



# Western Islands of the Zadar Archipelago (South Croatia) – Geographical Problems of the Coastal Development and Engineering

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## Abstract

The paper deals with some recent problems of the western part of the Zadar Archipelago in the Croatian Adriatic. The islands belonging to the group are Silba, Olib, Premuda, Molat and Ist (with Škarda island). They pertain to small Croatian islands, with an area of 85,9 km<sup>2</sup>, and only 925 inhabitants in 7 settlements (1991). The geographical problems of recent development have been connected with the isolation and dispersion of the zone, singularity of each island, poor natural resources (carbonate sediments and soils, lack of water, dry summers etc.), and sociogeographical and economical decrease (depopulation, closing of industries, fisheries, schools etc.). In the 18<sup>th</sup> and 19<sup>th</sup> centuries this zone was much more developed and well known for its maritime activities (fishing and navigation). The climax of inhabitation was at the end of the 19<sup>th</sup> and the beginning of the 20<sup>th</sup> c., and was accompanied by a specific balance between density of population and natural possibilities of the development. The result was the degradation of the natural holm oak forests and maquis, as well as a highly expressed agricultural expansion to the last piece of the arable and pasture land.

Depopulation in the 20<sup>th</sup> c., which has been the result of the expressed emigration and the collapse of sailing on these islands, resulted finally in almost no natality, a high mortality rate and prevaluation of elderly population. It led to some kind of revitalization of the natural forests and maquis, and to certain attempts to proclaim some of the islands nature reserves (Silba, Olib, Grebeni). The problem is how to redevelop these islands and include them in the general process of growth along the Croatian coast. Some planning documents (Spatial Plan of the Zadar Commune, 1978–2000, Zadar, 1978; Spatial Plan of the City of Zadar, in the process of compilation), have been trying to define the basis of revitalization, but unsuccessfully so far.

## Introduction

The main purpose of the paper is closely connected with the main topic of the conference Littoral, which is dedicated to the responsible coastal zone management as the challenge of the 21<sup>st</sup> century. Discussing the problems of the small group of islands in the Zadar archipelago, the authors try to explain the basis of the recent problems concerning their development. Also the aim of the article is to comment some spatial planning documents and the possibilities of the management and engineering of these islands in the future.

So far there have been no papers on the subject. But some papers, written by different authors and from different points of view, have considered this area. Some geographic papers study specific islands such as Silba [1, 2], Molat [3], Premuda [4], or wide zone of Zadar islands including these islands too [5]. Among historical works few ones written on Silba [6, 7] and Olib [7] should be mentioned. Maritime subject matter was studied on Silba [8], Olib [9], Silba and Premuda [10]. The demography of the Zadar archipelago was discussed [11, 12, 13], as well as its toponymy [14]. Geologic study on Silba [15], and vegetation studies on Silba [16] and Molat [17] should be mentioned too.

Table 1 – Main geographic data on Western Islands of the Zadar Archipelago

ISLAND	Surface km <sup>2</sup>	length (max) km	width (max) km	coast line km	indentedness coeff.	height m
Silba	15.00	8.30	3.1	25.04	1.82	83
Olib	26.10	9.45	4.6	34.50	1.90	74
Premuda	8.61	8.86	1.6	23.60	2.27	88
Molat	22.80	11.20	3.1	50.55	2.98	148
Ist	9.65	4.60	3.2	22.31	2.02	175
Škarda	3.74	3.70	1.7	12.27	1.79	102

Resources: Geographical map of Republic of Croatia, Zagreb, 1992, and Special military map, scale 1: 50.000, VGI, VGI, Beograd, 1969–1972., Sheets Silba 1, Silba 2 and Silba 3.

## Natural Features of the Zone

### Geology and geomorphology

Islands Silba, Olib, Premuda, Molat, Ist and Škarda, as well as all other Croatian islands (with exception of eruptive Brusnik and Jabuka) are built of Cretaceous and younger sediments deposited in a form of carbonate platform. Prevailing sedimentary rock is limestone with less frequently dolomite forming lenses, intercalations, zones and alternations with limestone. Only the sequence of Lower Cretaceous sediments has dolomite as dominant sort of rock. These deposits continuously pass upward into Upper Cretaceous deposits which, according to marine macrofauna fossils, can be divided into Cenomanian – Tournonian ( $K_2^{1,2}$ ) Chondrodontian limestone, and Tournonian – Senonian ( $K_2^{2,3}$ ) or Senonian ( $K_2^3$ ) rudist limestone. Both of those well stratified Cretaceous deposits can be found on all of these observed islands. The Lower and Middle Eocene foraminiferal limestone which has been deposited transgressively over Cretaceous, and contains large foraminiferae (Milliolidae, Alveolinae and Nummulites), appears on Silba, Olib, Molat and Ist filling the syncline holes. The prevalence of carbonate sediments causes absence of respectable surfaces of fertile soils on these islands.

Peaceful sedimentation in shallow and warm sea was disturbed by intensive tectonic movements at least three times from late Mesozoic till nowadays. The beginning of disintegration of the Adriatic Carbonate Platform was in Late Cretaceous and Paleocene times when Laramidian orogeny happened. The formation of present structures started in Eocene with intensive structural activity related to Alpine orogeny, and finally, Pyrenean orogenic phase in Late Eocene – Oligocene time folded older Cretaceous deposits together with younger Paleogene sediments. The result of all these processes was forming of, so called, Dalmatian type of coast – coast with parallel spreading of coastline, hinterland mountain ranges and island chains. The last impact in this relief forming is due to inundation caused by last sea level rising by the end of

Würm glacial some 10000 years ago. Melted ice and thermal expansion of the sea, raised the sea level for c 100 meters and, together with Quaternary slow epirogenetic motions, separated islands from the mainland. Today's lines of islands are tops of former mountain ranges, and parallel valleys became narrow channels and inlets. The general trend of geological structures is NW-SE («Dinaric direction»). Owing to an intensive tectonic activity with huge geodynamic pressure, geological structures, specially folds, are rather deranged – asymmetrical, reduced, secondary folded, etc. Anticline limbs of Ist and Molat islands are characterized by the second order folds (folds which are smaller than the first order fold and whose enveloping surface is folded by a first order fold), Olib and Škarda anticlines have secondary folded tops, Premuda's and Molat's layers are steep up to 85° (somewhere even vertical), plunging of syncline axis is obvious on Silba and so on. The faults of Dinaric trend are mostly reversed and very long, and the transversal ones are almost always normal and much shorter. Such a tectonic situation and geological evolution manifested with plenty of interesting and attractive coastal forms (beaches, cliffs, islets, capes, bays, etc.), which could be or even are exploited in tourism and recreation.

The disturbed and fractured well soluble carbonate basis generated secondary porosity, continuing disintegration and decomposition of rock by near-surface mechanical and chemical processes. The result is karst – terrain with distinctive landforms and predominant underground water circulation in relation to the surface circulation. Less permeable dolomite or beds of impermeable clay as well as flysch (marls, sandstone and detrital limestone) in form of barrier, would be able to accumulate and lead this water to the surface. Such a situation is common in Croatian karst, even on some islands, but not on these small ones. Infrequent lenses of underground water on islands are often useless because of diffuse mixing with the seawater. Such geological conditions on these islands do not offer many opportunities for their inhabitants. The product of limestone weathering is terra rosa – red soil generated from limestone dissolution with releasing clay

and iron compounds and red coloured from the conversion of hydrated ferric oxides to hematite. Such a soil and lack of water during the hot summers allow just a poor agriculture (pasture – ground, olive – grove, small vineyards). Concerning the mineral treasure, there is nothing but the limestone that can be used as a building material and for lime production (medieval quarries on Premuda, Škarda, Molat, Olib, Silba). On the other hand, Karst environment, specially coastal and submarine one is ideal for fishery (catching and rearing), recreation, nautic and diving tourism.

The indentedness coefficient of the Western islands of the Zadar Archipelago is well expressed (from 1.79 to 2.98). It is the consequence of the continuous exogenous forming of the relief in carbonate stones with prevailing processes of abrasion and fluvio-carstic modeling. Molat and Premuda, with plenty of bays are mostly indented, while Škarda and Silba are the least indented. Plenty of islets (Tun veli, Vela Tramerka, Planik, Strošnjak, Grebeni, Morovnik, etc.) and rocks contribute to general articulation of the morphology, making the navigation harder, but the recreation sailing much more interesting especially in the zone Premuda – Škarda – Ist – Molat.

Southern islands are higher than others, and their peaks dominate the group. The highest island is Ist (Straža, 175 m, Vrh gore 163 m), follow: Molat (Lokardenik 148 m, Knežak, 141 m, Bonaster 127 m) and Škarda (Čimbel, 102 m), which are also well expressed in local hypsography. Silba and Olib are much lower. Premuda and Silba are characterized by only one relief crest, and on Ist and Molat there are two crests rising almost parallel. Olib does not have any expressed relief rising, but is dispersed in isolated hills (so called »glavice«) divided by dry valleys or lower ground forms. Vertical articulation of the relief is consequently, more expressed on the Ist, Molat and Škarda islands, and much lower on Silba, Olib and Premuda. That is why the slopes in the first group are steeper, which causes more intensive exogenous modeling in the Karst (erosion, corrosion, dredging, abrasion, etc.).

Dry valleys, formed in Pleistocene in wetter climatic conditions, when erosion, dredging, corrosion and torrential activity were very strong, are the prevailing forms in the local morphology. In the limestone, many Karst microexogenous forms as kamenitzas, rock rills, grikes, limestone cracks, are well expressed as the result of corrosion. In more dolomite formations, denudation mechanic processes, which cause the development of sandy zones, are more prominent. Besides dry valleys, there are many Karst dolinas (sinkholes), especially on the Molat, Premuda and Olib islands. Small Karst fields, poljes, can be recognized on Molat (Zapuntelsko polje), Premuda (Poletić) and Silba.

Sea shores are mostly stony, but on the bay ends or their sides there are sometimes pebble deposits. Along

the shore line there is, more or less continuous, a few meters wide girdle of stony cracks and rock rills, as the result of the abrasive process in limestone-dolomite complex. The SW shores of Premuda, Škarda, Ist and Molat are steeper because of being exposed to the open Adriatic Sea wave activity, and because of being tectonically predisposed (Premuda). Very interesting morphologic forms are seen on Grebeni islets. Here, a range of denuded stony islets and rocks comes out of the sea up to 40–50 m high, and disappears steeply and suddenly down into the 50–60 m deep sea.

The submarine relief is characterized by relatively big depths in Silba Channel, as well as in NW part of the Vir Sea. Near the SW shores of Škarda, Ist and Molat there are many small banks. The bottom along the islands shores is mostly stony in relation to the sea wave threshing but, in the distance, sandy and muddy bottom appears too, which is the result of relatively intensive streams in sea channels and sea gates of the island group.

A very important element of the local landscape are numerous vertical or parallel stony walls which were built to divide land properties as well as to prevent slope denudation processes. That is the way the local inhabitants for centuries saved and kept valuable fertile soil from dredging and erosion. But, after the process of deagrarisation started and the islands depopulated, many walls have been neglected and very often demolished. The decay of the anthropogenic relief, contributes to the visual degradation of the specific cultural landscape of the western islands of the Zadar archipelago.

## Climate and vegetation

The main climatic features of the western islands of the Zadar archipelago express Mediterranean »olive climate« (Csa climate according to Köppen's climatic classification). Very dry summers, with refreshing effects of NW »maestral« and rainy, mild winters, with moderate winds (NE – bora, SE – sirocco), are the main characteristics of this climate.

Insolation, global radiation and cloudiness, being in correlation and influencing each other, express high values. In July there are 343 hours of sunshine (the day is long and the Azores anticyclone maximum prevails), in December 105 hours (the day is short and there is often cyclone activity from Iceland or Genoa depression). Mean value of cloudiness is about 4,4/10 per annum (in January 5,6/10 and in July 2,6/10)

Mean annual air temperatures are about 15 °C (Silba 15,4 °C, Bonaster 14,8 °C), lower than on southern Croatian islands (Hvar and Palagruža 16,3 °C), and similar or a bit higher than on northern ones (M. Lošinj 15,1 °C). Amplitudes are about 17 °C. The lowest

temperatures are in February (6,9 °C – 7,5 °C), and the highest are in July (23,0–24,5 °C). The Table 2 gives monthly average temperatures for Silba and Bonaster, as well as for some neighboring stations:

Precipitation quantity is much more expressed in colder than in warmer part of the year, which is not stimulating for growing vegetables. The average humidity is during almost whole year 70–72% which, on the contrary, suits vegetation. Annual precipitation

caused by etesian circulation in the atmosphere, and locally canalized according to the general direction (NW-SE) of the interinsular sea channels. Stormy and dangerous winds happen rarely.

All of these islands belong phytogeographically to the eumediterranean climato-vegetation zone. The local, eumediterranean clima-zonal vegetation is the result of geographical position, relief, waters, soils, and especially of climatic features of the zone. Evergreen

Table 2 – Mean month and annual air temperatures (°C)

Station	J	F	M	A	M	J	J	A	S	O	N	D	Ann.
Bonaster	7.0	6.9	9.3	12.5	17.0	20.7	23.0	22.9	20.5	15.9	11.8	8.9	14.8
Silba	7.8	7.5	10.1	13.2	17.0	21.0	24.5	24.1	21.0	16.8	12.0	9.3	15.4
Božava	6.8	7.1	9.8	13.9	17.5	22.0	23.4	24.1	21.0	16.8	13.4	9.1	15.4
Mali Lošinj	7.1	7.4	9.2	13.1	17.2	21.3	23.8	23.6	20.4	16.5	12.4	9.1	15.1
Zadar	6.7	7.4	9.4	12.9	17.2	21.0	23.6	23.1	19.8	15.8	11.5	8.1	14.7

Resources: Meteorological year-book of National hydrometeorological Service, I, 1952–1985, Beograd; National hydrometeorological Service of Republic of Croatia, data 1985–1990 (interpr.: A. Cvitanović, 1989, D. Kraljev et al., 1995, N. Stražičić, 1997 and D. Kraljev, 2000).

measured in rain-gauge stations of the islands is given in the Table 3, as well as those in Zadar and Mali Lošinj so that the data could be compared.

Annual averages vary from 889 mm (Molat) to 977 mm (Olib). The highest precipitation quantity falls in autumn, especially in November (118 mm in Molat to 136 mm in Olib), as cyclonic rain. In summer, July is the most arid month with maximum 34 mm on Olib and

sorts, with thick and hairy leaves acclimatized to high temperature and dry summer period dominate in autochthonous holm oak (*Quercus ilex*) forests and maquis. The holm oak (*Quercus ilex*) is the main tree of the domestic forests. It is very good for firewood, and in the past it was used for shipbuilding, too. Among other sorts, juniper trees (*Juniperus phoenicea*, *J. oxycedrus*), erica (*Erica arborea*), strawberry tree (*Arbutus unedo*),

Table 3 – Mean month and annual values of the precipitation of the western island of the Zadar archipelago (mm)

Station	J	F	M	A	M	J	J	A	S	O	N	D	Ann.
Ist	85	74	76	62	51	44	34	60	99	96	113	96	901
Mali Lošinj	95	76	76	58	57	48	55	70	98	89	135	106	965
Molat	80	73	69	59	51	53	36	60	100	103	122	84	889
Olib	82	80	72	67	60	59	34	61	109	117	136	100	977
Premuda	81	67	89	59	49	46	51	52	96	95	137	100	922
Silba	87	71	80	72	59	51	42	63	112	107	135	94	973
Zadar	77	72	74	60	61	52	35	63	98	112	119	94	917

Resources: Meteorological year-book of National hydrometeorological Service, I, 1952–1985, Beograd; National hydrometeorological Service of Republic of Croatia, data 1985–1990 (interpr.: A. Cvitanović, 1989, D. Kraljev et al., 1995, N.

Ist, and 51 mm on Premuda. Summer rains are mostly convective, as the result of intensive warming and evaporation of the sea.

Wind is also a very important climatic element. All settlements are raised in sheltered conditions in order to avoid dominant wind directions. In colder part of the year, bora (NW) and »jugo« (sirocco, SE) winds prevail, as the result of the secondary changes in the atmosphere (cyclone and anticyclone). In summer mistral (»maestral«, NW), refreshing and pleasant wind,

terebinth tree (*Pistacea terebinthus*), wild olive tree (*Olea oleaster*), myrtle (*Myrtus communis*), mock privet (*Phillyrea latifolia*), and viburnum (*Viburnum tinus*) are well known. In garrigue and maquis: rock-rose (*Cistus villosus*), immortelle (*Helichrysum italicum*), Spanish broom (*Spartium junceum*), sage (*Salvia officinalis*), rosemary (*Rosmarinus officinalis*), as well as different grasses (*Brachypodium ramosum*, etc.) and many others appear frequently. The passage through maquis is very difficult because of many climbers (lianas) like smilax

Table 4 – Some data and water resources of the western islands of the Zadar Archipelago

island/ village	num settl.	area km <sup>2</sup>	inhab. 1900.	inhab. 1991.	waterline	reservoir	water ship	mari- cult.	tour- ism	naut	undergr. water
Silba	1	15,0	1100	221	m	++	+	-		+	4z
Olib	1	26,1	1495	168*	-	+	+	+		+	4z, 2i
Premuda	1	8,6	446	73	(m)	++	+	-		+	3z
Ist	1	9,7	432	237	(m)	+	+	-		+	3z
Škarda**	1	3,7	23	4	-			-			3z
Molat isl.	3	22,8	893	222	-	+	+	-		+	6z
Brgulje			170	56	(m)	+				+	1z
Molat			560	114	m	+				+	3z
Zapuntel			163	52		+					2z
<b>total</b>	<b>8</b>	<b>85,9</b>	<b>4389</b>	<b>925</b>	<b>m</b>	<b>+</b>	<b>+</b>		<b> </b>	<b>+</b>	<b>31</b>

\* reduced to real number;

\*\* statistically belongs to settlement Ist.

(*Smilax aspera*), blackberry bush (*Rubus ulmifolius*) and asparagus (*Asparagus acutifolius*). Many of the sorts are medicinal herbs like fennel (*Anethum foenicum*), St. John's wort (chantaranion, *Hypericum perforatum*), amaranth (*Amaranthus*). On some wet locations reed (*Phragmites communis*) and fern (*Aspidium filix mas*) can be found. Aleppo pine (*Pinus halepensis*) is domesticated as well as cypress (*Cupressus sempervirens*), laurel (*Laurus nobilis*), pomegranate tree (*Punica granatum*), locust tree (*Robinia pseudoacacia*), tamarisk (*Tamarix gallica*), etc.

During millenniums, natural vegetation was partly supplemented by cultivated plants (olive trees, vine, almonds etc.), nowadays mostly abandoned and degraded as the result of rapid deagrarianization and deruralization. So, during the process of natural reforestation, autochthonous vegetation, almost totally replaced by cultivated plants or degraded by long-lasting cut and livestock farming (with exception of the Olib island), rapidly comes back not only to previous stony pastures but also to many cultivated areas. Although the woods have been revitalizing quickly in the last decades of the 20<sup>th</sup> century, the exploitation of the holm oak is more marked only on the island of Olib.

From the spatial planning point of view, local clima-zonal features indicate concrete possibilities of developing nautical and bathing tourism, recreation and medicinal herbs production as well as the chances of the specific Mediterranean polyculture production (olive growing, sheep and goat breeding, forestry, fishing, etc.).

## Waters

There are no surface flowing waters on these islands, because of the carbonate stones in the base. Limestone and dolomite sediments are secondary porous, so there is an underground water circulation. During heavy rains, short lasting torrential waters flow

through usually dry valleys. Corrosive and erosive processes caused by precipitation, are well seen in modeling of different carst surface forms as mentioned before.

The underground water only here and there approaches near the topographic surface, mainly along the coast line. But, that is mostly brackish water. There are some wells on Molat (6), Olib, Silba and Premuda (3-4). There are some small springs on the Silba and Premuda coasts. As the water supplies were poor also the water from pools was used before, especially to water sheep and goat, or for watering plants and crops.

As natural water resources are really poor, islanders used to build concrete water reservoirs (cisterns), for collecting rainwater that flows from the roofs, or concrete plateaus (in 20<sup>th</sup>.c). Richer families had also private reservoirs before, that is why some older houses have stony gutters and downspouts, and also stony well crowns on the cisterns. Nowadays almost every new house has its own rainwater reservoir for the roof water, with the electric well-pump. But, this technology depends on precipitation and does not satisfy all the needs of the population especially in summer when the islands are to be supplied by tanker-ships. That is why it is necessary to construct a water supply network for all Zadar islands.

## Soils

The main soils on the islands are thin rendzinas, mostly terra rossa, as the product of limestone chemical weathering (often mixed with the pieces of original stone) and greyish or brown sandy soils which are products of dolomite decaying. Sometimes there are 4-5 m thick soil deposits. In the holm oak forests, humus soils originate as the products of organic detritus (leaves, small branches). People use this soil to improve their agrarian terra rossa areas. Very rarely appears tiny-granulated brown or grey-brown soil, with-

out pieces of origin stone. There is a 7–8 m thick zone of such a soil on Premuda (Poletić). All the soils are pretty fertile, especially when upgraded by forest humus or manure. Artificial fertilizers have also been applied recently.

## Depopulation and Problems of Recent Development

The islands belonging to the group of the western part of the Zadar Archipelago in the Croatian Adriatic are Silba, Olib, Premuda, Molat and Ist (with Škarda island). As a part of small Croatian islands they cover an area of 85.9 km<sup>2</sup> and, in 1991 they numbered 925 inhabitants. That was only 21.1% of the number of the population that lived here in 1900 (Tab. 5.).

In the 18<sup>th</sup> and 19<sup>th</sup> century this zone was well known for its maritime activities (fishing and navigation) and much more evaluated. According to the official census data, it enabled Silba (1559 inhabitants) and Premuda (577 inhabitants) to reach their maximums in 1857, and Olib reached its maximum in 1900 with 1495 inhabitants, as well as Molat with 560 inhabitants.

of development. The result was the degradation of the natural holm oak forests and maquis, as well as the noticeable agricultural expansion to the last piece of the arable and pasture land.

Being predominantly the result of significant emigration and the collapse of sailing on these islands, depopulation resulted in almost no natality, a high mortality rate and prevalence of the older population. Accordingly, an intensive process of deagrarization and rural exodus started. Almost all vineyards and arable lands were abandoned. Only olive-groves resisted, but many of them neglected and in bad condition. Breeding sheep and goat was also diminished to the lowest number. Last cattle disappeared from these islands at the beginning of the 20<sup>th</sup> century. Donkeys have been replaced by small tractors so only few of them remain. The result has been a kind of revitalization of the natural forests and maquis, covering not only the former stony pastures, but also many deserted vineyards and abandoned pieces of arable land. The process is strongly visible on all islands, except on the Olib island, which has been well known for its holm oak groves for centuries and where the cultivation of

Table 5 – The number of inhabitants of the western islands of the Zadar archipelago 1857–1991

island/ village	1857	1869	1880	1890	1900	1910	1921	1931	1948	1953	1961	1971	1981	1991
Silba	1559	1272	1387	1120	1100	929	929	747	514	444	397	339	198	221
Olib	1195	1297	1256	1371	1495	1331	1331	1128	914	805	585	569	226	168*
Premuda	577	503	560	453	446	473	473	374	320	273	213	152	98	73
Ist	332	348	409	391	432	433	433	476	466	458	435	386	295	237
Škardax	10	–	–	38	23	43	43	51	86	86	60	26	4	4
Molat is.	662	645	674	777	893	867	867	931	977	930	771	547	301	222
Brgulje	140	–	154	167	170	176	176	231	252	247	202	132	76	56
Molat	400	420	409	466	560	546	546	504	467	424	335	247	135	114
Zapuntel	122	225	111	144	163	145	145	196	258	259	234	168	90	52
<b>total</b>	<b>4335</b>	<b>4065</b>	<b>4286</b>	<b>4150</b>	<b>4389</b>	<b>4076</b>	<b>4076</b>	<b>3707</b>	<b>3277</b>	<b>2996</b>	<b>2461</b>	<b>2019</b>	<b>1122</b>	<b>925</b>

\*reduced to the real number to avoid fault of the official census; x Škarda belongs statistically to the village of Ist – here is presented separately

Other smaller settlements reached their maximums later Ist in 1931 (476), Škarda in 1948 and 1953 (86), Brgulje in 1948 (252) and Zapuntel in 1953 (259). In 1857 the zone numbered 4389 inhabitants. Zadar, the regional center and ex capital of Dalmatia, numbered 8331 inhabitants in the same year. The proportion was approximately 1:2. In 1991 the zone numbered only 925 inhabitants and the city of Zadar 76.343 which makes the relation 1: 80 (!). This shows how drastic changes and disproportional development (caused by depopulation of the region, especially of the small islands, and by the significant concentration in regional centers in this area) happened in some 150 years. The climax of inhabitancy at the end of the 19<sup>th</sup> and the beginning of the 20<sup>th</sup> c. was accompanied by a specific balance between density of population and natural possibilities

autochthonous evergreen oak for selling still exists.

In addition to depopulation, main ecogeographical problems of recent development have been connected with the isolation and dispersion of the zone, singularity of each island, poor natural resources (carbonate sediments and soils, lack of water, dry summers, etc.) and sociogeographical and economic decrease (collapse of sailing, closing of fisheries, handicrafts, schools, etc., deagrarization), bad official policy in treating islands, etc. That is why the depopulation in the 20<sup>th</sup> c. was so fast and drastic.

The problem of isolation and dispersion of the zone and singularity of each island are strongly expressed in these days. Sufficiently connected till the beginning of the 20<sup>th</sup> century (Silba, Olib, Premuda) or

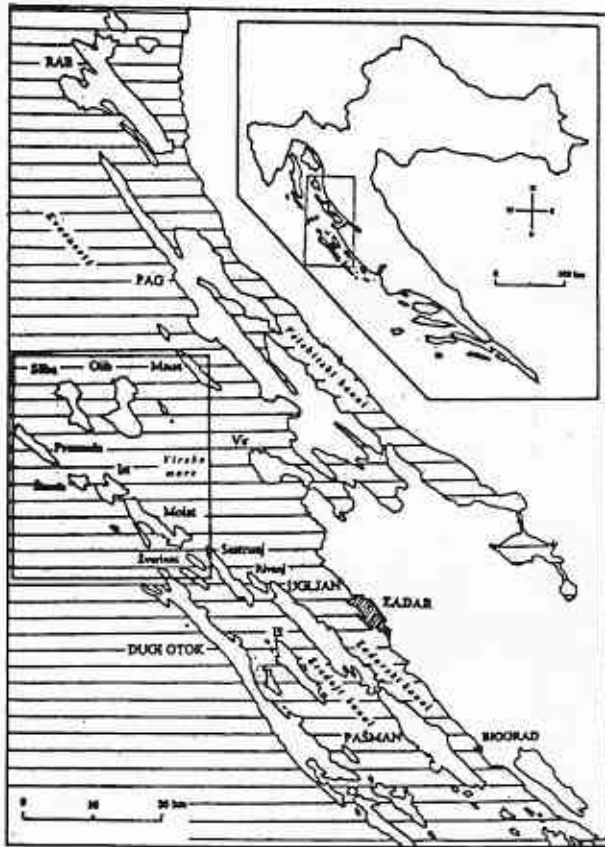


Figure 1 – Geographical position of Western Islands of Zadar Archipelago

during the first half of the 20<sup>th</sup> c. (Ist) owing to their own fleet, nowadays these islands belong to the most isolated ones on the Adriatic in the last decades of the 20<sup>th</sup> c. This group of islands is the most isolated one in the Zadar archipelago. Traffic and trade connections are miserable, although the first steamship lines were introduced in the second half of the 19<sup>th</sup> c. They were replaced by passenger motor ships in the fifties and sixties of the 20<sup>th</sup> c. During winter there is only one daily ship line connection with Zadar touching all settlements except Škarda, and once or twice a week Mali Lošinj (from Silba, Olib, Premuda). In summer Silba has 4 more ferry connections a week with Zadar and Mali Lošinj, and one with Pula. The island of Škarda has never had a regular ship connection. Lately, some lines have been modernized (speedboats). The nearest continental center, Zadar (76.000 inh. 1991), in the same time the administrative center, is far away, as well as Mali Lošinj (6.000 inh. 1991) or Rijeka (169.000 inh. 1991). There is a need to enable reaching Zadar in max. 2 hours in one direction. In the case of sudden illness attack there is almost no possibility of taking an ill person quickly to the nearest hospital. Sporadically, army or police boats or a helicopter intervene.

Singularity of the islands is extremely manifested as, except on the Molat island where there are three vil-

lages, on the other islands of the zone there is only one settlement. On the Molat island, the only local and narrow road was modernized in 1995. It connects the three villages. The frequency of vehicles is poor, not worth mentioning, but it helps post, medical and other local services. The sea connections among the islands of the group are sporadic and nonfunctional so that there is better connection between each island and Zadar than among the islands themselves.

There are also other reasons that caused the decline of these islands. Relatively poor natural resources (carbonate sediments and soils, lack of waters, dry summers, etc.) and economic decrease (closing of industries, fisheries, schools, etc.) play an important role, too. In the 18<sup>th</sup> and 19<sup>th</sup> century this zone was much more developed and well known for its maritime activities (fishing and navigation) and sheep breeding (Olib and Molat islands were well known in producing special cheese and curd). The only fish factory, opened in Silba in 1907, was soon closed in 1914.

### The Problem of Management and Engineering (Spatial Planning)

Lots of actions were declared in order to help redeveloping these islands, but there were practically no results. Some attempts to convert some of the islands into nature reserves (Silba, Olib, Grebeni), did not result in any concrete action. There are plenty of problems related to redeveloping these islands and including them in the general process of the growth along the Croatian coast and it seems to be a too hard work for spatial planners, managers and economists. Some planning documents (Spatial Plan of the Zadar Commune, 1978-2000, Zadar, 1978; Spatial Plan of the City of Zadar, just in the process of compilation), have been trying to define a basis of revitalization, but unsuccessfully so far.

Coordinate Regional Spatial Plan of Upper Adriatic (1972) defines two »primary tourist areas of intensive use«, one on Silba and the other on Olib both planned as tourist centers of third order. Bigger base of the nautical tourism (»bigger marina with recreational base«) is placed on the Molat island (Tun). Smaller marinas were proposed in the St. Ante Port, in the Brguljska luka and in the Kosirača bay (Ist). All other ports were planned as »smaller harbours« (Premuda, Silba, Olib, St. Nikola, Ist, Zapuntel, Molat). The surfaces of the islands of the group are mostly planned for »melioration of underwood and maquis« (all islands), or for »organization of tourist and recreational forests« (parts of Silba, Olib and Molat islands) and »melioration of carst pastures and production of medical and aromatic herbs« (NW part of the Premuda island). All villages (except Škarda) were proclaimed »rural agglomeration of historical character«.

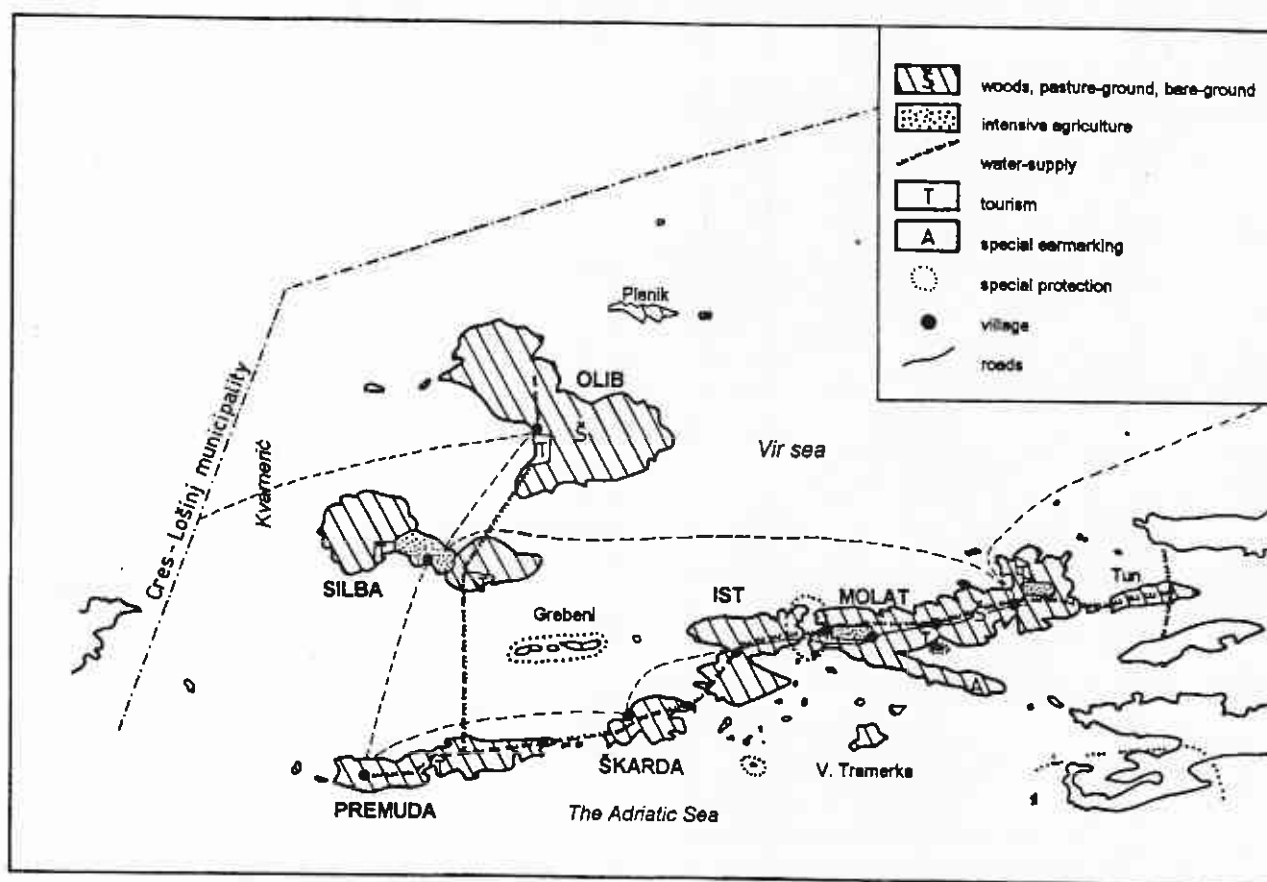


Figure 2 – Western Islands of Zadar Archipelago in Spatial Plan of Zadar County (1978–2000) Zadar, 1978

In the Spatial Plan of the Zadar Commune, 1978–2000, zones of settlements, tourist zones, zones of special purpose, natural preservation zones and forest-pasture zones on these islands were defined. Ship connections were planned (from Zadar, and Mali Lošinj). The local road Molat (Lučina) – Zapuntel (Zapuntelska luka) was projected too. The water supply was envisaged from the land (Zadar-Ugljan-Sestrunj-Molat-Ist-Premuda-Silba-Olib), but local solutions were not rejected. Electricity supplying was planned from Zadar direction. The function of central places should remain in Silba and Molat. Post offices were planned in Silba, Olib, Premuda, Ist and Molat.

Settlements were planned on the existing locations with new large extensions inside the building area borders (Olib, Silba, Premuda, Ist, Škarda, Zapuntel with Zapuntelska luka, Brgulje with Brgumul and Molat). Separate tourist zones were located on the Silba (St. Ante Port, Papranica bay), Olib, Premuda (Premudska luka) and Molat islands (Jaz bay). Total capacity was planned up to 2000 beds in hotels, 1000 beds in tourist resorts, and 3000 in private and weekend houses (in 1975 there were only 310 renting beds in tourist resorts and 963 beds in private and weekend houses). Nautical tourism ports (marinas) were given consideration on all islands (Silba: Žalić, Mulić; Olib; Premuda: Krijal,

Loza; Ist: Široka, Kosirača; Molat: Lučina, Jaz; Brgulje; Zapuntel; Škarda). Besides these zones, smaller tourist objects were permitted to be built inside villages. Agricultural activity was scheduled on the existing agricultural surfaces. Fish farming (mariculture) activity was permitted in every available location, too. Zones of special purposes were planned on the island of Molat (military zone of Bonaster) and smaller points inside other zones (Premuda, Ist). Natural preservation zones included the whole islands of Silba and Olib as nature forest parks, Grebeni islets as geomorphological reserve, Zapuntelski prolaz (the sea passage of Zapuntel) and the islet of Brguljak (Brguljski školj) as natural landscape reserves. A memorial monument zone was planned in Jaz bay on the island of Molat.

Regional plan of the Split intercomunal association (1982) generally respected this area as the zone of the high tourist and recreational evaluation and development within the borders of South Croatia (Dalmatia).

After 20 years of »development«, the realization of spatial engineering in this zone was more or less irrelevant. It was the reflex of the general situation on small islands along the whole Croatian coast. No hotels were built, settlements raised slowly, mostly as the result of building weekend houses. Agriculture and sheep and goats breeding was abandoned, and demographic situ-



ation as already explained, is extremely worrying. Only one fish farm (10 metric ton production a year) was installed in the St. Nikola bay (Olib). Many schools were closed (Škarda, Premuda, Molat, Zapuntel, Brgulje). In 1996 primary schools on Silba (30 pupils), Olib (14 pupils) and Ist (12 pupils) still existed. The new road Molat (Lučina) – Zapuntel (Zapuntelska luka) was realized, as well as new ferry quays in Silba, Molat (Lučina) and Olib. Electricity connections, as well as phone (GSM system) ones were improved, but water supply system was not realized. Nautical tourism was initiated by placing buoys in the St. Ante Port (Silba), Olib port, Krijal (Premuda), Ist port, Škarda, Brgulje, Zapuntelska luka, etc. Many local trails and pathways are not passable any more having disappeared in autochthonous forests and maquis. The fire dangers multiplied, as well as problems of managing the waste.

After the new administrative and territorial organization was introduced in Croatia in 1993, these islands devolved to the City of Zadar. The attempt to constitute their own commune did not succeed. The Spatial plan of the City of Zadar was initiated in 1997, but it has not been finalized up to now. In the same time, the Spatial Plan of the Zadar County, was initiated too. Both plans, treat again the islands as mostly tourist and recreational zones. The main guidelines of the plans are to keep and even diminish buildings areas planned before in settlements and tourist zones in order to concentrate the housing and make the settlement and port infrastructure profitable and more developed. Only two tourist zones (Silba and Molat-Jaz) resisted. Tourism should be primarily nautical or specific (diving, diving schools, skin diving, etc.). The main economic activities, besides tourism, should be sheep breeding and exploitation of the holm oak trees (Olib, Silba). Maritime nature park is projected on Grebeni islets. No new marina is planned, but local ports should be improved and should get new and well equipped moorings and quays.

In 1997 the new National Program for Island Development was introduced by Croatian Parliament. It gives the recapitulation of basic data considering all Croatian islands (area, number of inhabitants, tourist capacities, water supplying, electricity distribution, roads, etc.). The group of Western islands of the Zadar Archipelago is studied too. Local roads are proposed on Silba (0,8 km), Premuda (1,6 km), Olib (1 km), Ist (3,5 km) and Molat (10,5 km). No areas of natural protection are defined on these islands. The National Program proclaims the need of creating local »programs of complete and sustainable use of the island resources«. Such programs are suggested for Premuda-Silba-Olib and Molat-Ist-Škarda groups.

The Strategy of Spatial Management of the Republic of Croatia (1998) expresses the semi-urban/rural

units of Silba, Olib, Premuda and Molat settlements with the active protection of the building heritage. Silba and Molat are considered as »tourist centers of subregional significance« and classified in »B category« group. Ist is ranged in C category and Molat and Brgulje in D tourist settlement category. All these islands are classified in the zones of small islands without car traffic or with very distimulative measures for vehicle traffic. Silba is envisaged as a »port of county significance«, and other settlements, excluding Škarda, as local ports.

## Conclusion – Proposals and Suggestions

Studying the basic natural-geographic, demographic, economic problems and some problems of recent spatial planning and engineering of the Western islands of the Zadar archipelago, it is obvious that there are no simple and cheap solutions. Many declarative, and more or less professional attempts, have not given satisfying results so far. It is interesting to mention that in the earlier phases of spatial engineering in Croatia, especially in sixties and seventies of the 20<sup>th</sup> c., much bigger ambitions and appetites were expressed even on these islands. That is why many planned objects and zones have never been realized here. New spatial planning documents show less ambition, but also some disorientation and clumsiness when considering these islands. Such a situation is partly the result of insufficient financial budget assigned for the development of small islands in Croatia in previous decades. Now, when the economic situation in Croatia is unfavorable, there are no possibilities of directing enough fresh capital to these islands. What are the possibilities of existence and development in such conditions? It seems that, when small islands are in question, only limited but direct and concrete actions could be adequate. Forming some groups of islanders who moved to cities, especially those who possess houses on these islands, stimulating them to turn back to the villages they came from, in the same time making possible the normal way of life (health protection, post, supplying, ship lines, employment, etc.), which could open new possibilities of coming back. Even pensioners should be stimulated to live on these islands, because many of them dispose of good money. Small special health and recreation services for pensioners should be organized as well. Nautical services are not expensive, neither is sheep breeding or fish farming. On the other hand, some younger people can get employed. Weekend migration of domestic people is very stimulating. The villages revive at weekends, especially in summer, so there is a need to organize adequate activities for weekenders. These activities (recreation, working actions, different economic actions, etc.) could generally contribute to different forms of existing and managing on these islands in the future.