	264.1	532	459	177	151	112	-	-	566	4	-	-	-	640
2	NARTA	199.7	148	204	68	25	45	-	-	551	4	1	-	-	351
3	MERXHANI	29.6	180	24	30	-	6	-	11	-	27	2	-	2	14
4	CEKA	70.4	85	174	26	-	-	-	1	-	3	1	-	-	414
5	BUTRINTI	95.8	658	120	4	-	112	48	-	-	3	2	11	-	-
	TOTAL	639.6	1603	981	305	176	275	48	12	1,117	41	6	11	2	2019

In Narta lagoon, about 1/3 of the surface is devoted to the production of salt, which amounts to 120 000 tons a year.

In recent years, the deviation of Bistrica river made it possible to cultivate on a large scale *Mytilus galloprovincialis* in Butrinti lagoon: its production reaches 4500 tons. This waterbody is now threatened by eutrophication and registers from time to time biological disorders, associated with the massive death of mollusks.

Lagoons represent important nesting places for birds, which belong mainly to the classes Ardeidae, Phalacrocoridae, Pelecanidae. The Karavasta lagoon has always drawn the attention of foreign researchers for hosting about 50 couples of *Pelecanus crispus*. In the vicinity of lagoons hunting reserves and national parks are located. (Fig. 7).

In future years, the Albanian coast is likely to become an object for increasing and wider intervention. In 1991 on the entire Albanian coastal shelf, research for oil and gas was started by five foreign societies. Their activity will certainly generate positive economical returns for our country, but it carries also certain dangers for our environment.

The Albanian coast has enormous touristic potential. Its hotel capacity is planned to increase from 4000 beds in 1990 to 35 000 in 1996, in order to

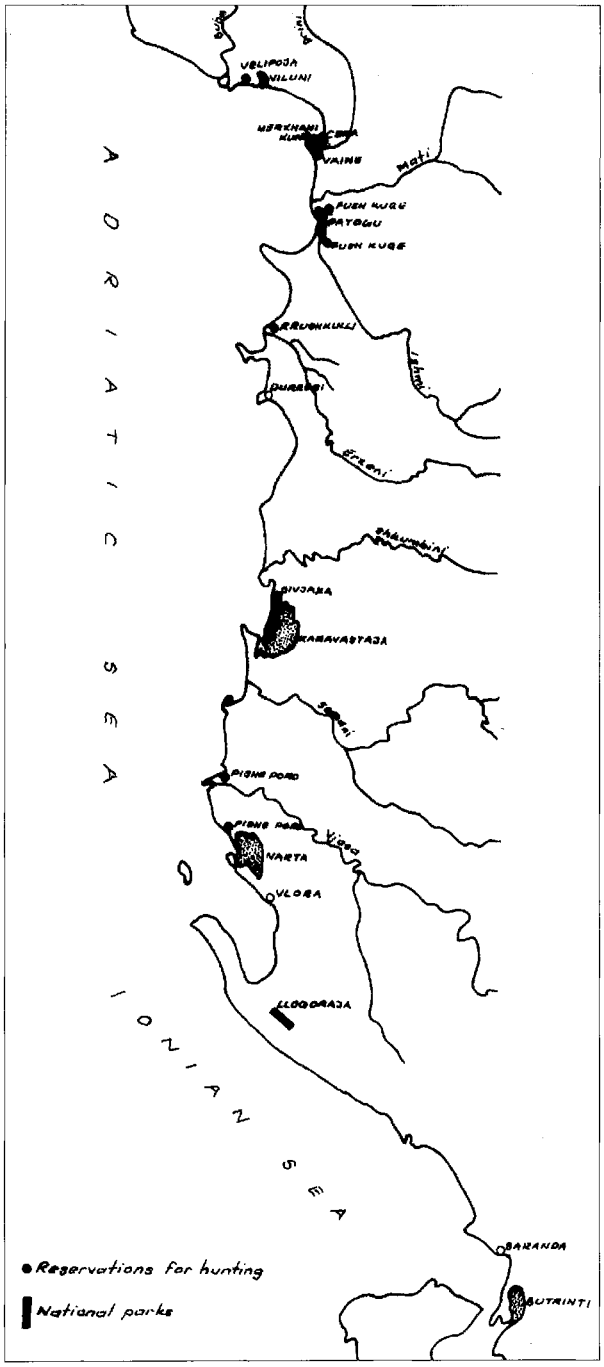


Fig. 7

reach 100 000 towards the year 2 000. Such a growth requires a well-planned, integrated, coastal development. It relies on the active collaboration of international institutions, such as the World Bank, and the European Bank for Reconstruction and Development, along with albanian experts.

It is expected that in the future, the Albanian coast will represent an important port and communication center, offering easy and direct connections with Balkanic and European countries.

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