

## CONTRIBUTION TO THE KNOWLEDGE OF THE GEOGRAPHICAL CHARACTERISTICS OF THE PAG ISLAND

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Tema članka je geografska problematika otoka Paga u zadarskoj regiji Južne Hrvatske (Dalmacija). Autor posebno obrađuje geografski položaj, veličinu i obuhvat, fizičko-geografska obilježja (geologiju, geomorfologiju, speleološke značajke, klimu, kopnene vode i more, biljni pokrov, tla) te socio-geografska obilježja. Posebno se razmatra historijsko-geografski uvjeti razvoja i naseljenosti od najstarijih vremena do danas. Kretanje broja stanovnika pokazuje stalan pad u sve tri jedinice na otoku, Pagu, Poveljani i Novalji 1948. - 1981. Popis stanovništva 1991. bilježi porast broja stanovnika. Strukture stanovništva uglavnom pokazuju nepovoljna obilježja. Završni dio rada obuhvaća značajke gospodarstva i društvene nadgradnje. Ovčarstvo, turizam i lokalna industrija pokazuju najviše vitalnosti. Autor posebno razmatra perspektive i dileme otočkog razvoja u složenim uvjetima administrativne podjele na dvije županije.

**Ključne riječi:** Pag, geografska obilježja, stanovništvo

The theme of the paper is the geographical characteristics of the Pag Island, which belongs to the Zadar region in South Croatia. (Dalmatia). The author gives careful consideration to its geographical position, extension and size, physiogeographical features (geology, geomorphology), speleological characteristics, climate, land and sea waters, vegetation, soils) and sociogeographic characteristics. Special attention is paid to the historic-geographical aspect of the development and population in three districts of the island (Pag, Poveljana, Novalja). The characteristics of population structures are generally unfavourable. The final part of the paper includes the characteristics of economy and social superstructure. Sheep-breeding, tourism and local industry show the greatest deal of vitality. The author analyses perspectives and dilemmas concerning the development of the island under complex conditions of the administrative division between two counties.

**Key words:** Pag, geographic features, population

### Geographical position, extension and size

The island of Pag is situated in an inland range of the East Adriatic Croatian islands. Geomorphologically, it is the component part of the Ravni Kotari zone from which it has been split by recent geologic processes. Prehistorical connection with the Ravni Kotari close land caused the millenary appertaining of the island of Pag to the South Dalmatian area. Historical and geographical development points to the direct

connection with the insular area of Pag and the Ravni Kotari land area with gradual realization of the adequate degree of the Pag island autonomy.

Prominent maritime features and the vicinity of other bigger Croatian islands of the larger Kvarner maritime zone have made possible the partial connection of the Pag Island with other insular entities especially with the Rab Island. Lately, the connection with the coastal sloping area of Velebit has become increasingly strong, especially by modern car-ferry connections. Therefore, historically and geographically the duality, namely, the transition of the Pag area, has been emphasized: it represents the part of the NW Dalmatia, the Zadar region, but it is a part of the Kvarner group of islands as well. It was confirmed from the first regionalisation attempts of Croatia (ROGIĆ, 1963) until more recent ones (ROGIĆ, 1983,1984; ROGLIĆ, 1984).

As those two regions are the areas of penetrating gravitational influences of Zadar, in the first place in the southern, and Rijeka in its northern part, nowadays it is spoken about the position of the Pag island in one of these two regions, or about their interweaving influences.

Administrative and territorial belongings of the Pag Island to Zadar region, and in the 20<sup>th</sup> century to Zadar or Rijeka regions, confirm the problems of its geographic position and advantages that this island can achieve. The administrative and territorial organisation in Croatia consisting of counties, defined Pag (1993-1997) as a part of the Lika-Senj County and encouraged new, sometimes controversial opinions about the regional and economic links, even though according to many characteristics the Pag island will use and evaluate first and foremost the functional links with the nearest regional and traditional centre in Zadar and a strong economic centre in Rijeka. After referendum in 1997, the SE administrative units of City of Pag and Poveljana district have belonged to Zadar County, and the Novalja district to Lika-Senj County. By new traffic solutions, especially road, bridge and car-ferry links, the distance of the town of Pag to the nearest country centres would be: by road to Zadar 46 km (under 1 h), by road to Rijeka 160 km, and by car-ferry 2 km (ca 3 h), by road 39 km and by car-ferry Pag - Karlobag about 15 km to Gospić (less than 2 h). The distances from Novalja would be: by road to Zadar 69 km (about 1 h), by road 136 km, and by car-ferry 2 km to Rijeka (less than 3 h), and by road 45 km/car-ferry 2 km to Gospić (about 1,5 h).

The Pag island covers the area of 284,56 km<sup>2</sup>,<sup>1</sup> and with appertaining islands and islets making the Pag island group (Maun 8,54 km<sup>2</sup>, Škrda 1,95 km<sup>2</sup>, Veli and Mali Sikavac, Veli and Mali Brušnjak, Šestakovci /5 rocks/ two rocks Maletinac, Veli and Mali Maškalić, Triget, Mišnjak, Žigljen, Zakućenica, Lukar etc.) it has a total of 296,26 km<sup>2</sup>. In 1993 the division of Pag group of islands was administratively and territorially constituted of three parts: the City of Pag occupying the larger south-eastern part of the island, the commune of Poveljana (only one settlement) and the district of Novalja with the appertaining smaller north-western part.

Among the Croatian islands Pag is the fifth in surface, after Krk, Cres, Brač and Hvar, and before Korčula, Dugi Otok, Mljet, Vis and Rab. According to the number of inhabitants in 1991, it is only the seventh, after Korčula, Krk, Brač, Hvar, Rab, Lošinj, and before Ugljan, Čiovo, Murter, Vis and Pašman.

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<sup>1</sup> Republic of Croatia, Statistic chronicle, 24, Zagreb, 1992, p.36

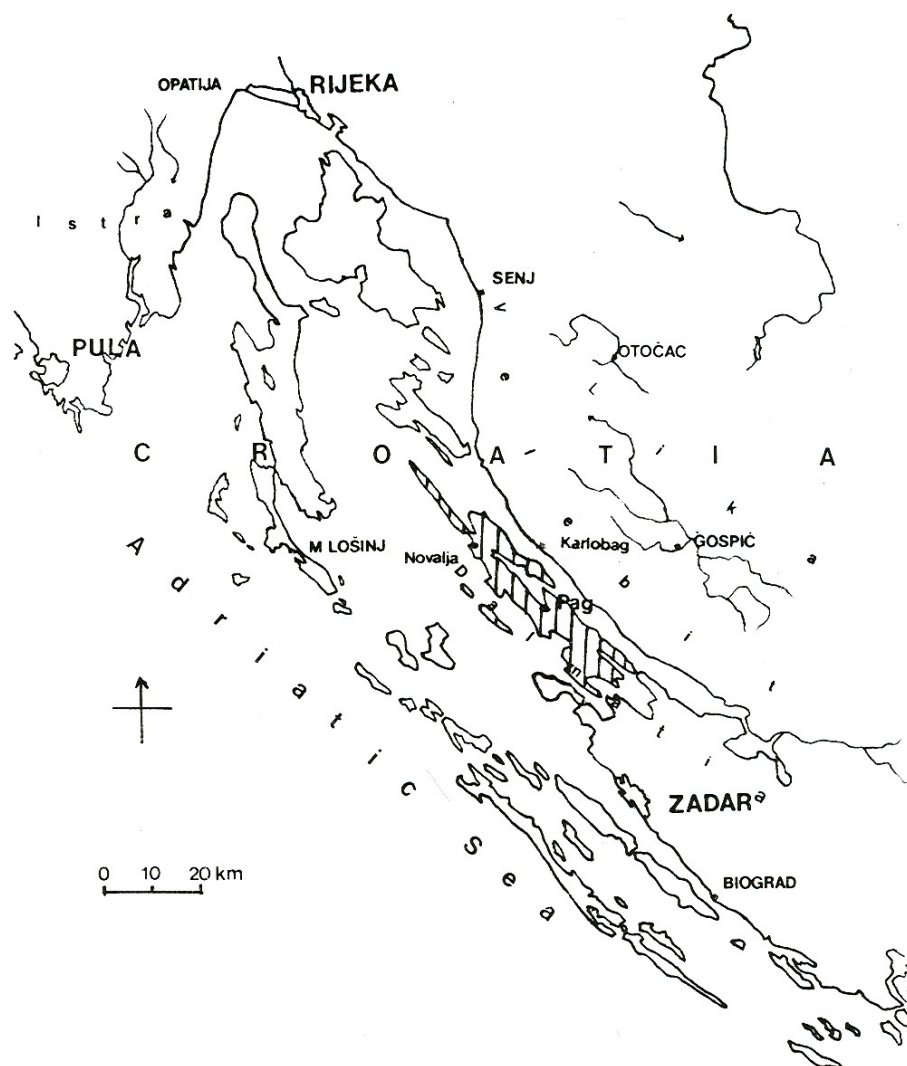


Fig. 1 - Geographical position of the Pag Island  
 Sl. 1 - Geografski položaj otoka Paga

With coastline of 269,2 km in length, it is the most outstanding Croatian island, before Hvar, Cres, Krk and Korčula.<sup>2</sup> Together with Dugi Otok, it has the most expressed so-called coefficient of indentedness among our islands, fully 4,50. The height of the island above sea-level is 349 m.

<sup>2</sup> Ibid.

## Physico-geographical characteristics

### *Geological structure*

In the structure<sup>3</sup> of the island of Pag cretaceous-palaeogenic carbonate sedimentary deposits of limestone and dolomite prevail, and Palaeogenic zones of softer sedimentary deposits (flysch) and younger Quaternary ones are less exposed. After the last thaw caused by glacioeustatic movements in Würm, large parts of the north Adriatic area were drowned, in the same way the Velebit Channel, Kvarner etc. and the significant zones of gentler, younger sediments were submerged by sea.

The Cenoman-Turon limestone and dolomite of the upper Cretaceous age (K<sub>2</sub><sup>1,2</sup>) raised by folding are the oldest rocks, building the central zone of the most distinguished insular crest from Novalja to Košljun, and the separated zone of the north eastern crest southeast of the town of Pag. There are some zones of these sediments in the northern part at Lun and in the northern part of the Maun Island. Structurally, they make the cores or wings of anticlines. Limestone is considerably more manifested than dolomite appearing here and there in the forms of lenses. These sediments belong to the sea reefy bioaccumulation where the remains of numerous organisms accumulated in the region of breaking waves or somewhat calmer surroundings. The remains of petrifications and microfossils were found (*Aelisaccus sp.*, *Cuneolina pavonia parva*, *Dicyclina schlumbergeri*, *Nummoluculina heimi*), chondrodonts (the most frequent *Chondrodonta munsoni*), rudists (*Hippurites/Orbignya/requieni*, *Nerinea requieni*, *N. schiosensis*), ichthyosarcolites and caprina (it is very frequent *Ichthyosarcolites bicarinatus* on the Novalja-Kolan stretch, whereas *I. tricarinatus*, *I.cf. monocarinatus*, *Neocaprina sediments*, *N. gigantea*, *Caprina cf. carinata* and some others are rare) etc. suggesting higher levels of these sediments. The layers are poorly stratified, partly well and partly weakly sorted, with frequent reefy breccias. They are light brown and grey covering about 20 % of the island surface. They can be seen in the northern part from Tovarnele beyond Lun to Valjermica, in the southern part up to Novalja they are covered by younger sediments from the Cretaceous and Palaeogene ages, and from Novalja towards SE they cover the place Novalja, Vrtić, Straško, Špital, Čiponja, Zrće, Gajac, Katarelac, Prnjica, Veternica, Panos, Čurliz, V. Gramača, Reštur, Komun, Renovice, Bocolić, Šimuni, Fabijanić, Paška Rebra, Maslinice, Praskarovo, Dumboka Draga, St.

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<sup>3</sup> Island relief, respectively, geologic characteristics to: Basic geological map of SFRY, IGL, Zagreb, Cons. geol. inst., Belgrade; Explanatory notes and bulletins: Zadar, L 33-139 (authors: Ž. Majcen, B. Korolija, B. Sokač, L. Nikler, 1973), Silba L 33-126 (P. Mamužić, B. Sokač, I. Velić, 1970), Gospić L 33-127 (B. Sokač, L. Nikler, I. Velić, P. Mamužić, B. Ščavničar, 1974, 1976) and Rab L 33-114 (P. Mamužić, A. Milan, B. Korolija, I. Borović, Ž. Majcen, 1969, 1973); R. Schubert, Geology of Dalmatia, Zadar, 1909; R. Schubert, L. Waagen, Geologische Spezialkarte Österreichischungarischen Monarchie, Pago, Geol. R.A., Wien, 1913; L. Margetić, Pliocene coal marl of the Pag island (Kolan), Fund doc. Institute of Geologic Researches, n. 1745, Zagreb, 1950 (project work); V. Petričec, Report of Geologic shooting of Pag, Vir and neighbouring islands, Fund doc. IGI n. 3054/3-4, Zagreb, 1958; O. Radimsky, Das Lignitvorkommen auf der Insel Pago, verh. geol. R.A., 1-18, Wien, 1877; Lj. Tolić Contribution to reambulation of geologic map Lošinj Mali - Lun, geologic news, II-IV, Zagreb, 1952; Idem, Analysis of drilling in the Kolan area, Pag island, Fund doc. IGI, n. 1746, Zagreb, 1950; idem, Carboniferous sediments of neogene basin of Kolan in Pag, fund doc. IGI, n. 1954, Zagreb, 1951; Idem, Bauxite deposits of the Pag island, geol.news, 33-34/1971-72, Zagreb, 1972, p. 145.

Petar, Paladinka, St. Martin, St. Toma, Negulići, Javor, Grobine, Trstenik to Košljun. SW of the line are manifested in Zaglav the Cape Proboj - Kruna Zaglave - Tihovac cove. These sediments are manifested in a narrow zone east and southeast of Pag: Grbe - Brusna - Malenica - Slana, and in the zone Plati - Broćna - Movra - Grabovac - Drakovac - Stražice - Komorova - Dumboka - Glave - Kućine - Škaničko, with isolated points at Opći Port, Bunjice and in Tust. These sediments can be seen in the Maun Island in a very small zone of the NE side in the region of Petrača - Škar - Golubera.

In the northern part of the Lun peninsula from Valjermica in the NW to Stare Kuće in the SE transitional sediments of the Uppercretaceous limestone of Touron and Senon ( $K_2^{2,3}$ ) are spread. Structurally, they form the syncline core, and their age is proved by numerous petrifications of macro and micro fauna, predominantly rudists, foraminiferas, globotrunkans, globigerinas etc. This limestone is weakly dolomitized, from light grey to light brown, with the layers 20-80 cm thick. They occupy about 4% of the island surface in the regions of the Lun peninsula: Valjermica, Gager, Badnjišta, Konobe, Gradac, Borovići, Dubac, Mrzlanovica, Dabove, Stare Kuće.

Senon rudist limestone from upper Cretaceous age ( $K_2^3$ ) is most widely spread in the island formatting lateral sides of synclines, namely, anticlines. They are most frequently covered by younger Tertiary deposits in synclinal parts accumulating one above the other on carbonate sediments of Cennoman-Touron. They contain the remains of rich and different rudist of paleofauna and a few and weakly conveying microforaminifera. Numerous rudists, manifested in lower senon are represented by petrifications of radiolite and hippurite. Among them distinguish *Radiolites cf. trigeri*, *R. radiosus*, *Praeradiolites anatolicus*, *P. lusitanicus*, *Hippurites (Orbignya) canaliculatus*, *H. (O.) matheroni*, *H. (O.) toucasianus*, *H. (O.) turgidus*, *H. (O.) mirostylus*, *H. (O.) sublaevis*, *H. (O.) praecessor*, *H. (O.) cf. socialis*, *H. (O.) toucasi*, *H. (O.) cf. praebioculata*, *Hippurites (Hipuritella) cf. maestrei*, *H. (H.) cf. incisus*, *Hippurites (Vaccinites) praesulcatus*, *H. (V.) aff. sulcatus*, *H. (V.) cf. boehmi*. There are rudists in the Kolan-Novalja stretch, near Pag, in Zaglav between Stara Novalja and Barbat, in Košljun etc., and considerably less in Maun (there is also *Durania cf. gaensis* here) and in Škrda. The species *Pithonella ovalis* and *Stomiosphaera sphaeric* were found in several places of Pag at this complex (Novalja - Dabove etc.).

Lithological structure of these sediments is mostly limestone, whereas dolomite limestones and dolomites are in a considerably less degree and they appear in the form of thin inserts or lenses. The limestone is well stratified, the sediments are mainly 20-60 cm thick. The entire, proportionally monotonous complex reaches the thickness of 350-400 m. The colour of the sediments is from light grey to brown, covering about 30 % of the island, i.e. having a great surface range. They occupy the following regions: Mrzlanovica - V. Kanat - V. peak - Grba - Šegovica - Pudarica - Burin Bok - Cape Zrće, the great Zaglav area and a part of Barbat with the zones Jadra, Ded, Koromačno, Orlje, Karsa, Turnić, Komorovac, Tusto Čelo, Zabaldušov Gramač, Narčela, Panos, Teplice, Široka Glava, Furnaža up to the NE side of Krištofor, with the separated zone Nova Pošta - Paklenica Cove - Vruje Cove - Široka Cove. The narrow Mrzlanovića - Zrće zone, partly sunk in the Caska Cove, appears again in the area of the Kamariž Cove proceeding farther on to the SE in the Škarić, Crkvine regions down to the NE slopes of the Saint Vid ridge (Grubišnac, St. Grgur, Vrtlace, Grabašnjaci) expanding to the Košljun bay zone on the Podlučje, Binca, Turnić, Mlinica, Malo Jezero and Basa terrains, and from the Velo Jezero area it is branched into two sides on the surface among which these

sediments are covered by younger Eocene layers in the Vlašić field syncline. The NE side runs the NE part of Velo Jezero along the Lukovac, Nesenj and Kamik zones ending at the hill Vlašići in Divišćaci. The SW side occupies the Basa area, across Turnići, Stari Stan, Grušna, Kunfina, V. Drakovac, Mikulinac, Guste Laze to Grušine. They appear on the surface here and there, and at Povljana, Čelo and Glavica, in a narrow zone at Zaglav between the Cape Proboj and the Tihovac Cove but they are more strongly manifested in the SW part of Prutna in the Babe - Čabrijanke - Gusti, Mali Gašparovi and Bili Lazi - Selina zone. The Kolan Cove - Olišnjak - Ravno appears in another smaller zone in the western part and in the wider region of Mandre (Selac), from Mišnjak, Solinice, Vrtača and Gaj in the NW to Lisičnjak, Dražica, Letavice, Duboke Stine and the Cape Selac in the SE. They cover the entire island of Škrda, the whole Veli Brušnjak, the NE part of M. Brušnjak and the greater part of Maun, where they are covered by younger Eocene sediments and that way divide the coastal NE and SW zone which is separated by the central Eocene zone. They appertain to the large anticline zone in the southeastern part of the town of Pag continually spreading to Lisičja Glava, Ledenik, Lutešovica, Grbe, Slana Uvala, the cliffs Šestakovci, Ražaško, Ortarnice, St. Ivan, Rudinsko, Propast, Bevandićevo, Pećane, Pećine, Zvonigrad, Vrčić kanat, Magro, Gramanik (Panos), Tusta, Prlinac (namely Čiker), Čista, Bili Rt, Santiš, Movra, Trsak, Debelo Čelo, Vranjinac, Paški Oštrljak. The formation of these sediments is connected with the relatively shallower sea, a little bit farther from the coast because some terrigenous composites are missing. Organogenetic detritus of small particles and pieces of bigger organisms are mechanically accumulated there.

After the raising of the upper Cretaceous limestone had occurred by tectonic movements and denudation in the land various karstic forms were made: joints, entrapped waters, cracks in limestone etc. Unmelted remains of carbonate dissolution were often deposited out of which diagenetic bauxite was formed. Such bauxite formations, which developed in the upper Cretaceous Senonian sediments, were noticed at several places in Pag. (SE of Caska, Pastura - Veli Vrh - Grba, Trimalj, Fumje, Perić Stan, Kozarina, Barbat). They were already exploited to the maximum extent. Deposits are poor, the maximum size of 10 m x 50 m, mostly elongated and narrow. The research works in Pag (mentioned deposits, Šimuni etc.) and in Maun suggest of non-economic deposits with narrow significance to economy.

After a shorter land phase, marine foraminiferous limestone of lower and middle Eocene (E<sub>1,2</sub>) transgressively deposited on older Cretaceous stratifications. They most often form Palaeogene synclinal wings and contain numerous petrifications of various miliolids, alveolin and numulite in microfossile, and sea-urchins and oysters in macrofossile spectrum. Miliolid and then alveolin and numulite limestone are accumulated transgressively on a series of sill-like limestone. From petrifications on Pag the species like *Litunella liburnica*, *L. roberti*, *Orbitolites douvillei*, *O. complanatus*, *Alveolina (Glomalveolina) minutula*, *A. oblonga*, *A. collosa*, *A. canavarii*, *A. cremae*, *A. distefanoi*, *A. dalmatica*, *A. gigas*, *Nummulites globulus*, *N. complanata*, *n. perforata*, *N. cf. fraasi*, *N. millecaput*, *N. atacicus*, *Assilina spira*, *discocyclina discus*, *D. sella* etc., prevail.

Among bigger petrifications in numulite limestone the cross sections of oysters (ostrea) were found, and in the youngest sediment sea-urchins of *Conoclypeus* genus, most often *C. conoideus*, and some *Cidaris*, shells, globigerinae and globorotalies. Lithologically these sediments are formed by limestone of high purity, and the sediments are deposited in hot sea, without strong currents, under conditions of littorally-neritic surroundings. The colour of sediments is yellow brownish to light grey, and of limestone

of uneven shell-fishing breach. The sediments are about 250 m thick covering about 15 % of the island surface. They are most widely spread in the southern part of the island. They can be found in the northern part in some places alongside the NE coastal slopes of the Lun Peninsula (Kruna, Trimalj, and more often from the Pastura cove along the western coast of the Trinčel cove.), continuing further on along the shelf of Novalja field to the western part of the Caska Cove. They are also found scattered in the NE shelves of Novalja field from the cape of Ded to Caska, confirming this way the forming of Novalja and Pag synclinal field which is in NW and SE flooded and covered by younger Quaternary sediments. They are found in a large scale on Barbat as well (Torine - Kustići - Zubovići - Plat - Vilinjak, Zaglava - Ručica - Beretnica, SW part of Furnaža etc.) This complex continues more distantly in SE of the Pag valley syncline coming out to the surface on both sides of a narrow partly drowned valley. It is possible to watch these sediments permanently on the NE shelf of the valley in the narrow St. Nikola zone, glavice, Kotice, St. Juraj, Hunjci, St. Karin, Gornja Kršina, Lopate, Bevandićevo, Vrčići, Humić, St. Cross, Janjilo, Magaš, Moravčić, and along NE coasts of the Dinjiška bay across Miškovići and Slana to Fortica. In the narrow zone of the Kamariž - Bok - in the SW shelf NE slopes of St. Vid - Dubrava - Visoki Brig - Žestoko - Počivalo - Podno Gradac - Iznad Starog Grada - Debelo Čelo - Dundovo Plandište - Turnić - Murvica - Debelo Čelo, are visible continuing to the SW side of the Dinjiška Bay (Novakovica, Stražica, Goluberje, Sure Stine) spreading in the zone Kraljeve Ograde and Mrtve. In the Poveljana and Vlašići zone these sediments are most distinguished extending the zone around Vlašići, Smokvica and Poveljana flysch syncline. They spread in the following regions: Dubrovnik - Poveljana - Plantaža - Pusta greda - Konjska, Velo Blato - Šimićina Glava - Grušina - Škamica - Sv. Pavao - M. Sikavac, Velo Blato - Tašnice - Grbica - Viljenka - Čunji - Kraljeva ograde - Cape Mrta and in Prutna from the cape Rastavac to NW across Škrlina, Visoka and Kurozeb to the cape of Prutna in SE.

Gradually, marl, sandstone and limestone ( $E_{2,3}$ ) frequently called flysch accumulated on the carbonate complex in the middle and upper Eocene filling the syncline beds of the Pag valley, Vlašići and Poveljana fields, and at Smokvica. They are very often covered with younger Quaternary sediments (Novalja field) and so do not come out on the surface, or are sunk in sea bays and channels (The Pag bay etc.). In a few smaller zones, on Barbat, they are separated as Mideocene flysch complex ( $E_2^2$ ). The transition from foraminiferous Loweocene limestone is marked by the layers of lumpy and detrital marly limestone with glauconites containing petrifications of sea-urchins *Conoclypeus conoideus*, whereas sea-spiders, customary for the same sediments in Pag are found mostly fragmentarily. Globigerinae *Acarinina bulbrooki* and *A. pentacamerata* with some oysters were also noticed. Mideocene marl are rich in the foraminifera remainders, and sandstones contain the remains of numulite, usually of the same species as in the older foraminiferous marl. The following species differ: *A. rotundimarginata*, *A. centralis*, *Globigerapsis kugleri*, *Globigerina boweri*, *Hantkenina alabamensis*, *Truncorotaloides tripilensis*, *T. rohri*, *Globorotalina bolivariana*, *Globigerinoides conglobatus* etc. *Globigerina corpulenti* and *Globorotalia cocoensis* are found in upper Eocene sediments, and species *Globigerina officinalis* and *Cibicides pseudoungerianus*, as some of observed ceratobuliminida indicate the transition towards younger Oligocene sediments. The composition of these sediments suggests the prevailing limestone detritus, and in a less scale the flint grains, chert, quartz, feldspar, mica of heavy minerals (garnet, epidote, zircon, tourmaline etc.) are found. The thickness of this complex varies from 100 to 350 m.

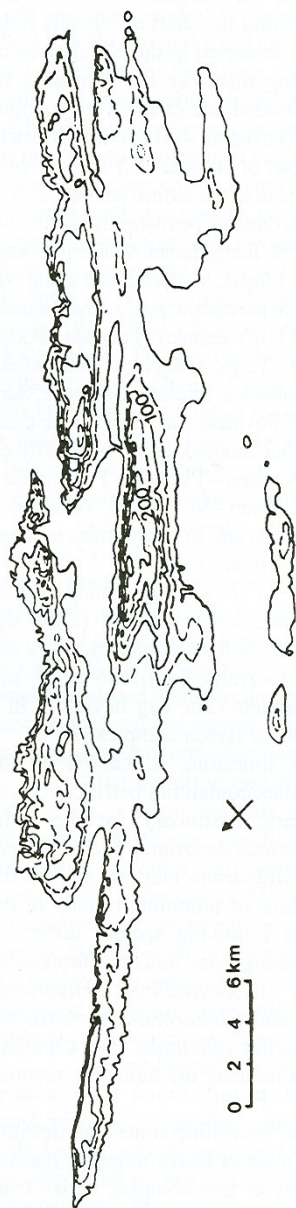


Fig. 2 - Hipsographic map of the Pag island  
 Sl. 2 - Hipsografska karta otoka Paga



Fig. 3 - Geological map of the Pag island : a) Cretaceous limestone and limestone with dolomite, b) Paleogene limestone, limestone breccia, limestone and conglomerate, c) Middle-Upper Eocene "flysch", d) Miocene-Pliocene marl, e) Quaternary (Deluvium and Aluvium)  
 Sl. 3 - Geološka karta otoka Paga: a) kredni vapnenci i vapnenci s dolomitima, b) paleogenski vapnenci, vapnenačke breče ili vapnenci s konglomeratima, c) Flis srednjeg i gornjeg eocena, d) mitocensko-pliocenski lapori, e) kvartarne naslage (deluvij i aluvij).



These sediments suggest the so called molass formation, stratified in the period of orogenesis but outside geosyncline. In nowadays scenery they stand out with their peculiar outfit in relation to the limestone forming with them an outstanding visual contrast. They are very often covered with younger and softer Quaternary sediments. On the surface a favourable pedologic cover is formed mainly of brown soils in flysch.

By the end of Palaeogene, Eocene-Oligocene sediments of younger Palaeogene (Pg<sub>2,3</sub>) are probably formed made of limestone breccia, of various sizes, age from the Jurassic period to Eocene with conglomerates. They can be found in the Lun Peninsula northwest of Novalja, and they appear sporadically west and southeast of Novalja as erosive remains on the cretaceous ground. They are transgressively located on limestone of the upper Cretaceous age.

The connection of breccia and conglomerate is mostly calcite, often reddish or contaminated by clayey contents. The fragments of breccia often contain petrified remains corresponding to their age. Their formation suggests the distinguished erosion in a high relief outstanding space, fast and intensive washing out of slopes, short transport and fast accumulation. The sediment thickness is here from 50-100 m.

A very interesting and rather rare Miocene-Pliocene complex of Neogene (M,Pl) can be found in Pag at Kolan divided into two zones, one in Kolan field, and the other in the Crnike area on the coast of the Pag Bay. It is mostly covered by younger Quaternary sediments and therefore it can not be seen on the surface in Rogoza zone, or it is flooded by the sea in the Pag Bay. The question is about clayey and less sandy marl with some lime pebbles (concretions) and the appearance of coal (lignite). They are well deposited, and their colour is grey greenish, grey to dark grey. Lithologically, it is about very fine sand with coal shreds. The sediments were probably formatted by wearing and transporting of flysch sediments, and their thickness was defined by drilling which comes to 143,6 m. The coal of Kolan is of a good quality but it is not the matter of economic quantities for bigger exploitation. Before the First World War an Italian joint stock company pulled it out.

These sediments abound in microfossil remains of Miocene-Pliocene animal and plant life: foraminifera (Miocene), gastropoda, ostracoda, fish teeth, eggs (mostly Lower Pliocene), pollen and spores of different plant genres (*Engelhardtia*, *Larix*, *Taxodium*, *Pterocarya*, *Cupuliferae*, *Quercus* etc.).

Among bigger petrifications, older researches have already confirmed the finds of fragments and pieces e.g. *Taxodium distichum miocenicum*, *Pinus holothana*, *Sequoia langsdorfi*, *Congeria triangularis*, *C. cf. croatica*, *Paludina acuta*, *Melanopsis esperi*, *Unio* sp., *Planorbis* sp. etc.

Among the youngest, Quaternary (Q) sediments, most frequently diluvial and alluvial layers are found in Pag. There are diluvia in the Pag valley, Novalja valley (from Stara Novalja to Caska) and in the Kolan field, around the mud Rogoza, in The Povljana valley, around Metajna and very little in the Vlašići valley. It is about the deposits from slopes, weaker or stronger, sandy-gravelly connected. In the gravel pit near Pag these layers are even 14 m deep. Alluvia can be found mostly in the Povljana valley, in the southern part of the Pag valley along the creek flowing downward to Dinjiška, in the mud Rogoza, at Kolan and very little in the Novalja valley. The Quaternary formations, e. g. in the Novalja field, were made of sand with clay lenses and clayey sand 3-4 m deep, 6 m at the most. The appropriate sediments in Kolan field are formatted by sand, clay, sandy pebbles, breccia, silty dusty and clayey alluvial deposits and recent forms of

the developing peat soil. The sandy layers are in the upper parts of the field, whereas clayey composites prevail in the lower ones. In the Pag valley the Quaternary sediments are formed by sand, clay, clayey sand, clayey deposits, clayey deposits inside sand, calcareous karst, sandstone and breccia.

Tectonically, the Pag Island pertains to the tectonic unit of Ravni Kotari, whose characteristic is the change of gentle vertical or weakly inclined folds of the Dinara range. The anticlines Lun - Novalja - Košljun dominate, St. Nikola - Grabovac - Fortica and Caska, and synclines Novalja - Pag - Dinjiška. There are more smaller synclines and anticlines. The Barbat zone is mostly differentiated by faults.

From raw minerals the most outstanding are the deposits of pebbles at Pag and Stari Grad, beds of high-quality lignite, quantitatively non-exploited at Kolan, and bauxite deposits in the Novalja - Dabove - Lun stretch. The research works were made at Novalja and Maun but without any significant results due to scarce deposits.

### **Relief**

Mostly carbonate structure of the Pag Island and the spreading of layers in the direction NW-SE affect its basic relief properties. Different notion of anticlinal crests and types of peneplain surface dominate the island, with one larger and several smaller ones also longitudinal narrow dell zones between. It is the reflection of geomorphological basis of the island determined by its longitudinal stretching of relief structures mostly coinciding with the ones in the North Dalmatian land.

The most prominent crest in its length and height runs to the west and outward from the cape of Lun on the NW to the cape of Škamica and the rocks Sikavci on the SE. It can be called conditionally the ridge of St. Vid (349 m). Here and there the remainders of older erosive plains in karst are manifested, which are split from the Kvarnerić area, namely, the valley Novalja - Pag by gentler or steeper slopes. They came to different high-altitude positions by younger tectonic disturbances being eroded recently. The highest peak is St. Vid, and the most distinguished are the peaks through the NW towards SE Mlaji (127 m), Krune (140 m), Kućicino (133 m), Gradac at Stanišće (135 m), Veli Vrh (131 m) at Lun, Šegovica (77 m), and Stražica (64 m) in the lower part between Novalja and Kolan, Grubišnac (165 m), Gradac at Kolan (206 m), Nebeska (256 m), Bošanić (302 m) NW and Vela Crna Glava (316 m), Visoki Brig (262 m) and Gradac at Pag (197 m) SE at St. Vid at the highest part of the ridge, and Debelo Čelo (53 m), Turnić (60 m), Orlova Smrt (78 m), Pasja Stina (80 m), Stražica (63 m) and Jamurina (40 m) at the milder SE prominent part of the island. The elevation Panos or Lopata (134 m) and Olišnjak (244 m) are divided laterally, west of Kolan by the Bartol dry valley and the valley Vrulje at Kolan.

The eastern or inside crest runs to the cape of Ded on Zaglav to the NW to the cape of Fortica on the SE. It can be conditionally called Barbat and Kršina ridge. It is divided into the NW part (Zaglav and Barbat) by the deep Strait of Pag (the depth larger than 50 m), and to the SE part (Kršina - Fortica). The Strait of Pag is the sea passage, which connects the Velebit channel with the Pag bay emerged by recent drowning of the deep canyon valley of the former water flow. The waters of Novalja - Pag valley, quite possibly, flew into the pleistocene bed of the Zrmanja river whose course can be followed in the Velebit Channel to the strait between Rab and Pag (MAGAŠ, 1993, 36). Morpho-genetically, this crest is adequate to Kamenjak on Rab, namely, to Ražanac - Slivnica in Ravni Kotari. The stretch in some places and flat surface of the crest (Zaglav,

Prozor, Ravno in Kršina, Dolac etc.), the similarity with the floors of the southern slopes of Velebit (see ROGIĆ, 1958, 1972) and later erosive-tectonic differentiation, indicate that it is the question about the remainders of the karst plateau. The dissection by numerous coves and gullies is pointed out, especially towards the Velebit Channel. On Zaglav and Barbat from the NW towards the SE are the prominent karst peaks Čun (on Ded, 41 m), Orlje (178 m), Karsa (176 m), Komorovac (206 m), Zečji vrh (140 m), Modrža vrh (129 m), Tusto čelo (190 m), Osapnik (174 m), Kozje brdo (127 m), reaching the highest altitudes NE and SE of Metajna: Narčela (210 m), Panos (218 m) and Teplice (206 m) and ending with the rocky high grounds of Furnaž (117 m), to Čun (90 m) and Kristofor (47 m). Extending to the SE part of the island, this island ridge begins with the cape of St. Nikola and rises towards Ledenik (236 m) and the most distinctive Veli Brig i.e. Kršina (263 m), and further on the peaks Ražaško (208 m), Vlaški Brig (182 m), St. Ivan (153 m), Vrši (154 m), Pećane (139 m), Tri Gramače (126 m), Grabovac (129 m), Stražica (124 m), Panos near Magaš (127 m), Strigarska Glavica (121 m), Tusta (112 m) and Prlinac (51 m) follow.

Separated from the two named most outstanding island ridges considerable smaller crests are placed longitudinally. In Selce at Mandre, separated from Panos (Lopate) by the small cove and the Šimuni Cove, is a relatively low Lisičnjak (72 m). West of Košljun there are Kruna Zaglav (63 m) and Trstenik (17 m) with which the drowned crest ends in its greater part which can be followed from the islet of Škrda (54 m) across Maun (with peaks Brdo Golubere 40 m, Debelo brdo 65 m, Rankovica 61 m, Mali 7 m and Veli Brušnjak 19 m). Between the Dinjiška cove and the Vlašić valley there is Vlašičansko Brdo (74 m with Ploče 73 m and Kraljeva Ograda 71 m), and in Prutna the peaks of Rastovac (14 m), Panos (61 m), Škrline (42 m) and Vranjinac (38 m) dominate.

Karst crests are mutually separated by longitudinal valleys. *The Novalja-Pag valley*<sup>4</sup> predominates, running between the two largest crests. Its flooded part divides it into two separated parts, the Novalja-Caska and the Pag-Dinjiška valley, whereas the central part is preserved only sidewise, along the bay margins, prominently featuring in the landscape by sharp contrast to carbonate rocks. Smaller *valleys are Poveljana, Vlašići, Kolan and Smokvica valley* but there are softer sediments on Barbat either. The valleys are the most important agricultural regions of the island, filled with soft sediments, Eocene flysch and the Quaternary sedimentary deposits. The examinations show scattered depths of the youngest alluvial layers up to 5-6 m.

Karst morphology is expressed all over the island. The proof of its prominence even at its oldest epochs is the evidence of a very old toponymy connected with the karst configuration.

*Endogenous* relief is designated by neotectonic forms of the karst shoulders i.e. crests identical with the geological anticlines (Lun peninsula, Kršina, St. Vid etc.), fault slopes, faults, fissures etc. *Exogenous* relief is designated by various forms of *sloping, fluvial, karst (in a narrower sense), fluvio-karst, marine and antrophogenous relief*.

*The sloping relief* is represented by various destructive forms of non-active pediments and glacis, narrowly dissected and non-dissected reefs, conical or rounded peaks, saddles (Prozor, Počivalo etc.), rocky walls, drippings, derasion valleys, land-slide

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<sup>4</sup> Very often this and many other valleys in Pag are traditionally called *polje* even though morphogenetically it is not the question of classical types of karstic *polje* but of valleys filled with small, soft sediments. Morphogenetically the type of field would correspond only to the flooded zones of Velo and Malo blato.

sites and ravines. Accumulative forms of the sloping relief, landslides, salted soils, colluvial masses and proluvial inundations, are also seen in the island.

The characteristics of *fluvial relief* are evident in the valleys where the water inundating formations made of sand and pebbles are so frequent.

*Real karstic forms* of relief are here most predominant, with numerous manifestations of bleak rocky country, rocky, pitted and off-shore karst full of cracks in lime-stone, karstic valleys, huge stones and various accompanying micro and macro forms. Very frequent are karstic valleys, sink-holes, dolinas, hips, cages, pits, semi-caves, notches etc.

*Fluviokarstic forms* stand out by numerous dry fossil valleys (creeks) either without water flow or with temporary water-worn ravines, some hanging dry valley, closed karstic valley (with temporary water flow), plateaux in karst and muddy zones (Velo and Malo Blato, Rogoza).

*Marine relief* is represented by different abrasive forms of low and steep cliffs. Low rocky cliffs are made of limestone, sandstone, dolomite, marl or conglomerates. Cliffy shores are mainly of limestone and more rarely of sandstone, and periodically, they are constantly or occasionally exposed to abrasion.

Out of anthropogenous relief the quarries (abandoned or active), gravel pits, piers, dams, terraced hillsides, drystone walls (defensive, protective, enclosing etc.) huge stone masses etc., stand out.

Conditionally taken in consideration ecological evaluation of relief shows the influence of a comparatively great part of unfavourable good categories, the existence of some relatively less precious grounds, whereas a valuable and highly precious relief is poorly manifested.

Long and indented coasts are specially distinguished relief categories of the Pag Island. With the coast of 269,2 km (145,4 NM) in length Pag is together with Dugi Otok the most indented Croatian island with the index of indentedness  $I=4,50$ . The coast of Pag is together with Maun, Škrda and other appertaining islets over 300 km long. The appearance and coastal forms are directly connected with the structure and composition of coastal rocks. Therefore more gentle coasts are mainly connected with flysch and alluvial valleys ending with sandy and gravel beaches or gentle hillsides (the Pag bay with coves Caska, Zrće, Pag, the cove Povljana and Stara Povljana, Vlašići, Dinjiška, Stara Novalja etc.) The most beautiful and the largest beach is on Prosika in Pag but the beaches Zrće, Straško etc. are also attractive where gravel is the most frequent. The major part of other coasts, especially the ones to the north-eastern sides of the island, are unfavourable and rough, exceptionally at the mouths of water-worn ravines or less steep areas.

In the Pag island there is a number of potholing objects, especially caves, notches, pits, precipices etc. One of the caves is in the region Antibel NE of Gračište SE of Stara Novalja. A smaller cave is along the coast NW of the town of Pag, opposite Krištofor, the sign for the cave on the topographic map is Golubara. Smaller cave is at Stari Grad. There is a smaller cave above Dinjiška in the locality of Kućine. The mentioned cave Šepurine is in the Maun Island with the homonymous well in its nearest vicinity.

The Ivča pit is at Caska, a pit typical for karst, probably a sign of boundaries between a part of the island Pag and Novalja in the past. There is a similar pit above the Gaća cove at Kustići. On Barbat there are some outstanding pits in Brestovac east of Metajna and the pit in Teplice above the Slana cove. There is one pit in Kršina in the nearest vicinity NW of the highest peak (Veli Vrh 263 m), and one in the region Rudinsko. There are two pits in Veli Drakovci at Povljana in the southern

part of the island, and one in Tust northly of Miškovići. Besides, there is one pit in Binjac east of Košljun. Some toponyms speak of speleologic phenomena: Jamurina (water 350 m SW of the pit in Rudinsko), Pećani etc.

### *Climate*

The island of Pag as regards climate belongs to the transitional eumediterranean-submediterranean zone of the Mediterranean climate, which reflects in the plant cover, soil features, karstic forms etc.

It does not differ essentially from the neighbouring areas of the Ravni Kotari coastal zone and the Rab Island. There are less microllocation particulars because of different insulations, exposed position to the wind and other climatic factors. The main meteorological stations are in Pag and Lun (Gager), and rain-gaugy stations are still in Novalja, Vlačići and Barbat.

The global radiation is calculated with approx. 357 cal/cm<sup>2</sup> a day (116 in December, 604 in July), which is more than in Zadar and other parts of the Zadar archipelago, and considerably more than generally in the northern Adriatic.

Tab. 1 Annual schedule of global radiation in cal/cm<sup>2</sup>/day

Tab. 1. Godišnje vrijednosti globalne radijacije u cal/cm<sup>2</sup>/dan

Station/ zone	month												
	J	F	M	A	M	J	J	A	S	O	N	D	Ann
Pag	143	226	322	440	501	585	604	530	408	253	158	116	357
Zadar	131	237	296	399	450	547	588	513	385	238	145	105	334
North. Adriatic	140	200	270	370	420	530	550	480	350	220	130	100	310
Zadar Archip.	140	220	275	400	450	550	590	510	375	225	145	100	332

Source: TEŠIĆ, 1974, 366; ROGIĆ, 1972, 145

The number of sunny hours for the period from 1961-1985 was in Pag 2268/ per annum, which is a great deal less than in Zadar, 2475/per annum, and that is the result of larger energy relief in the nearest surroundings of the town of Pag. Annual schedule of the number of sunshine hours<sup>5</sup> is shown by the following table:

Tab. 2 - Annual schedule of sunshine hours

Tab. 2 Godišnje vrijednosti broja sunčanih sati

Station /period	month												
	J	F	M	A	M	J	J	A	S	O	N	D	Ann
Pag 1965-85	82,4	118,6	156,2	198,3	245,7	281,4	324,4	290,5	231,6	167,5	99,2	74,2	2268,2
Zadar 1965-85	108,1	129,1	171,2	201,7	266,7	291,3	345,0	308,0	240,1	194,3	121,2	98,1	2474,8

Mean annual temperature in Pag is 15,3°C (1951-1985), mean amplitude is 17,7 °C between 7,0°C in January and 24,7°C in July. The measured temperature maximum is 37,0°C (1957) and minimum of -12,5°C (1963). Measured mean temperature in Lun is 15,2°C and

<sup>5</sup> Meteorological chronicle I (1961-1985), Federal Meteorological Institute Belgrade (hereinafter MGSHZ).

maximum 37,0°C (1957). The hottest months are July and August, and the coldest January and February. Mean course of air temperature can be seen from the following table:

Tab. 3 Mean air temperatures (°C)

Tab. 3 Godišnji hod temperature zraka (°C)

Station (period)	month												Ann	Ø ampl
	J	F	M	A	M	J	J	A	S	O	N	D		
Pag (1951-85)	7,8	7,5	9,9	13,6	18,2	22,1	24,7	24,1	20,8	15,8	11,7	8,7	15,3	17,7
Lun (1952-63)	7,6	7,5	9,5	13,5	17,4	21,2	24,0	24,1	20,8	16,2	11,9	9,1	15,2	16,6
Zadar (1850-87)	6,7	7,2	9,4	13,5	18,1	21,9	24,5	24,1	23,3	16,1	11,5	8,0	15,2	17,8

Source: Climatic data of SR Croatia, RGZ, Zagreb, 1971; MGSZH I (1951-1985); For Zadar supplemented with older and latest data.

Relative humidity air course is very favourable, annually below 70% on average. The relative mean humidity of 68% (1948-1960) was measured in Pag, and in Lun 66% (1952-1960). Mean annual precipitation quantity in the island of Pag is between 1050 mm and 1106 mm a year. Through several-years records relatively standard values have been obtained in Pag, Novalja, Kolan, Vlačići and Lun (Gager), just a little bit less precipitation has been recorded in Novalja, and value clashes of some months for Gager are the result of a short examination period. In comparison with the southern Zadar, Pag receives on average 150-200 mm more precipitation a year. The precipitation are most frequently connected with the so called cyclonic north-eastern wind *bora* ("dark *bora*") or south winds. The biggest quantities of precipitation have been recorded in all stations in the period September - December, with maximum in November. The least quantities of precipitation have been recorded mainly in July (Pag, Vlačići, Novalja). It is unusual that except in Vlačići (and in Lun), August stands out by the quantity of precipitation of most summer and spring months. It suggests significant and sudden showers in the second half of August, which in some years repeatedly raise the averages of this month. Besides, drought is very frequent in June which happens to be considerably less rainy than August.

Tab. 4 Annual course of precipitation (mm)

Tab. 4. Godišnji raspored padalina u mm

Station (period)	month												Total
	J	F	M	A	M	J	J	A	S	O	N	D	
Pag (1955-1984)	92	89	85	74	72	53	43	92	110	129	146	121	1106
Novalja (1955-1984)	88	85	77	77	68	55	48	86	113	120	147	118	1050
Kolan (1959-1979)	85	88	84	79	70	52	58	90	112	113	146	123	1100
Vlačići (1959-1984)	97	85	86	71	77	55	43	71	110	125	138	120	1081
Gager (1952-1963)	12 4	85	78	63	50	51	61	50	105	155	155	121	1099
Zadar													

(1930-1987)	86	72	68	58	54	55	34	43	90	118	124	111	914
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Source: MGSZH, II (1955-1985), For Zadar supplemented with older and latest data.

Average number of days with precipitation<sup>6</sup> bigger than 1,0 mm in Pag is 86,1, in Novalja 83,2, in Lun 86,4, in Kolan 75,5, and in Vlačići 72,8, and in Zadar 87,4 annually. The number of days with heavy precipitation of 10,0 mm and more is uniform and it was 39,0 in Pag, in Lun 37,1, in Novalja 37,6, in Kolan 37,2, in Vlačići 38,8.

Snow is rare and lasts for a short time<sup>7</sup>. Average annual number of days with snow is in Pag 1,7, in Lun 2,2, in Novalja 0,5, in Kolan 1,8, in Vlačići 0,6, in Zadar 1,9. The biggest measured snow heights are in Pag 40 cm, in Lun 37 cm, in Kolan 5 cm, in Novalja 15 cm, in Vlačići 7 cm, and in Zadar 18 cm. These averages, as there are no data for Novalja, Kolan and Vlačići for an extremely snowy year -1956, and the data for a very severe winter of 1985 have not been included, have to be taken with a qualified acceptance. Namely, Pag, Kolan, and Lun have more days with snow than Novalja and Vlačići. A very heavy snow followed by bad weather and north-westerly winds was recorded in 1956 (8 snowy days) and in 1985. Snow and bad weather were very heavy in Kolan and Pag in 1971, but they were not recorded in Novalja and Vlačići. There was also more snow in the island in 1963.

Average annually cloud<sup>8</sup> is in Pag 4,5, in Lun 4,6, in Zadar 4,4 tenths of the sky. The number of clear skies per annum<sup>9</sup>(less than 2 tenths cloud of the sky) and on the average it comes to 118 in Pag, 123 in Lun, and 115 in Zadar. The number of cloudy days (with cloud larger than 8 tenths of the sky) comes to 90 in Pag, 75 in Lun, and 84 in Zadar.

Windiness predominates the Pag Island, especially in its NE sides exposed to *bura* (*tal. bora*, NE dry and relatively cold wind) blowing from Velebit. *Bura*, (ca 35% of all winds) can blow at hurricane-like strength, especially in the winter season, and in the summer time it is generally more rare and weaker. During the autumn and spring times of the year it can sometimes surprise which in that case has negative influences on field crops. Sometimes *bura* interrupts the traffic of car-ferries and the land overlooking Velebit, and even with the bridge in the road Zadar-Pag. Along with *bora* salt appears covering the NE sides, and more rarely the whole island, making crops, soils and waters salty, and that way causing severe damages and rendering impossible the renewal of the flora at denuded parts. An old datum shows that on the average per hectare around 530 kg of NaCl per annum has been deposited in Pag (GRAČANIN, 1935, 107-181). The data obtained by examining the waters in the island (MAGDALENIĆ, 1974; MAGDALENIĆ, 1984, 119-137) show the raised salinity i.e. chlorinity. So it was found mainly 170-200 mg/l of Cl in puddles, and most in the puddle at Vrčići, 420 mg/l Cl. It was remarkably lower in cisterns and moving from 20 mg/l (Lun) to 180 mg/l Cl (Vrčići). Chlorinity ranges in wells and springs from 30 mg/l to 300 mg/l Cl most frequently, but it can reach higher values either. So at scooping the water up at Velo Blato it can reach up to 600 mg/l Cl, and in some spots on flysch and Quaternary layers even more (spring at Vrčići more than 700 mg/l, spring east of Metajna more than 1500 mg/l Cl). Offshore brackish waters have a considerably higher chlorinity, from 800 mg/l Cl to more than 10.000 mg/l Cl (MAGDALENIĆ, 1984, 126, 131, 132). Besides *bora*

<sup>6</sup> MGSZH, II (1955-1985), For Zadar supplemented with older and latest data.

<sup>7</sup> as veg. 6.

<sup>8</sup> Ibid. p. 121.

<sup>9</sup> Ibid.

the south wind *sirocco* dominates, too, and it is the most frequent wind in the island (about 39 % of all winds).

### **Waters**

As all karstic area, the island of Pag is in want of above-ground and underground waters. However, water is important and present all over the island, and it is used and appreciated from the earliest days of population of this island about which a very old island hydronymy gives evidence.

The appearances of lake-mud are found at Povljana, where there is Velo and Malo Blato, and at Kolan in whose vicinity is the mud Rogoza. The water flows are periodical in the Novalja, Vlačići and Pag flysch valleys, in mud Rogoza (Vrulja), and connected to V. and M. Blato. Gullies (ravines) are an occasional event during heavy rains on karstic slopes, when the excess water is rapidly flown away down the dells to the sea or under the ground. Wells, springs, submarine springs and puddles are frequent, and rich hydronymy suggests of significant and ancient water appreciation from the earliest days.

Modern methods of water supply in the 20<sup>th</sup> century have imposed professional explorations, especially hydrogeologic. Owing to them we are aware that local water supplies are not enough to fulfill the entire needs of the population and economy, so today the water supply of the island normally proceeds partly from the land. This supports the fact that the quantity of water evaporation from water surfaces is above 1800 mm on the average per annum (data from the salt pans for the period from 1955-1980), which is 70-80 % more than the determined precipitation quantities (MAGDALENIĆ, 1984, 121). Most of the waters disappearing underground are filtered towards the sea or towards the karstic valleys, respectively parallel with the valleys on the surface to the sea. Therefore submarine springs (11) and brackish springs (more than 60) are very frequent along the coast. There are no permanent flows, and brooks appear occasionally in low valleys (Foše, Ričina, Vrulja etc.) Very rare events are heavy abundant springs of several litres a second.

Nevertheless, in some situations local springs of water could be of great importance. Therefore it is of use to remember the existing waters, which have made possible the survival of population and the development of this island for thousands of years.

In Lun there are Donja Lokva, Lokva at Stanišće, Slatina at Gager, Lokva at Peričev Kanat. Then Donja and Gornja Lokva follow and the cove of Potočnica at the hamlet Bonaparte, Lokva between Bonaparte and Vidas, puddles Liša and Vrginica between Vidas and Dabove, three wells and Lokva in Dabove - Stare Kuće zone, Lokva in the hamlet Škunca and Lokva and well in the hamlet Šankovi.

In the NW part of the Novalja valley there is a more abundant and captive spring Škopalj, (obviously used in antique period, "Talijanova buža", ILAKOVAC, 1982), which together with three more drilled wells gives 5-6 l/s of water in summer (MAGDALENIĆ, 1984, 128), and in winter almost three times as much. It is about subartesian, partly artesian flow under pressure as the sand in this part of the valley is covered by clay. Larger puddles are Svetojašnica in the Stara Novalja area towards St. Janj and the puddle in the Pecašna cove NW of Žigljen,



Kaljac and Prozor (Prozorska lokva) in the slopes of Prozor toward Caska, Peteljka at Zrće, Lokva in Špital at Novalja.

At Kaštela there is the well Gušternica, and with the swampy mud Rogoza more springs are connected (Dobra slatina, Vruja in (V)Rankovci and Lokva) in the zone of Slatina at Gajac. Drilling to the underground water near Dobra Slatina quantities of water of about 8 l/s have been obtained but with an increased chlorinity (ca 2000 mg/l Cl) (MAGDALENIĆ, 1984, 125). Fresh underground waters are mixed in mud together with waters flowing up in rainy season from the Kolan field (brook Vrulja) with the salted water, which is a good basis for making peat in the lower muddy parts. The dell of the Vrulja has been formed in the upper flow rather distinctly, and in Rogoza it has overflowed with mud and has been flooded. The Rogoza mud basin covers an area of 3 km<sup>2</sup>. The springs Uljačine, Motišnjak and several wells (Butovac etc.) spread in the Kolan field.

On Barbat there are puddles in karst at Komorovac, Osojnik, at Kustić in Gaća Cove, the well in Zubovići, and in the Metajna area there are three springs along the shore, from which one is the biggest among the Pag springs which get the water from limestone, (0,25 l/s in summer and several l/s in winter) (MAGDALENIĆ, 1984, 125), then there is one on the slopes of Panos and one in the Malin Cove. Between Caska and Kustići there is Vela Vrulja Cove. The cove of Slatinica, Cape Vruje, Vruje Peći, Lokva at the cape of Zakučenice in the northern side of Barbat confirm the appearance of water even at the most karstic regions.

Springs and swampy soils from St. Duh (Crkvina) at the foot of Grubišćina, across the spring in Filino cove, Hričevac Grdanov, Oguičeva Voda, Mirmanića Voda, Kozlinjak to Bošane, Vodice, Marijanovo and other springs in the western side of the Pag Bay, are connected with the flysch zone. These waters appear usually at the touch of quaternary sand and Eocene flysch, they are not brackish as marl and sandstones along the coast prevent the sea breakthrough. Abundance of these springs is small, below 0,05 l/s (MAGDALENIĆ, 1984, 130).

In the Selce area to the NW there is the Slatina Cove, the well and Lokva in the region of Vrtače, Lokvanjić at Šimunsko Polje, Lokva in the Lazina Cove. There are two puddles (pools) east of Kolan on the crest of St. Vid in the area Nebeska and Rujna Lokva and Lokva at the foot of St. Vid. From the SE the puddles Sušica, Bunarić, Lebarska Lokva, Bodulska Lokva, Lokva St. Jelena, Lokva NW of Dumboka Draga, Bevandičeva Lokva, Dumbočica, Lokva Gaj continue. There are two larger wells in the Javor zone at the Proboj Cove where there is a pit with water, and in the Bok Cove at Košljun there are two springs called Vruje and a pit with water.

More springs are connected with the NE part of the Pag flysch zone from Pag to Gorice: Kokolovo, Mirožić (captivated), Na Babino, St. Jadrić, Smamjakova Voda, etc. The most outstanding is Mirožić which gives 0,8 l/s in summer, and in winter even more than 3 l/s of water, whereas the others are considerably less abundant, in summer usually less than 0,1 l/s. In 1995 it was connected with Pag by waterworks. By hydrogeologic works 3 wells were dug 12 m deep which altogether give 1,5 l/s in dry season. There are a couple of bigger wells in Pag, and in the whole zone to Dinjiška there are more than 70 smaller private wells, with richness without exception under 0,1 l/s (MAGDALENIĆ, 1984, 127, 129).

On the southern side of the saltpans there are also some springs: Mlinovo, at St. Stari Grad, at St. Kuzme, at St. Bartol etc. Farther on, to the SE part of the Pag valley there

are more springs, especially at the NE side: there are three springs at Vrčići (one is captivated), Križina and Studena at Stara Vasa, Lokvina in field, spring and well in Foša at the foot of Šišini, and the springs Svaroš and Slana in Dinjiška. From the Vrčića area a brook periodically flows toward NE to Solana, and at the foot of Humiči more streamlets arise (Križine, Lokvina) joining and flowing away down the Foša area to the Dinjiška Cove.

There is a great number of puddles on the limestone crest of St. Nikola - Fortica, from Pag to Dinjiška: at the foot of Ledenik, south of St. Nikola, SE of Veli Brig, Slana at the foot of Vlaški Brig, Jamurina, Propast, Paštorova Lokva, Movra, Kalac, Kopna, Slana at Šišini, Lokva in Kolišče, Lokva in Kućine, Vranjinac etc. The name Slana partly confirms the saltiness of these puddles.

In Poveljana field there are about ten bigger and about 200 smaller shallow wells (2-4 m deep and the water level is 0,5-2,5 m high.) (MAGDALENIĆ, 1984, 130) which serves for watering. A smaller gully called Ričina sometimes flows into the same cove at the far end of the Stara Poveljana Cove. Two springs called Jezerine are fairly abundant, to several l/s of running water. One well is in the Smokvica Cove, linked to that flysch zone.

In the Vlašiči field there are about ten bigger and smaller wells through which Ričina flows into the valley with the same name at the end of the Vlašiči Cove. On the spot where the fields and the crest touch each other at the southern side of the mouth Ričina there is the Krasulja Spring.

Velo and Malo Blato (MAGDALENIĆ, 1984, 125, 126) are permanent lakes at the southern part of the island N and NE of Poveljana. Velo Blato with the area of 1,6 km<sup>2</sup>, 3 m deep, 1,8 km long and about 1 km wide, with the confluence area of about 6,5 km<sup>2</sup> is the most significant water supply of the island (345 smaller and bigger springs, flowing power is about 780 m<sup>3</sup> a day). Next to Blato there is Šipnata, a toponym suggests using the water from the earliest days, during heavy rains a small brook flows from SE side into Blato, and from NE and SW side short-lived springs appear. During longer dry period the surface of the lake is reduced to 1,12 km<sup>2</sup>, and the water level from its maximum of 2,36 m, comes down to the altitude of only 0,5 m, and the surface of the water about 1,3 km. The deepest point of Blato is -1,8 m. The lake is a protected natural object because of specific plant and bird life. Mild saltness (430-720 mg/l Cl), on the average about 600 mg/l is the result of salt. Water temperature depends on the season and weather conditions. Rarely, when the temperatures are very low, the lake freezes, and in summer the temperature is very often above 20 °C. Underground connections of Velo and Malo Blato have been proved by staining, whereas connections with the sea are probably revealed at high water levels. At the NW end of the lake a captive gallery with periodic abundance to 20 l/s was built in 1971 from which the waterworks expanded to the town of Pag (across Vrčići and Gorica) and Poveljana making the necessary water supply possible for the southern part of the Pag Island.

Malo Blato is situated immediately along the Mlinica valley connected with the channel very often cutting the waterless mud surface. During the dry months only underground water springs are present, here called *krinac*. Water is very often brackish, as it is salted directly by sea and salt marshes. The mud surface is about 0,9 km<sup>2</sup> at high water level.

In the SW side of the Prutna peninsula there is Vrska Vrulja, the spring Vrulja in the Mali lazi cove, and the well and puddle in the Selina cove.

There is a puddle in the middle of the island in Škarda, and on the Maun Island the well Šepurina next to the cave with the same name at the central part of the island (Tanko), Lokva in the region Crkvine at St. Ante in the northern part, and two puddles in the southern part of the island (near Kolan port and in Koromačno).

In the islet of St. Pavao (V. Sikavac) next to the church foundations there is a less salted puddle.

Springs, mud and puddles are on the island of Pag very often with the raised salinity, namely, chlorinity. It is the result of very heavy saltedness (hoar-frost, rime) caused by *bora*. Magdalenić drew the attention to very interesting hydrogeologic formations relating to salinity and chlorinity in the mud Rogoza and in the Povljana valley. In the western part of Rogoza "open water surfaces in dry period contain from 5000 to 6000 mg/l Cl, and in the eastern part from 700 to 2000 mg/l Cl. In rainy season the entire field is flooded and water mixing is possible. At the time the chloride quantity is reduced to half in the western side, the values being almost identical that way." "The Povljana field differs by chloride substance. The water samples from 126 wells have been analysed. Chloride substance ranges from 160 to 350, and in the central part of the field 400 and 500 mg/l Cl. This phenomenon has not been completely explained." "Small chloride particles have been registered in the Novalja field (spring Škoplje 136 mg/l Cl). Springs and wells in the upper Kolan field contain from 140 to 160 mg/l Cl. Springs along the western shelf of the Pag bay have from 140 to more than 200 mg/l Cl. The chloride contents vary from 260 to 270 mg/l in dug wells. The springs and wells of the Vlašići field contain from 240 to 270 mg/l Cl" (MAGDALENIĆ, 1984, 132).

**Sea waters** around the island of Pag appertain to internal waters of the Republic of Croatia. The Nin-Ljubač channel divides the island in the south and SE from the Ravni Kotari land by a spanned narrow passage of the Strait of Ljubač, where Pag Island is closest to land. On the NE side of the island there is the Velebit (Velebitski, Podvelebitski, Podgorski or Planinski) Channel splitting the island from the Velebit offshore. Between the Pag and Rab islands, along N and NE coast, the Pag Channel spreads connecting the Velebit Channel with Kvarnerić washing the NW Pag coasts. Between Pag and Maun there is the Maun Channel, and the Vir Sea spreading towards Vir.

The deepest sea around Pag is in the Pag Channel (to 97 m), and a little bit less in the Maun Channel (to 91 m), Kvarnerić (to 87 m) and the Velebit Channel (to 85 m). The Strait of Pag is up to 63 m deep, and the Pag Bay to 50 m. The shallowest parts are in the Nova Povljana Channel between Vir and Pag (just 4 m), and towards the Nin Bay (the biggest depth of 15 m). The biggest denivelations are along the coast towards the Velebit Channel and along the Lun coast. Coastal shallow spots are more expressed in the SW sides of the island.

Sea transparency is considerable, and the currents are the strongest in the narrow passage of the Strait of Ljubač, Nin-Ljubač and the Pag channel. NE coasts of the island are exposed to waves caused by *bora*, whereas the exposure to the waves during *sirocco* is less. The surf along NE coasts caused the cliffy coast.

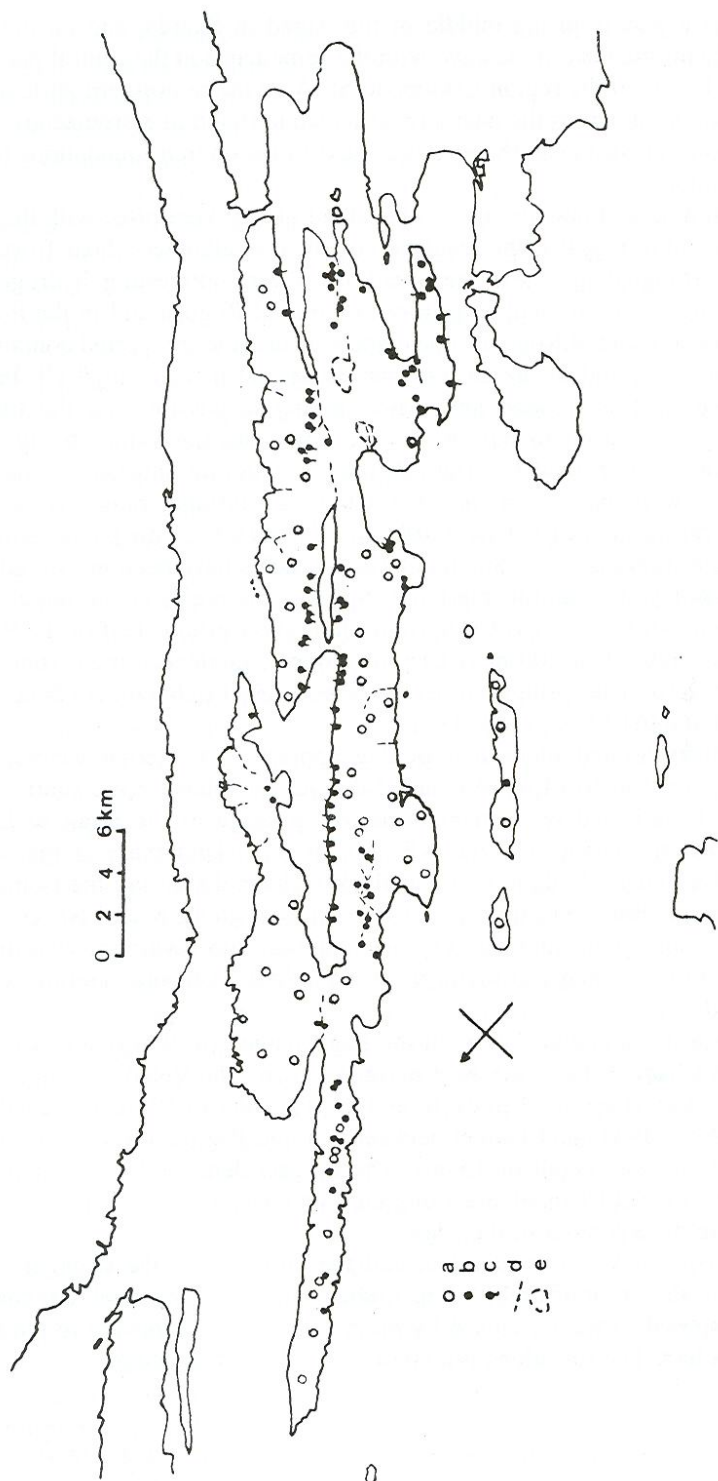


Fig. 4 - Hydrographic map of the Pag island - water appearances: a) puddles (pools), b) wells, c) springs, d) brooks, e) lakes  
Sl. 4 - Hidrografska karta otoka Paga - pojave voda: a) lokve, b) zdenci, c) izvori i vrulje, d) potoci, e) jezera

## Vegetation

Vegetation of the Pag Island varies. Climatically, the southwestern parts of the island with Maun and Škrda pertain to the real Mediterranean (Eumediterranean), and the northeastern parts mainly to the so called semi-Mediterranean (Submediterranean) vegetational zone. The major review of the basic plant life characteristics of the Pag Island, was made by S. Horvatić (HORVATIĆ, 1933; HORVATIĆ, 1934; HORVATIĆ, 1963)

He found altogether 650 various species and subspecies of vascular plants with a specific number of different subspecies (varieties and forms) without cultivated plants. A significant number of endemic plants have been found among them (45). More than 30 plant associations have been established (32), with several subassociations and 12 vegetational types. Although more than 40 years have passed since the island was phytogeographically explored and charted, and some changes took place, the basic classification of the plants has been of topical interest so far, and we use it in an abbreviated review of the Pag vegetation which has been completed by mentioning the presented regions and localities.

*Woods and underwoods* as the highest vegetational forms in this area occupy today a small part of the island, (about 15 km<sup>2</sup> or 5% of the total area) although after introducing electricity and gas in households they spread again at some favourable parts of recent rocky grounds (Selac, Paladinka). Eumediterranean association of *holm-oak woods* (*Quercus ilex*), found in the Lun peninsula, in the region Straško - Gajac, in Selce, around the cape Suha, and in the Šimuni punta, in the line Stara Novalja - Caska, on the Maun and the Škarda islands and some other places. Holm-oak mostly and some other accompanying species (holly, terebinth, myrtle etc.) have been found.

Long time ago these higher forms of vegetation occupied considerably larger areas of the island about which numerous phytonomy testifies which was very often kept even at the place where such cover had lost, or is being renewed again (Dubac, Crnotinac, Gaj, Komorovac, Komarde, Crna, Gajac, Vela, Srednja, Gornja i Donja Crnika, Dubrovica, Gorica, Dubrave, Grm, Mrta, Dubrovnik, Rastovac, Rasovača etc.).

In the Submediterranean zone *constituents of oak pubescence* (*Quercus pubescens*) suit it, preserved along the old road Pag-Novalja on the coast of the Pag Bay at the foot of St.Vid. Toponyms Grabovac, Brestovac, suggest of more wide-spreading community of this kind and some other species in the past.

*Associations of black and Aleppo pine-trees* (*Pinus nigra* and *P. halepensis*) have been regularly planted and cultivated in Pag by man. A sample of pine-tree sprouted from seeds brought by *bora* from Velebit is rare. The pine-woods are around Novalja (Grbica, Špital, Groblje) and in the zone Antibela - Morožin Peak - Košljun between Stara Novalja and Caska, in the region of Zrće, in Šegovići, in Mandre, around Suha Punta (Gredice), at Košljun etc.

As one of the most exposed degradational forms of vegetation in the Pag Island are various predominating *rocky pasture grounds, dry grassland, and meadows* in lower areas of the flysch valleys.

*Rocky pasture grounds of maritime small hills and karst* (*Asphodelo-Chrysopogonatum typicum*) have been found in Lun, in the Novalja - Zrće zone, around Košljun, Vlašići, Prozor, The Slatina Cove, in the Mavra - Stražica zone, around Povljana, in the region Binjac and somewhere else. Several facies out of this association have been especially differentiated: with *spinescence* (*Cytisus spinescens*), *immortelle*

(*Helichrysum italicum*), golden thistle (*Scolymus hispanicus*), Wulfen spurge (*Euphorbia veneta*), blue stem (*Inula candida*) and blessed thistle (*Cirsium acarna*).

Zones with *spinescence* have been ubiquitous in the locations east of Dabove, north of Šankov Kanat, in Stražica at the hamlet of Škunca, in the Škarić - Crkvine - Grubiščinac - Restur stretch, and especially in the zones Grobine - St. Toma - Kravarice and Negulići - cape Trstenik, and mostly in the zones of Košljun - V. Blato - Bas - Povljana - Dole, Prutna, Nesenj - Tašnice and Grabovac. The areas with distinguished *immortelle* are from St. Martin till Furnje and other smaller zones in Lun, Šegovice - Burin Bok at Novalja, at Šimuni, Kamik at Vlašići, NW part of Prutna etc. Rocky grounds with *golden thistle* can be found in a few smaller regions of the Lun Peninsula, in Prutna and Barbat, and there are some more in the Drakovac - Stražica zone and in Tusa (Dinjiška). A special facies with *Wulfen spurge* often grows in the Lun Peninsula (Kamenjak, Stare kuće, Šankov kanat - Novalja, Kolan etc.). Blue stem dominates the St. Peter's karst area, Kršine, around Lokve, St. Jelena, and in the region of St. Ivan etc., and the karst with distinguished *blessed thistle* has been found at Stan Okić.

The rocky feather-grass and medicinal sage (*Stipo-salvietum officinalis typicum*) have been found in a significant number, with a distinguished *blue stem* (stage with *blue stem*) here and there. It occupies the following zones: Selac - Veternica - Panos - Gradac, Gradac - Nebeska - Kapitanija, Paladinka, St. Peter, Kruna Zaglave, NE of Vrčići, cape Crnotinac, Dražica - Borovići, SE of Šankov Kanat in Lun, Straško - Gajac, in Vlašići hill, in Panos at the hamlet Magaš and elsewhere.

The so called *east-Adriatic submediterranean dry grassland viper grass* has been especially manifested such as *grassland of maritime hare thorn and pilose upright brome grass* (*Ononidi-Brometum condensati*), found in several different forms with *bog rushes* (*Schoenus nigricans*, on more humid ground), with *milliet grass* (*Chrysopogon gryllus*), with prevailing *pilose upright brome grass* (*Bromus condensatus*) and with *immortelle* (*Helichrysum italicum*). They usually occupy small areas along the northern side of the cove Mihovilje at Šankov Kanat, but they are somewhat more prominent in the Pag flysch valley in the St. Bartol - Zamet - Konija - Pliša - Lokvina - Križina - Studena zone, in the upper part of the Vlašići valley towards Velo Blato (Šarine Drage etc.), in the Povljana valley, around Malo Blato, at Magaš, and periodically along the NE coast of the Dinjiška bay. *Meadows* can be also found usually in valleys, in Pag at the most, from Gorica to Dinjiška, about Blato Rogoza, in lower parts of the Vlašići and Povljana valleys and in Malo Blato. The meadows are humid *Pospikal's sow fennels and littoral molinia* (*Peucedano-Molinietum litoralis*), meadows *strawberry clover and squirrel grass with facies of drizzle* (*Trifolio-Hordeetum secalini typicum with fac. Agrostis maritima*) and with special facies of *alkali grass* (*Atropis festucaeformis*, along the salted areas), *ditch reed* (*Phragmites communis*), and *strawberry clover* (*Trifolium fragiferum*) and *dog's toothgrass* (*cymodon dactylon*). Maritime moist and salt meadows of coastal *creeping twitch and maritime plantain* also grow with ingredients of the *monermatia meadows and coastal creeping twitch* (*Monermati-Agrophyretum litoralis*) and the meadow *bog rushes and maritime plantain* (*Schoeno-Plantaginetum maritimi*).

Salted soils of low flooded coast in Pag also distinguish especially with the salted soils of the *Adriatic meadow rank grass, bushy glasswort (sea grass), herbaceous glasswort and maritime Junacacae*.

The *Adriatic meadow-salted soil rank grass* are here represented by the ingredients of *meadow rank grass and "santonika"* (*Statice-Artemisietum coerulescentis*

*typicum*) found south of the hamlet Šiša in the regions Foše and Bartul, west of Gorica, along Solana, sporadically west of Vrčiči in the region of Konija, at the end of the Stara Novalja Cove, at the way out of Blato Rogoza to the sea, in Dinjiška, at the end of the Caska cove, in the SE part of Lokunje near Pag, in the coastal part of Lod etc., but they are exceptionally small areas. There are more forms of these haloid communities from which the most frequent is facies with *alkali grass* (*Atropis festucaeformis*).

*Coastal salted soils of bushy glasswort* (*Salicornietum fruticosae*) accompany the former community in the Foša zone, however, it is sporadically developed (mouth of Vlašiči brook at Krasulje etc.), and sometimes with a significantly manifested facies of *alkali grass*.

*Coastal salted soils of bushy herbaceous glasswort* (*Salicornia herbacea*) are presented, besides at the mouth of the Vlašiči brook, along the northern fringes of the Saltpan from Pag to Malenica, more at the mouth of Foša only, but nowadays they are in regression because of the renovation of the saltpan in Dinjiška, whereas they used to be exposed directly to the sea.

*Salted soils of maritime Juncaceae* are presented by *salted soils of maritime and severe Juncaceae* (*Juncetum maritimo-acuti*) and the *salted soils of maritime Juncaceae and marshy viper grass* (*Junco-Scorzoneretum candollei*). Composition with maritime and severe Juncaceae have been spread especially on the western part of Malo Blato and along the coastal shelf towards the Maletinac Cove and farther north to the cape of Dubrovnik southernly, along N, E and S shelves of Velo Blato, around Krasulje along the brook of Vlašiči, along the shelves of Blato Rogoza, in the Pag valley on a few spots from Konija to Foša, especially SW from Studena, at the bottom of Stara Novalja Cove, along the cove of Slana on Barbat, in Prutna along the coast SE of Seline etc. The association with maritime Juncaceae and swampy viper grass is most frequently found in Malo Blato and along the coast of the cove Ričina in Stara Poveljana.

Swampy vegetation, respectively *thin reed*, is spread on the island of Pag with *thin reeds of fresh and brackish waters and composition of scallion*. Thin reeds are represented in associations of *round logs and simple reed and scirpetum reed*. Association of *reed round logs and simple reed* (*Scirpo-Phragmitetum typicum*) found in fresh-water mud and marshes is especially distinguished in Velo Blato and somewhat less in Blato Rogoza, Malo blato, in the Pag valley (Gaj) at the mouth of Vlašiči brook etc., whereas in facies with *maritime drizzle* (*Agrostis maritima*) it is more distinguished only in Velo Blato. The association *scirpetum reed* (*Scirpetum maritimi*) in want of brackish water is more distinguished in Blato Rogoza, in the part of Novalja field to the Stara Novalja cove, in the southern part of Caska Cove, along the southern edge of Saltpan from Lokunje to Stari Grad, in the Stara Poveljana valley along the coast etc.

Composition of *scallion* (*Mariscetum*), is the only representative of the *high rush vegetation*. They are spread in Velo Blato only.

*Vegetation of maritime calcareous drippings and deforested rocky grounds* cover the largest area of Pag. It is represented by the *association of maritime drypetum* (*Drypetum jacquinianianae*), which extended from limestone spots (drippings) to the deforested karstic areas arisen by forest, thicket and grassland degradation. It occupies the largest parts of Zaglav (Orlje, Karsa, In Gros), Grgurevac, Barbat, Paško Bilo (Crest) from St. Nikola across Kiršina and Tust to Fortica, NE parts of the Lun Peninsula, parts of the crest St. Vid, especially Žestoko and Počivalo, large parts of Vlašičansko Brdo (hill), the crest Grušina - Škajnica - Sikavci, parts of Turnić and some smaller zones. Here and there on Barbat (Metajna - Visoka Strana - Panos - Furnaža and Zaglav), and

on the Kiršine crest (Plati, Vrši, Bunjica) this association has been distinguished in facies with *blue stem (Inula candida)*.

*Vegetation of maritime sand, sandy and pebbly coast* has been represented here by the *association of coastal spurge and sea poppyseed roll on the pebbly sandbanks (Euphorbio-Glaucietum petrosum)*. It is distinguished along the coast of the small bay Krlič, Mihovilje, I. Novalja, Straško, Rogoza, in Lodovo, in the cape Gaj, in Furnaža from Malina to the cape of Krištofor etc.

*Halophilous vegetation of limestone coastal reefs* has been widely spread in Pag on a narrow coastal shelf. It is about the association of coastal plantain and statice (*Plantagini-Staticetum cancellatae*) as in other coastal areas. It is most widely spread along SW coast of the Stara Povljana bay, in the southern part of Šepurinac Cove near Povljana, in the region from the cape Malin to the cape of Krištofor on Barbat and on the SE coast of the island towards the Velebit channel (Ortarnice, coves Broćna, Movre, Čista, Santiš, Šamagošnica, Bunjica, on Paški Oštrljak etc.)

Very often the so called *hasmophyte vegetation of the rock fissure* is connected with the rocky areas, which is in Pag represented in association with *narrowleaf reed and Austrian viper grass (Seslerio-Scorzoneretum austriacae)* and *blue-bells and Dalmatian knapweed (Campanulo-Centaureetum dalmaticae)*. Narrowleaf reed, Austrian viper grass and accompanying species are spread in the more distant regions from the sea in Krištofor, around St. Vid and elsewhere. The association of the Istrian blue-bell and Dalmatian knapweed is more distinguished on the NE coast of Lun, but it can be seen in some other spots on coastal rocks.

*Semi-cavern vegetation of trickling sedric caves* is a very frequent phenomenon connected with subdrippings and semi-caverns of diluvial and flysch sediments in the regions of Vodice, Rozin Bok etc. It is represented with the *association of eucladium and dudder grass (Eucladio-Adiantetum)*, very poorly spread in Croatian regions.

The association of *frog lily and naiad (Potameto-Najadetum)* represented by *halophyte vegetation of salt, brackish and fresh waters*, has been spread in mud Rogoza, whereas at other muds it is represented only partly and sporadically.

On dressed planted areas and abandoned cultivated land, as around vegetable plots, a few *weed associations* appear, usual in the Mediterranean area. Besides, very often the forms of *thorn-bush associations (Palieretum adriaticum)* are found in karstic areas, along deserted olive-groves etc. It can be found rarely in combination with *juniper berries (Juniperus phoeniceae)*, which replaced rocky grounds and grazing-lands in some places ( St. Vid - St. Petar - St. Toma, Zaglav and Jadra at Stara Novalja belt etc.) while the terrains exposed to *bora* are of low vegetation and sporadic.

In some places tamarisk ("*kamariž*") is found from which the toponym Kamarizac originates.

## Soils

In relation to the karstic island basis, the soils are developed only in the valley parts on flysch, diluvial and alluvial deposits. The point is about less brown soils on flysch, and more often about various kinds of soils on flooded areas covering flysch basis in the valleys. Heavy clay soils have been found, clayey-loamy and lighter sandy ones. Other soils, shallow brown soils, spring heath, clayey soils, red soils etc., are sporadically



developed. A very solid pedologic study of the Pag Island was made by M. Gračanin in 1935 (GRAČANIN, 1935). He found that there were only 2 % of the areas with poor skeleton soil and some loose cover on the karstic, rocky grounds, whereas other areas of the rocks are of limestone. The lack of red soils is the result of young rocky ground in Pag. The soils are frequently salted, especially in Vlašići, Poveljana and Kolan valleys, whereas the major part of inland zones is in want of phosphorous and nitrogen.

## Socio-geographical characteristics

### *Review of historic-geographical development<sup>10</sup>*

The population of the Pag Island dates from the earliest time of human prehistory. Although relatively spare researches have been made so far, and there are only initial ideas about the oldest periods of the Stone, Copper and Bronze Ages, natural geographical characteristics suggest the favourable possibilities of inhabiting of this area with the oldest human communities. Former connection with the island, up to the recent flooding of the Nova Poveljana Kanal, the existence of spring water, cultivated, grazing and wood areas, cages and other factors, provided subsequent and continuous development of settlements until today.

The oldest population was confirmed by archeological finds of Palaeolithic, Mesolithic and, the most relevant, Neolithic ages, when a man in this area (at that time far from the seaboard) ensured his survival by hunting, fishing and harvesting. Great changes in surroundings, which happened from that ancient time, wiped off a greater part of cultural traces from the Stone Age, but found sporadic remains suggest the possibility of new finds and needs for further explorations. Some toponyms preserved in this area suggest the possibility of their ancient origin, linked with the oldest pre-Indoeuropean groups of inhabitants who lived on the Mediterranean coast. Here frequently mentioned Caska (from Cissa), Škrda, Maun, Panos, and hydronyms Jadra arise, then (V)Ra(n)kovac, Rankovci, Magran, Mirmanića (voda-water), Mramora, Krnelja and Pinjari, where it is the point of the old basis "rn", "arn" (see FILIPI, 1984), then Karsa, Orlje, Vajerma, Škrdenac, Škarić, Škar, Škripe, Hripe, Lovčen, Labin etc.

The existence of a great number of hill-fort settlements, grave-mounds, necropolis, roads, drystone walls, artificial pools, remains of agriculture and other remains of material culture, and especially toponymies, suggest of significant valuation of this area during the Bronze and Iron ages and the opportunity of using grazing, farming, muddy, coastal, wood and sea lands in local economy. Frequent appearance of a younger Croatian toponym Gradac (at Lun, Novalja, Gradašćica, Pustograd at Vlašići, G. Grad in Kolan, and others (Kruna, Panos, Košljun) suggest the existence of prehistoric hill-fort settlements, which can be more than 30 ubiquitous. Some of them have names according to their location, objects or some other characteristics (Zaglav, St. Vid, Komorovac, St. Juraj, Stari Grad, Gramajnik etc.). Here previously mentioned toponyms of chiefly undefined meaning should be emphasized which could suggest some very old, prehistoric forms of the Liburnian or expressions accepted by Liburns. Favourable

<sup>10</sup> On prehistory and history of the island of Pag see more detailed at: RUIĆ, 1780; BATOVIĆ, 1973; SUIĆ, 1953, 1981; STICOTI, 1940.

localities near water and cultivated areas (Pag, Kolan, Novalja, Stara Vas, Povljana etc.) are evidently the ones around which forms of settlements and remains of material culture of that time should be searched, even though there are exceptions to it (see BATOVIĆ, 1973).

The oldest hill-fort settlements on the island could date around 400 B.C., according to the finds from the Bronze Age often found in many hill-forts. At the time the island was connected with land via Vir (Ura) by a narrow isthmus. Only the third of the hill-fort settlements continue to live in the Iron Age. Zaglava at Metajna distinguish in size and meaning, St. Vid at Kolan, Košljun at Caska, Gradac and St. Juraj at Pag, Gramajnik and Panos at Dinjiška, Stari Grad, Pustograd at Vlačići etc. Hill-forts are of different forms, usually circular, some of them with complex walls, with remains of drystone walled houses or grave-mounds, whereas others served only as refugees' camp. Their density and arrangement at all high-altitude zones to the highest peak of the island, suggest significant and intensive valorisation of all existing natural potentials at the time of prehistoric Liburnia. The position in relation to the agricultural zones, water and roads, was of special importance. Protected harbours and their position with reference to the sea waterways had a special significance. Such advantages were used at the northern part of the island by the hill-fort in Košljun, most probably later on Kissa, which lasted through the Bronze Age until the 15<sup>th</sup> century (see BATOVIĆ, 1973).

In several spots of the island there are numerous remains of stone and earthen grave-mounds, respectively, necropolis. Jewellery, tools, arms of various metals, amber etc. testify the level of these cultural achievements and civilization of this area, as its connection with the wide Mediterranean expanse and continental hinterland, even though it is obviously weaker than in the neighbouring land (see BATOVIĆ, 1973).

The development in ancient times (see more SUIĆ, 1953), also inside Liburnia, approve the remains around Caska and Novalja, and a series of sporadic finds all over the island inform about considerable valorisation of natural potentials of the island, especially of fertile areas, water sources, seas (saltpan, rifts for fishing in shallow spots, fishing, shell gathering etc.), quarries (at Novalja) and pasture-grounds and woods. Numerous toponyms could originate from this period (Novalja, Povljana, Košljun, Brbonovica, Pagus, Kolan etc.). The most significant are kastrum Cissa, probably in Košljun, port Navalia, Svetojašnica (Zaglav), Pagus, Tovarnele, Lešandrovica, Trinčel, Gradac at Vlačići, Pauliana, Šip, Šipnat, Pastura, Antabela, Košljun, Kaljac, Kantarelac, Letovica, Veternica, Sega, Mandre, Bošana, Bošanić, Malin, Paladinka, Gustirna, Konija, Kaljac, Mulobedan, Bodunalva, Belolije, Furnje, Rom, Bas, Turnić, Santiš, Murvica, Foše, Reštur, Polačine, Sakarata, Lokunja, Drakovci etc. Although Pag did not have its municipal centre, but had come, as it has been concluded so far, within the competence of the nearest Aenona whose area is associated with the prehistoric times, however, it could develop rather independently as a separate insular community. As early as the 2<sup>nd</sup> century B.C. the initiated process of leaving smaller Liburnian hill-forts and building of bigger centres had an influence here as well, especially at the time of Roman-Illyrian wars. In the 1<sup>st</sup> century, after the Roman power had been established, Romanization in Liburnia, which was not so

manifested in Pag, had started. Except in the offshore part of Cissa, in the Caska cove, where a larger complex of the Roman architecture was found, and the remains of country houses and *villa rustica*, predominantly from Novalja to the south, there are not any other more important finds of the Italian immigrant penetration. They use the area around the strongest centre, Cissa, which is as regards traffic, the most important, because only the protected and convenient port of Novalja could be more significantly evaluated at the important marine direction from Iader towards Kvarner and Istria, and Cissa had two inland ports, both in Stara Novalja and in the Caska Cove.

Found remains of pitosa, amphoras, *tegulas*, grindstones, various ceramics etc. testify of trading with the whole known world from Asia Minor to the west Mediterranean. Valuable agricultural areas, pasture-grounds for sheep and goats, possibilities of hunting and fishing, were also the prerequisites of development in this microregion. The remains of aged limitation in the Novalja valley<sup>11</sup>, built waterworks Kolan - Caska and Škopalj - Novalja (ILAKOVAC, 1982, 245-251), finds of shells for colour production (scarlet), remains of brick production and various others, approve this to have been an important, if not main centre of life on the island. Accordingly, there were good preconditions for Cissa to have the status of one of the prefectures. With Pliny it is *opida* Cissa, and Porfirogenet and Ravennan call Cissa the entire island which has a definite meaning (SUIĆ, 1976, 305) There are no solid leads that there was a similar centre in the southern part of the island at the time of the Roman domination, even though natural-geographic base offers significant opportunities, as it used to be in the prehistoric time. Some settlements evidently connected with fertile valley zones around Pag, Dinjiška, Poveljana, Vlašići, and Košljun with other small bays played the roles of local ports. Grave remains were found near Pag (Zamet), remains of brick-kiln in Dinjiška, and a fairly large number of *villa rustica* in a few favourable positions.

Initial changes during the great movements of the peoples and recognition of Christianity (early Christian basilica in Novalja and in Gaj at Novalja from the 5<sup>th</sup> c. and the remains of the church in Poveljana from the 5<sup>th</sup> c., in Jaz on Rtić at Novalja threenave basilica of St. Ivan and Pavao from the 6<sup>th</sup> c., a small church on the cape Lun, from the 6<sup>th</sup> c., etc.), mark the transition to medieval period. The size of particular church objects (apse diameter of "big church" in Novalja is as long as 13 m), their numerosity, finds of big sarcophaguses, reliquaries etc. speak of a distinctive early Christian tradition, especially in the wide Cissa region, which does not completely exclude the possibility of the existence of diocese. At the same time *Byzantine administration*, most probably during the Justinian reconquest, made efforts by ensuring the navigation waterways to keep the geopolitical influence in Liburnia, which can be testified by fortresses (kastron) in St. Jure at Pag west of Kiršina and in the cove Svetojanj (Svetojašnica) in Zaglav ME of Stara Novalja, probably as early as the 6<sup>th</sup> c. Gradually, old Liburnia disappears, and the idea of Dalmatia comes to particular towns and islands run by Byzant.

*The Croats* come to Pag very early, immediately after having settled and established the centre of the Croatian country in the direct surroundings of Zadar with Nin as its main centre. They have the main settlement on the island around the

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<sup>11</sup> Visible on topographic maps M= 1: 100.000, M= 1: 50.000 and M= 1: 25.000,

remains of antique Cissa (Keša at the time) giving names to Stari Grad, Stara Vas, Vlašići, Divin, St. Vid at Vidas and at Kolan (Svetovid) to the spring Starovasica, locations of Vidonjica, Vidonj in Povljana, Božavka, Božan in Vlašići, Divišćaci, Parunka in Kolan, Svaroš in Dinjiška, Svetište, Babe, Na Babino, Babin Potok, Stari Stan and numerous hill-forts and localities, so by accepting and transforming the old and including new terminology they make the basis to the present day toponomy. They inherit presumably ancient Liburnian shrines at Vidas where the names to the church St. Vid, at St. Petar (St. Petegula), and in Triblje at Borovića and others (Gramajnik at Panos in Dinjiška etc.) had been given.

*Christianity of the island* is being testified by building a series of small churches, in the settlements as well as outside them, even on smaller islands, important roads and passages (St. Vid at Kolan, the 13<sup>th</sup> c., St. Vid at Vidas, St. Krištofor, the church in Novalja from the 9<sup>th</sup>/10<sup>th</sup> c., St. Juraj in Caska with the pre-Romanic foundations probably from the 9<sup>th</sup> c. and later, St. Ante in Caska, Sv. Križ in Stara Novalja, St. Nikola near Povljana, probably the 9<sup>th</sup> c., St. Ante in Maun, St. Janja (Agneza) in Sutojšnica, St. Pavao on the same island i.e. Veli Sikavac etc.), St. Martin in Lun, Stomorica at Novalja, St. Nikola at Šankove, St. Bartul in Dinjiška, numerous churches in the region of Stari Grad (St. Antun, St. Martin, St. Grgur, St. Kuzma, St. Juraj, St. Marija Stara, St. Marija, St. Bartul etc.), St. Toma in Košljun, St. Duh at Kolan, St. Križ, St. Kristofor and St. Marija (Gospa) in Trinčel at Stara Novalja etc.

Geopolitical interests in the early medieval Croatian state in which Pag from its beginning in the 9<sup>th</sup> c. to the first days of its existence as well as later at the time of Croato-Hungarian Kingdom, clashed with the Byzant, Venice and others who tried in the early and at an advanced stage to govern Zadar and its wider area. The questions of jurisdiction over Pag have also been put as an imperative as the medieval Keša, like Zadar, subsequently pursued anti-Venetian policy impeding Venice in realizing its conquering plans over the Croatian coast at the Adriatic. In addition, there were large salt pans here, a remarkable source of richness and power. Therefore Venice waged a sustained struggle to break the connection of Pag with Zadar. By the end of the 11<sup>th</sup> c. Pag was under the jurisdiction of the Croatian rulers, which is evident from realized donations (Caska, Maun) (Codex Diplomaticus.).

Centennial Venetian persistence to conquer Zadar and received severe blows, especially in 1202/1203 with the help of the Crusaders, weakened Kissa, namely, Novalja either, and gradually in the 13<sup>th</sup> c. it had to accept the predominance of Rab which had already attempted to adjoin Pag to its district. This way, along with church competence of the Rab diocese over the northern part realized at the end of the 11<sup>th</sup> c. at the expense of the Nin diocese entirely appertaining to Pag until then, the profane competence was achieved.

At the same time, weakening of Keša by the end of the 12<sup>th</sup> c. the role of a leading settlement was taken over by Stari Grad, which developed along with Saltpan at a relatively inconvenient place. It tends to be independent of Zadar, whose interests were not only because of saltpan but also because of the sea domination over the eastern part of the Adriatic specially emphasized and most frequently coincided the interests of the Croatian country to prevent the Venetian empire in its violent invasion of the Croatian coast. Nevertheless, as early as at the

beginning of the second half of the 12<sup>th</sup> c. the major part of Pag came under the jurisdiction of the archbishop of Zadar, again at the expense of the Nin diocese. Venice makes efforts to force off Pag from Zadar, to offer a defined autonomy (by the end of the 12<sup>th</sup> c.) and bring it in under its authority. This was the reason of violent struggles for centuries on end between Pag and Zadar, and of local disputes on the island. Latter ones emphasized the question of whether Caska belongs to Rab or Pag, although in the middle of the 13<sup>th</sup> c., after Tartarian breaking in, under the privilege of Hungary-Croatian king Bela IV, Pag formally became united and free of Rab and Zadar (SUIĆ, 1953). That issue ended after the process of realizing complete Pag autonomy at the beginning of the 15<sup>th</sup> century within the scope of Venetian possession on the Croatian part of the Adriatic, that is by demarcation at the beginning of the second half of the 15<sup>th</sup> century. Then Caska appertained to Pag, and that conflict completely ended in 1538 and the frontier established at that time, not only profane but of the church either, has been practically retained until nowadays. After Rab diocese was integrated to Krk diocese (1828), the church frontier to the Zadar archdiocese remained, whereas the profane frontiers changed. The aspiration for establishing Pag diocese has never realized. The northern part of the island, Novalja and Lun, belonged for a longer period, in profane as well as in the church sense to Rab. After 1993 even the last part of Pag under Rab administration, Lun, belonged to the island of domicile, district of Novalja, whereas the church competence of the Krk diocese remained linked to the ex-frontier of the Rab diocese. In 1993 the new administrative border between districts of Pag and Novalja was established so that Caska and all settlements of Barbat joined to the district of Novalja.

Geographical valuation of the Pag area at an early and advanced Middle Ages shows not only toponymic characteristics but documents as well, unfortunately insufficiently studied, in the history of Zadar as well as other church and municipal archives from Zadar beyond Pag to Rab and Karlobag. Indispensable autogenetic economic base, first of all farming and pasture land, saltpan, maritime connection possibilities, chiefly linked to the central flysch valley, to an extent along the SW offshore zones and the parts in Lun. Old ancient forms of economy keep the population in all parts of the island, and the tendency to be autonomous in the conflicts with the old interests of Zadar, Rab and Nin, Pag resulted not only as an autonomous town with its further reputation as the centre of salt production at our coast of the Adriatic, but its transformation to the present-day position. *The Pag saltpans*, which were certainly on more places of the island (Pag, Vlašići, Dinjiška, Povljana etc.) among which the one near the town itself always had the greatest meaning, are a remarkable economic object of the east Adriatic around which the interests of Zadar, Venice and inhabitants of Pag interfered for centuries. The Pag saltpan had a crucial influence for its independence, even though it had always been under the patronage of Venice after its territorial expansion on the Croatian coast of the Adriatic and forming of Venetian Dalmatia in the 15<sup>th</sup> c.

In Pag, the archbishop's diocese of Zadar, diocese of Rab, particular monasteries and richer families acquired profits from agricultural land, leased torrented pasture-grounds and shares in saltpans. Salt production, cheese pastoral products, leather, meat, wool, eggs, honey, etc. and agricultural products,

especially wine, corn, leguminous and tuber plants, olives, etc. as in a significantly less degree fishing, trade, craft, traffic and communications with under Velebit zone, were the basis for the long-term old way of using the land providing profit making and maintaining of population. Although such a base provided for the survival even though modest development, numerous struggles and wars interfered the stabilization of the situation and better progress. These are the times of modest but nevertheless precious achievements in the social superstructure, especially in the church architecture and art. The greatest intervention in that respect, and on the threshold of new era, represents a completely new urban conception and hardly anywhere with us a completely realized investment in constructing the present-day town of Pag at the middle of the 15<sup>th</sup> century.

The crucial part in arrangement of new Pag on the shore of the Pag valley, below Kiršine and the ancient early-medieval kastrum with a small church St. Jure, where even earlier there were possibilities of settling, and some particular objects, had a considerably more prestigious topographic situation. Namely, Stari Pag, even though situated as an acropolis on the foundations of the old Liburnian hill-fort, marked several weak opportunities: north exposition and overshadowing with high grounds of Kruna and Gradac, exposition to *bura (tal. bora)*, shallow of the bay with saltpans, which limited the sea traffic, erosion and land-sliding consequences on soft Quaternary sediments etc. Repeated destroying and poor foundation stability on which it arose should have caused a relatively bad construction condition and endangered the statics of many objects in shoring up and on the slopes, especially in SE part of Stari Grad. The only deficiency in the arrangement of new Pag was the fact that it was built in the bay linked to the Velebit channel, which was not the main sea route, unlike Kvarnerić where a distinctive traffic was always going on, so the southwestern parts of the coast of the island remained beyond adequate valorisation up to the present days. However, newly built Pag consolidated the meaning of the island main centre.

Ethnic structure of the Croatian population was expressed through the statute of the town regulating its autonomy, various customs, rights, and relations, inherited from the time of the complete reputation of Croatia. Names and surnames of the inhabitants point out the extremely predominating Croatian component, with certain Wallach and Roman influences.

Wars with Ottoman Empire, which tried to break Croatia completely for centuries, provided a long-term occupation of a large part of the Croatian regions by Turkey and Venice. Continuous conflicts in the neighbouring land (end of the 15<sup>th</sup> to the beginning of the 18<sup>th</sup> c.), weakening of Venetian influence and meaning after great geographic discoveries (15<sup>th</sup> - 16<sup>th</sup> c.), though it gradually enlarged its territory in these areas which Ottoman Empire occupied from Croatia, rendered a bigger development of this whole area impossible, in the same way of Pag. Geopolitical situation after the new world powers began to reign weakened the Venetian power and it disappeared as an independent political entity by the end of the 18<sup>th</sup> c.

That way Pag had continually below 2000 inhabitants from the beginning of the 16<sup>th</sup> c. to the end of the 17<sup>th</sup> c., even though the town of Pag itself was expected to have more than 400 objects which could receive 3000 people, and the island was caught by periodic settlings from land, especially by refugees before

war events. It is evident that diseases, sufferings in conflicts, fighting etc. as immediate reasons of high mortality in relation to the fertility, were the roots of such stagnation. A particular growth was not certainly reached in the 18<sup>th</sup> century, that is why at the beginning of the 19<sup>th</sup> century Pag has just a little more than 3000 inhabitants most of them living in the town itself (see also ROGIĆ, 1972). Introducing the Austrian administration, then French, and again Austrian, gradually it changed in a certain economic sense the chances on the Pag Island (PERIČIĆ, 1989). Health-related opportunities were being improved, political situation became settled, and new forms of agricultural-breeding valorisation arose.

Therefore the number of inhabitants, in spite of cholera in 1855 and 1869, typhoid etc., thanks to the bigger and bigger birth-rate, innovations in economy and better supply of the island after putting in the shipping lines, grows fairly fast from census to census, and this island more than doubles the population from the beginning (3177 inhabitants in 1807, and in 1813 the insular Pag canton had 3.162 inhabitants)<sup>12</sup> to the end of the 19<sup>th</sup> c. (7039 inhabitants in 1900). Significantly modified inherited relations enabled a rapid development in the town of Pag itself, which in 1900 reached the maximum census of 3960 inhabitants (about 60 % population of the island). Although in the 20<sup>th</sup> c. the number of inhabitants is increasing relatively slower, and after World War II even decreases, only the 20<sup>th</sup> c. brings changes reflected in the features of the scenery, changed placement of population and more modern space valorisation. The town of Pag decreases with its share of population from more than 50 % to approx. 25 %, and Novalja in the northern part becomes stronger from day to day.

Considerable emigration took place from the Pag island, not only to Croatian towns, but overseas as well. Hundreds of islanders left their Pag and went to America by the end of the 19<sup>th</sup> and at the turn of the 20<sup>th</sup> century. Unfortunately, there are not any particular researches about the emigration course of events.

## **Current basic features of population**

### *Some characteristics about the changes of the number of inhabitants*

In 1991, which was the last census in Croatia, 24 statistic settlements were singled, unlike the former census, when 12 settlements were singled (Dinjiška, Gorica, Kolan, Kustići, Lun, Metajna, Novalja, Pag, Povljana, Stara Novalja, Vlašići, Zubovići). Newly singled settlements, from which three with less than 10 inhabitants, which is from the point of view about real necessities of the national statistics questionable, are Bošana, Caska, Gajac, Košljun, Mandre, Miškovići, Potočnica, Smokvica, Stara Vas, Šimuni,

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<sup>12</sup> PERIČIĆ, 1989, 200, for 1807; for 1813: DAZD (State Archiv in Zadar), Various documents of the Dalmatian regency, vol. 8, Statistics for Dalmatia in 1813. In the year 1830 there were for ex. 4.335 inhabitants (Pag 2715, Gorica 56, Dinjiška 103, Vlašići 108, Povljana 104, Kolan 232, Novalja 734, Lun 102 and Barbat 81; Ibidem, vol. 21, Prospetto generale della Popolazione ...a tutto 31. Dicembre 1830.)

Vidalíci and Vrčići. Until 1993 Pag was (with the exception of the settlement Lun) organized as a unique district and the settlement Lun from the Rab district was joined to it. Finally, in 1997, the new statistical settlement Gajac was divided into two settlements, Gajac 1 (Novalja) and Gajac 2 (Kolan-Pag), so the total number of places rose up to 25.

The division into the southern part of the island belonging to the Town of Pag district, and into the northern one included into the newly established district of Novalja, was made by new administrative-territorial system. The Pag district has 15 settlements Pag, Bošana, Dinjiška, Gajac 2, Gorica, Kolan, Košljun, Miškovići, Mandre, Poveljana, Smokvica, Šimuni, Stara Vas, Vlašići and Vrčići, altogether 4.794 inhabitants, among which Pag distinguishes with 2.421 number of inhabitants. The settlements Novalja, Caska, Gajac 1, Kustići, Lun, Metajna, Potočnica, Stara Novalja, Vidalíci and Zubovići with 3.175 inhabitants belong to the Novalja district, and the largest settlement is Novalja with 1.912 inhabitants according to census figures from 1991.

Tab. 5 Change of population number of statistic settlements on the Pag Island according to the official censuses from 1857-1991

Tab. 5. Promjena broja stanovništva naselja otoka Paga prema službenim popisima stanovništva 1857.-1991.

Settlement hamlet/ part of the settlement	Year												
	1857	1869	1880	1890	1900	1910	1931	1948	1953	1961	1971	1981	1991
Bošana													21
Dinjiška <i>Jurjevići</i> <i>Seline</i>	107	127	51	91	128	90	241	182	186 105 81	161 91 70	137 63 74	401	181
Gorica	50		53	67	65	49	68	106	117	106	98	86	97
Kolan <i>Maun</i> <i>Slatine</i> <i>Sv. Duh</i>	207	245	202 5 28 13	234	261 20 6	327	532	633	678	688	597	633	525
Košljun			5		6	18		16	19	14	16		38
Mandre			21		28	5		24	41	73	65		160
Miškovići			16	17	22	48	62	99	82	76	62		53
Pag <i>Starigrad</i>	2926	3271	3369 2 3	3554	3960	3699	3257	2937	2697	2327	2198	2282	2421
Smokvica			7	21	13	17		44	52	68	46		59
Stara Vas			68	19	3	73		132	153	142	127		101
Šimuni			2		12	22		62	82	90	82		108
Vlašići	117		149	130	195	207	319	452	503	462	319	310	315
Vrčići			21	9	19	30		67	73	82	72		37
City of Pag	3407	3643	3964	4112	4712	4585	4479	4754	4683	4289	3819	3712	4116
District of Poveljana	132	322	207	185	176	236	405	635	698	746	693	658	678
Total in Zadar County	3539	3965	4171	4327	4888	4821	4884	5389	5381	5035	4512	4370	4794
Caska			26			48		39	24	20			16



Gajac													5
Kustići			61	61	140	96		171	178	172	169	139	123
Lun	164		267	326	352	429	526	675	646	551	483	381	357
<i>Dudići</i>								44	36	40	47		
<i>Gager</i>			8	74	70	66		127	131	115	80		
<i>Jakišnica</i>			25	34	15	22		62	65	61	71		
<i>Lun</i>	164		204	170	263	285		277	265	215	170		
<i>Stanišće</i>			26	33	4	37		58	50	43	28		
<i>Tovarnele</i>			4	15		19		107	99	77	87		
Metajna			106	134	151	191		315	324	350	321	281	272
Novalja	714	1006	915	1071	1011	1428	1988	1958	1981	1859	1834	1783	1912
<i>Boro-Šonje</i>								107	62	17			
<i>Dabo-Stan.</i>								78	3	20			
<i>Novalja</i>								1498	1898	1797			
<i>Šanko-St.</i>								49	9	4			
<i>Škunca</i>						51		41	9	10			
<i>Vidas-St.</i>								185		....11			
<i>Sv. Ante</i>			7		7	6							
Poto-nica													2
St.Novalja			117	145	350	204	255	315	288	229	205	182	234
<i>Bok</i>								32					
<i>Brajda</i>								41					
Vidalići													3
Zubovići	146	181	118	139	147	245	593	326	338	352	372	301	251
<b>City of No-valja (Tot. in Lika-Senj C.)</b>	<b>1024</b>	<b>1187</b>	<b>1610</b>	<b>1876</b>	<b>2151</b>	<b>2641</b>	<b>3362</b>	<b>3799</b>	<b>3779</b>	<b>3533</b>	<b>3384</b>	<b>3067</b>	<b>3175</b>
<i>Ukupno otok Pag</i>	<i>4563</i>	<i>5152</i>	<i>5781</i>	<i>6203</i>	<i>7039</i>	<i>7462</i>	<i>8246</i>	<i>9188</i>	<i>9160</i>	<i>8568</i>	<i>7896</i>	<i>7437</i>	<i>7969</i>

Sources: M. KORENČIĆ, 1979, 508-510, 576-578; Population census, households and apartments in 1981, Population, Doc. 553, RZSH, Zagreb 1984, pp. 102, 112; Population census in 1991, Doc. 881, RZSH, Zagreb, 1992, pp. 150-152, 172.

Remarks: a) hamlet population, namely, of the settlement parts is included in the total number of a particular settlement, b) number of inhabitants of the island of Pag in 1880 should be reduced for 5 people who were entered in the island of Maun (hamlet Maun, settlement Kolan), c) Settlement Dinjiška includes the settlements Miškovići (Ždrijac), Stara Vas and Vrčići in 1857, 1869 and 1981, and Stara Vas and Vrčići in 1931; d) settlement Kolan includes the settlement Mandre in 1857, 1869, 1890, 1931 and in 1981; e) settlement Pag includes the settlements Košljun and Šimuni in 1857, 1869, 1890, 1931 and 1981 and settlement Bošana 1857-1981; f) settlement Vlašići includes the settlement Smokvica in 1857, 1890, 1931 and 1981; g) settlement Zubovići includes the settlements Kustići, Metajna and Vidalići in 1857, 1869 and in 1931; h) settlement Kustići includes the settlement Vidalići from 1857-1981; i) settlement Novalja includes the settlements Caska from 1857-1900, in 1931, 1971 and 1981, Lun in 1869, Stara Novalja in 1857 and 1869, and Potočnica from 1857-1981; j) settlement Gajac was divided into Gajac 1 (to Novalja district, Lika Senj County) and Gajac 2 (to Town of Pag, Zadar County) in 1997.

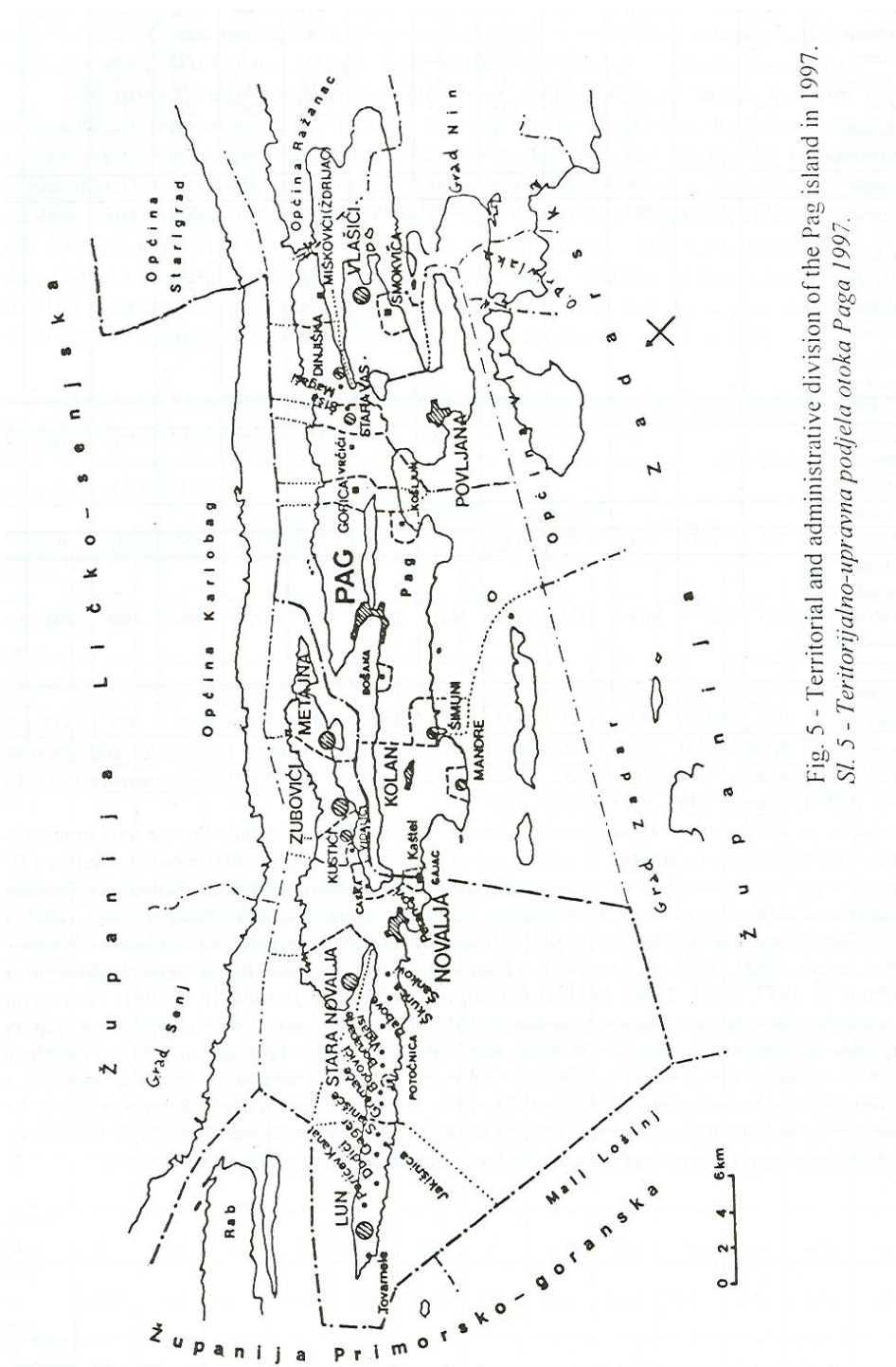


Fig. 5 - Territorial and administrative division of the Pag island in 1997.  
Sl. 5 - Teritorijalno-upravna podjela otoka Paga 1997.

The total number of the inhabitants on the island in the last census is 7.969. Out of that number 670 persons were abroad (temporarily employed and family members). The total number of households was 2.660, and an average household numbered 3,0 members. The number of apartments was 2868. The number of enrolled farmers together with their family members was 1.032, i.e. the number of agricultural population was 13,0 % in total.

In accordance with the changes of the number of inhabitants, general *population density* changes. Considering the entire surface of the island and the appertaining islets, it was 26,8 inhabitants /km<sup>2</sup> in 1991. It was increasing until 1948 when the largest recorded was 30,9 inh./km<sup>2</sup>, and then it was decreasing until 1981 when it was 25,0 inh./km<sup>2</sup>. In the first current census in 1857 it was 15,4 inh./km<sup>2</sup>, and before that even less.

### ***Other population structures***

The latest decades the Pag Island has been chiefly recording *the natural decrease* in the population number, which means that, the *birth-rate* was most frequently less than *mortality*. In succeeding years from 1963 to 1990, the birth-rate was ranging between 8,9‰ and 14,6‰ (64 to 120 born per annum), whereas the mortality was ranging at the rate between 7,1‰ and 15,9‰ (58 to 112 dead per annum). The birth-rate in the examined period was larger than the mortality rate till 1970, and since then only in two years in 1988 and 1990 (14,1 versus 13,4 and 13,5 versus 11,2 per mil).<sup>13</sup> Besides emigration, the natural decrease was the main reason for the decreased number of inhabitants up to the last inter-census period when the increase, which was mainly the result of immigration, the returning of some inhabitants and a better census of the temporarily absent, was registered.

*Age structure* of the population suggests a considerably aged demographic mass with relatively high shares of mature (25-59 years of age) of 51,1% and a very old group (60 and > years of age) of 23,2%, and especially low share of younger population (0-19) of 23,1%. The population of unknown age was 2,6%. In 1991, in 100 inhabitants to 19 years of age there was 101 people aged 60 and more, significantly more than the average in Croatia (67).<sup>14</sup>

*Sex structure* suggests a larger number of women than men. So in 1991, on 1000 male there were 1028 female persons. Previously, however, the number of male persons gradually increased with the tendency of balance. In 1961 it was only 47,84 %, in 1971 48,95 %, in 1981 48,98 %, and in 1991 already 49,30 % male persons.<sup>15</sup>

According to *nationality* the Pag islanders are chiefly *Croats*. According to the census in 1991 they made 95,4 % of the total island population. In addition to 2,6% of

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<sup>13</sup> Statistic Yearbook of SFRY, Fed. Bureau of Stat., Belgrade, 1964-1990, (hereinafter SGJ), Statistic Yearbook of SR Croatia, Rep. Bureau of Stat., Zagreb, 1964-1991, (hereinafter SGH), Statistic Yearbook of the Republic of Croatia, State Bureau of Statistics, Zagreb, 1992, 1993 (hereinafter SLJH).

<sup>14</sup> Population census in 1991, Population according to sex and age, Doc. 882, RHDZS, Zagreb, 1994, p. 156, 185

<sup>15</sup> Ibidem.

twenty various nationalities and uncommitted, there was 2,0% of unknown ethnic affiliation.<sup>16</sup>

By *denomination* inhabitants of Pag are mainly Roman Catholics, organized in 9 parishes, 7 in the archdiocese of Zadar (Pag, Gorica, Dinjiška, Vlačići, Povljana, Kolan and Barbat in the Pag admission) and 2 in the Krk diocese (Novalja and Lun in the Rab provicariate).<sup>17</sup>

*Household number* in the island of Pag in the 20<sup>th</sup> century grew to the '60s (in 1961 there were 2155 households). A slight decrease was recorded only in 1971 (2140), and then after 1971 the number of households started gradually increasing again (in 1981 2343 and in 1991 2660).<sup>18</sup> The growth is more the result of decreasing the number of household members, than of increasing the number of population.

*Average number of household members*,<sup>19</sup> however, has been constantly decreasing for the last thirty years. So in 1961 it was 3,98, in 1971 3,69, in 1981 3,17, and in 1991 just 3,00 (district of Novalja 3,05, district of Pag 2,96). Among the settlements numbering above 20 inhabitants in 1991, the most numerous households are in Vlačići (4,48 members per household), Smokvica (4,23), Stara Vas (3,74), Dinjiška (3,67), and Povljana (3,44), mainly at the southern part of the island. Only Stara Novalja (3,45) and Kolan (3,42) have slightly more numerous households. The least average number of households was recorded in Vrčići (2,64), in Pag (2,70) and Miškovići (3,08) at the southern part, in Mandre (3,08) at the central part, and in Novalja (3,06) and Lun (3,10) at the northern part of the island. Other settlements had an average number of households between 3,1 and 3,4.

If completely small settlements are taken into consideration, where the number of household members ranged from 0 (Gajac) to 5,33 (Caska), the picture of a very complex situation of households, in particular settlements, is obtained. General conclusion is that the households in the island of Pag are relatively small and they do not provide for the natural reproduction of the population.

In the former population census in 1981, the largest number of households was recorded in Kustići (4,09), and the smallest one in Pag (2,65) and in Stara Novalja (2,98). Although the data can not be entirely comparable, due to essential changes in number and borders of settlements, it is evident that in some settlements this indicator has been improved (Vlačići with Smokvica, Stara Novalja, Pag), whereas in major part of other settlements the situation has become worse.

In 1991 the number of recorded residential apartments in Pag was 2868, which is a little bit more than the household number.<sup>20</sup> However, about 4.600 apartments for holidays, abandoned and others, have been recorded. The largest number of such is in Pag, about 1200, in Novalja, about 900, in Gajac (about 880), in Povljana (about 450), in

<sup>16</sup> National structure of population of Croatia in settlements, Population census in 1991, RZZS, doc. 881, p. 150-152 and 172.

<sup>17</sup> Schematism of the Catholic church in Yugoslavia, Cerkev v Jugoslaviji, BKJ, Zagreb, 1974, pp. 318-319, 462-463.

<sup>18</sup> SLJH-92, p. 467.

<sup>19</sup> Worked out by the author according to the number of inhabitants and households.

<sup>20</sup> Population census, households, apartments and agricultural economy, March 31, 1991, First results, Settlements, RZZS, pp. 59, 67.

Lun (about 230), in Stara Novalja (about 200), in Potočnica (about 150), in Mandre (about 120), in Košljun (about 100), and in other settlements about 370.

### Some characteristics of economy and social superstructure

The island of Pag bases its economic development on its traditional forms of agriculture, fishing, salt production, stone, and modern forms of industry and tourism. Various catering, craft and traffic activities could be added, therefore today the island of Pag has different economic opportunities.

In 1991 about 1259 persons were employed in the island, in the so called social and 573 in the private sector, coming to the employment rate of 23,7 %. The employment gradually increased after World War II, with minor oscillations up to 1989 when the largest number of employed was recorded (1694 in social and about 700 workers in private sector).<sup>21</sup> Since then, due to war events it has decreased rapidly.

In *industry and mining* the number of employed is large (in 1985 and 1986 the maximum of 450 employees was reached, and in 1991 there were just 281, as e.g. 12 years before, in 1979). They are significant for employments in trade, tourism and catering, where the maximum of employed was reached in 1986 with the number of 699 employed, whereas in 1991 the number of recorded employed workers was 423.<sup>22</sup>

*Agriculture* is connected with the fertile zones of valleys and fields, and for the smaller part of rocky grounds covering even 86% of Pag, planted with more resistant cultures (olives, wine grape), and for pasture-grounds, usually karstic rocks.

*Farmlands* cover about 80 % of the island area. In the period 1973-1993 cadastre records between 227 km<sup>2</sup> and 234 km<sup>2</sup> of farming lands, and only the tenth is *arable* (entered between 22,1 km<sup>2</sup> and 22,7 km<sup>2</sup>), the rest are chiefly rocky *grazing-lands* covering over 200 km<sup>2</sup>. About 11,5 km<sup>2</sup> of *arable lands* lie fallow. In proportion to its use, the largest part belongs to *plough-lands and gardens*, whose areas have been mostly increasing (in 1973 1342 ha, in 1991 1464 ha, maximum in 1988, 1472 ha).

Then *vineyards* follow, whose areas have been essentially reduced from 721 ha in 1973 to 551 ha in 1991 i.e. for 1/4). The number of *orchards and olive-groves* is the smallest, about 169 ha in 1991, which is slightly less than in 1973 when they covered 170 ha. The olive-groves prevail mostly in Lun even 150 ha. *Meadows* covered 206 ha in 1973, and 195 ha in 1991. As regards the situation at the beginning of the century (1910), vineyard areas, which occupied more than 1700 ha at that time, were minimized.<sup>23</sup>

*Agricultural production* in 1991 was about 4400 t of hay, 17 t of potatoes, 3300 t of grapes, (sorts "gegić bijeli", "brajdica", "maraština" etc.), 10 t of olives, 1 t of plums, i.e. 13.000 hl of wine ("paška žutica" etc.) and 20 hl of oil. In bumper years up to 700 t of hay (in 1976), 42 t of corn (in 1962), 40 t of potatoes (in 1975), 50 t of olives (in 1963), more than 7000 t of grapes (in 1960), i.e. more than 30.000 hl of vine (in 1963 and before), was achieved. In Pag there is a wine cellar the capacity of 100 wagons.

Wheat is grown (about 13 t in 1960, and today very little), barley (about 32 t in 1960, today significantly less), onion (more than 250 t in 1963, and today from 100-200 t

<sup>21</sup> SGJ and SGH 1964-1991, SLH-92.

<sup>22</sup> Ibid.

<sup>23</sup> Ibid., supplemented by the data of the land-registry office of Pag

a year), beans, cabbage and kale, tomatoes, figs etc. Production of brandy varies significantly, from 80 hl to 1200 hl a year, depending on the year.<sup>24</sup>

In the past, and even today the vineyard production offers oversupplies, whereas in major part of other products the island has more debts than products. It applies especially to cereal (grains), olives and the major part of fruit.

*Cattle fund* had about 17.000 of sheep in 1991, a hundred pigs, 12.000 pieces of poultry and only a few horses and oxen in the private sector and a certain number of sheep in the social sector (about 3.000).<sup>25</sup> Sheep-breeding after which Pag is famous among the Croatian islands, gives a basic characteristic to its sheep-breeding. In the most favourable years the number of sheep on the island reached over 40.000 (in the 19<sup>th</sup> c. to the half of the 20<sup>th</sup> c.), and sometimes even more than 50.000 (e.g. in 1831 even 51.900) (PERIČIĆ, 1989, 205). The production of the Pag cheese, lamb, wool, "puina" (curd cheese) and cattle-breeding completely disappeared, rapidly decreasing in the 20<sup>th</sup> c. whereas in the 19<sup>th</sup> c. the number of oxen was most frequently over 1000 pieces. Also, the number of horses, sometimes over 200, today the number is irrelevant, only the number of donkeys is somewhat bigger but significantly below the number of over 1000 as many as it was in the middle of the 20<sup>th</sup> century. The number of pigs also considerably decreased. The number of goats ranged in the 19<sup>th</sup> century between 1000 and 200 (e.g. in 1827 it was 1625), and today there are only about 500 (PERIČIĆ, 1989, 205). The recent years the number of poultry has been on the increase (in 1991 almost 12.000 pieces). The ranging number of head for particular sorts is seen from the following table:

Tab. 6 Number of domestic animals 1830-1991

Tab. 6. Broj domaćih životinja (1830.-1991.)

Year	Sheep	Horses	Oxen	Donkeys	Pigs	Poultry
1830	26.790	319	1398		215	
1857	21.501	254	1.253	517	235	
1880	37.489	204	1.152	413	402	
1960	34.763	148	307	1.020	1.007	
1981 <sup>x</sup>	23.122	28	6		179	7.246
1991 <sup>x</sup>	16.966	3	3		108	11.990

<sup>x</sup> only private sector

Source: ROGIĆ, p. 152, supplemented for 1981 (First census results ) and 1991 (as in veg. 46), for 1830, DAZD, Various documents of the Dalmatian regency, vol. 21, Prospetto generale della Popolazione delle Case, delle Famiglie, del Bestiame...a tutto 31, Dicembre 1830).

The importance of *forestry* is, regarding the level of deforestation of the island, relatively small. Woods and woodlots covered about 1500 ha in 1993 (2125 ha in 1910). Woods cover only about 40.000 m<sup>3</sup> of timber mass. Every year smaller quantities are cut, at the most 200 m<sup>3</sup>, sometimes only several cubic meters, on the average around 200-300 m<sup>3</sup>. Every year areas of only 2 ha for example (in 1976) are afforested up to 86 ha in 1982, on the average around 25 ha.<sup>26</sup>

<sup>24</sup> as in veg. 47 and: ROGIĆ, 1972, pp. 151-152

<sup>25</sup> as in veg. 46.

<sup>26</sup> as in veg. 47

*Industry and mining* are important economic branches. Salt panning from the sea is an old activity in Pag, and nowadays it is produced in Pag and Dinjiška, where up to 20.00 t of salt a year is panned. The salt pans in Pag are the largest in Croatia. The one in Pag itself stretches on the area of approx. 3,01 km<sup>2</sup> (VIDAS-POSEDEL, 1960, 74). The conditions for production are very favourable (geomorphologically, climatically etc.). Besides production it deals with import and salt traffic. Among industrial objects the most important are "Pagplastika", production plant for processing of plastics, "Sirana" Pag, a plant for the production of cheese and dairy products, and there are a few smaller plants the so called small industries, and the plant HEP (Croatian Electric-power Supply; "Elektra" Zadar). By connecting the island of Pag with the power-transmission line DV 110 kV from Rijeka to Zadar, which was put into operation in the summer of 1994, electro-energetic conditions of the island have considerably been improved providing appropriate and more stable connections of industrial and other economic objects and households either.

*Handicraft* is not especially developed although a number of craft shops are on the increase, and the introduction of market relations opens new initiatives. In 1983 there was 131 craft shop with just 92 employees.<sup>27</sup> The ancient making of Pag lace is a speciality of this island and especially of the town of Pag. Today, fading away, it calls for urgent change in the relations toward such a precious craft, which can be of certain use to tourism and the handicraft of the island itself. Recently, making of Pag lace is obligatorily included in primary education of the girls in the town of Pag.

*Tourism and catering*, as well as *trading* are important activities on the island, especially in the recent decades. In 1990 there were 60 shops and 131 catering business unit on the island. It is at the same time a maximum recorded number after a several-years gradual increase. The number of tourist beds was near 22.000 (the largest in 1987-28.000). The largest tourist traffic was in Pag and Novalja, but other settlements recorded it as well, such as Poveljana, Stara Novalja, Lun, Vlašići, settlements on Barbat etc. After putting into service the Adriatic tourist road and the car-ferry services with land, and especially after building the bridge land-Pag in 1967, the tourist traffic recorded a high and continuous increase.

The largest number of tourists was recorded in 1987 (104.000) and in 1989 (103.000) the largest total of overnights was reached (1076.000 and 1067.000).<sup>28</sup> The foreigners took part in the tourist traffic at around 60 % in number and at around 65% of overnights. The guests usually stayed for more than 10 days on average. The tourist traffic decreased for about 30 % in 1990 in relation to the previous year, and in 1991 it was negligible, as the war started in Croatia, especially in the direct neighbourhood, in Ravni Kotari. Gradual increase is made in 1993 - 1998 period, then decrease again (Kosovo crisis) in 1999, decrease, and in 2000 again increase up to some 600.000 of tourist overnights.

*Traffic connections* are of extraordinary importance for maintaining life and progress of the island. Only forty people have been employed in the traffic activity. There are about 150 km of roads on the island out of which 80 % asphalt, about 1400 of registered motor vehicles, from which almost 800 cars.<sup>29</sup> By building the bridge towards

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<sup>27</sup> Ibidem

<sup>28</sup> Ibidem

<sup>29</sup> Ibidem

Zadar at Rtina in 1968 and the car-ferry landing at Žigljen in 1990, traffic communications of the island of Pag were remarkably improved after withdrawing the local ship lines. During the Great-Serbian aggression on Croatia, the island of Pag played an important part in the period from 1990-1993 connecting the South of Croatia and large parts of Bosnia and Herzegovina with the rest of Croatia and other countries. Reconstructing the road Dinjiška - bridge - Rtina - Ražanac from 1991-1994, and the bridge in 1999/2000, the road connection of the island with Zadar, the closest regional centre, was largely improved.

*Connections and telecommunications* undergo increasing development. The number of telephone subscribers is about 1500, and of telephones near 2000. There are 6 post offices (Pag, Novalja, Kolan, Metajna, Poveljana and Lun). Above the Pag Town in Kiršina there is a RTV transmitter.

The activities of social superstructure, *education and culture, health, administration* and others are also of importance for the development of Pag.

There are 9 primary schools, organized in two central PS with about 700 pupils and 50 teachers, and one secondary school with about 240 pupils and 18 teachers (in 1991). The number of pupils in primary schools has been decreasing from the 1960s and today it is less for about 30 %. The number of pupils in the island secondary school reached its maximum in 1980 (246) and since then it decreased in general till 1986 (159), and then it has been gradually increasing (1991 the number was 237).<sup>30</sup>

There are 8 doctors, 4 dentists and 2 pharmacists employed in the island.<sup>31</sup>

### **Perspectives and dilemmas in the island development**

The island of Pag, as never before in its past, has undergone an immediate and rapid development the recent decades, even though the number of inhabitants has been decreasing or sluggish. The development of tourism, building of island roads and better links with land enabled keeping of adopted forms of sheep-breeding, further development of saltpan and the appearance of various small economic plants. Increasingly better infrastructure connection (water and electro supply) will affect favourably, and the island will, in near future, in reference to its physical abilities of space and coastal length, realize its further development and maybe a small increase in number of inhabitants as it was realized in the inter-census period 1981-1991.

Of particular importance are the possibilities of tourism development and numerous accompanying activities, because the island of Pag is of particular natural attraction, it has historical-cultural inheritance, ethnological peculiarities, and very soon other tourist factors could be considerably improved: infrastructure and communications, various forms of services etc.

Besides tourism, it should be acted stimulatively on the existing forms of domicile cattle and agricultural production. In connection with that it is necessary to protect the farmlands of erosion, devastation and unnecessary construction, and stimulate the various forms of land cultivation.

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<sup>30</sup>Ibidem

<sup>31</sup>Ibidem



Building of small industrial plants and the development of various crafts are required for the settlements in the Pag Island in order to employ permanently a number of workers. Certainly, the plants should be the ones, which will not devastate the area, affect negatively on the tourist development etc. Microunit of the Pag Island does not stand large industrial capacities, especially the ones of the nuclear plant type which were discussed in some suggestions of the regional development of Croatia. Furthermore, the maritime exposed position of such a plant could endanger the tourism and some other activities not only in Pag, but also in the larger part of the Adriatic coast from Kvarner towards the south.

In social superstructure, except educational, health, administrative and other functions, which should be established to satisfy the population of the island, the renovation and presentation of many cultural-historic objects are of great importance, as forming of museum collections. Of particular importance is the maintenance of lacy-like skills with younger generations, as it was preserved only with a small number of old women and disappearance was stopped. Being of national interest, the obligatory program of the Pag lace for young women of Pag in primary schools has been regulated after 1995 by a special decree of the Ministry of Education. All those activities could also render possible a faster tourist development.

Today the island of Pag is in the zone of daily migration of workers, pupils and citizens to Zadar. It was particularly made possible after building the bridge Pag - land, and after modernizing the road Zadar - Ražanac - Rtina - Pag, and other roads on the island. Performing of numerous daily activities in Zadar suggests an increasingly greater significance in connecting this island with its old centre. The break of war events started by the Great-Serbian aggression in Croatia in 1991 enabled in that respect completely new, more favourable conditions for the development of Pag, one of the largest and most particular Croatian islands.

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## SAŽETAK

### Damir Magaš: Prilog poznavanju geografskih obilježja otoka Paga

Tema ovog rada je geografska problematika otoka Paga u zadarskoj regiji Južne Hrvatske (Dalmacija). Autor posebno obrađuje geografski položaj unutar zadarske otočne skupine i kvarnerskih otoka. Površina otoka iznosi 284,56 km<sup>2</sup>, a s pripadajućim otocima (Maun, Škrda) otočićima i grebenima 296,26 km<sup>2</sup>, a broj stanovnika 1991. iznosio je 7969 u 25 naselja. Na otoku se nalaze tri administrativne jedinice Grad Pag (170,69 km<sup>2</sup> i 4116 stanovnika u 14 naselja 1991) i općina Poveljana (38,24 km<sup>2</sup> s 678 stanovnika u jednom naselju) u zadarskoj Županiji, i općina Novalja (87,31 km<sup>2</sup> s 3175 stanovnika u 10 naselja). Dužina obalne crte je 269,2 km, what gives a coefficient of indentedness 4,50. Ujedno, Pag je otok s najdužom obalnom crtom među hrvatskim otocima. Najviši vrh je Sveti Vid (Saint Vitus, 349 m). Reljef obilježava krška morfologija. Osnovne reljefne strukture (krška bila Sv. Vid, Barbat, Kršina etc., i flišno-aluvijalne udoline: Novalsko-Paška udolina, Poveljanska, Kolanska, Vlašička i dr.) pružaju se u dinarskom smjeru NW-SE. Posebno se ističu zamočvarene zone Velikog (6,5 km<sup>2</sup>) i Malog Blata (0,9 km<sup>2</sup>). Najveći su zaljevi Paški, Stara Novalja, Vlašići, Dinjiška i dr. Geološki, Pag je građen od kredno-paleogenskih karbonatnih stijena (cenomansko-turonski vapnenci, turonsko-senonski rudistni vapnenci, eocenski vapnenci), laporovito-pješčenjačkog kompleksa (srednjoeocenski fliš), miocenskih i pliocenskih naslaga s pojavama lignita te mladih naslaga kvartara (blata, pijesci i sl.). Tektonika i geološka građa Paga nastavak su onih u Ravnim kotarima. Klima Paga prijelaznog je tipa eumediteransko-submediteranska. Glavne meteorološke postaje su u Pagu i Lunu, a kišomjerne u Novalji, Vlašićima i Barbatu. Broj sunčanih sati u Pagu je 2268 h/god, prosječna godišnja temperatura 15,3 °C (siječanj 7,0 °C, srpanj 24,7 °C). Godišnja količina padalina kreće se od 1050 u Novalji do 1106 u Pagu. Najviše je padalina u razdoblju rujna-prosinac. Pag obilježava oskudica nadzemnih voda i složenost podzemne hidrografije. Ima nekoliko blata (Velo i Malo Blato, Rogoza) i malih periodičnih vodotokova. Česte su vrulje, izvori, lokve i zdenci. Za opskrbu stanovništva koristi se voda Velog Blata, a izgrađen je i spoj s kopnom. Ovce i koze snabdjevaju se iz lokvi. Vegetacija

otoka Paga je odraz klimatskih prilika pa prevladavaju prave mediteranske i submediteranske biljne vrste. Ukupno je oko 650 vrsta pronađeno na otoku (od toga 45 endema). važnije su sastojine hrasta crnike, umjetno sađenog bora itd. Ipak, zbog stoljetne ispaše i klimatskih prilika česte su krške kamenjare s oskudnim niskim biljem. samo je 2% otoka prekriveno tlima

Posebna se pažnja posvećuje povijesno-zemljopisnom pregledu razvoja i naseljenosti od najstarijih vremena do danas. Otok je bio naseljen u prapovijesti (liburnske gradine: Gradac in Lun, Gradac in Novalja, Gradašćica, Pustograd etc.). Za vrijeme rimske uprave Kissa je bila najvažnije središte, ponajviše vezano za susjednu Aenonu (Nin), premda je i obližnji rapski centar nesumnjivo znatno utjecao na sjeverni dio otoka. Iz ranokršćanskog razdoblja sačuvano je više crkava i utvrda. Hrvati su naselili otok vrlo rano, u vrijeme naseljavanja Nina i okolice Zadra tj. u 7 st. Kršćanstvo je ostavilo na otoku brojne crkvice i kapele. U srednjem vijeku Pag je u Zadarskoj komuni (južni veći dio), a dijelom pripada i Rabu (sjeverni dio), ali pod stalnim napadima Venecije. Pag postaje poznat po velikim solanama koje su sačuvane do danas. Veći dio otoka se osamostaljuje u vlastitu komunu, a u 15. st. Venecija gradi novo središte otoka u današnjem Pagu.

Kretanje broja stanovnika pokazuje stalan pad u sve tri jedinice na otoku, Pagu, Novalji i Poveljani, poslije 1948. Strukture stanovništva uglavnom pokazuju nepovoljna obilježja. Završni dio rada obuhvaća značajke gospodarstva i društvene nadgradnje. Ovčarstvo, turizam and lokalna industrija pokazuju najviše vitalnosti. Autor posebno razmatra perspektive i dileme otočkog razvoja u složenim uvjetima administrativne podjele na dvije županije.

## SOMMAIRE:

### **Damir Magaš: Contribution à la connaissance des caractéristiques géographiques de l'île de Pag**

Le thème de cette étude est la problématique géographique de l'île de Pag. L'île est située dans la région de Zadar, dans la Croatie du Sud (Dalmatie). L'auteur élabore en particulier sa position géographique dans les limites de l'archipel de Zadar et des îles du Quarnero. La superficie de l'île s'étend à 284,56 km<sup>2</sup> et avec les îles appartenantes (Maun et Škrda), îlots et écueils, celle-ci monte à 296,26 km<sup>2</sup>. Selon le recensement de 1991 il y avait 7969 habitants dans 25 habitats. L'île est partagée en trois unités administratives: La ville de Pag (170,69 km<sup>2</sup> et 4116 habitants dans 14 habitats), la commune de Poveljana (38,24 km<sup>2</sup>, 678 habitants dans un seul habitat), qui appartiennent au Comitat de Zadar, et la commune de Novalja (87,31 km<sup>2</sup> avec 3175 habitants dans 10 habitats) appartenant au Comitat de Lika - Senj. La côte de l'île est longue 269,2 km<sup>2</sup>, ce qui donne un coefficient d'indentation de 4,50. Pag est à la fois une île dont la côte est la plus longue de toutes les îles croates. La plus haute crête est celle de Sveti Vid (Saint Vitus, 349 m). La morphologie karstique constitue le caractère distinctif de son relief. Les structures fondamentales de relief (crêtes karstiques Sveti Vid, Barbat, Kršina etc. et vallées flish-alluviales de Novalja-Pag, Poveljana, Kolan, Vlašić etc.) s'élongent dans la direction dinarique (nord-ouest - sud-est). Les terrains marécageux de Veliko Blato (6,5 km<sup>2</sup>) et Malo Blato (0,9 km<sup>2</sup>) se distinguent spécialement. Les plus grandes baies sont celles de Pag, Stara Novalja, Vlašići, Dinjiška etc.). Au point de vue géologique l'île est composée des rochers et des calcaires datant du crétacé et du paléogène (calcaires cénomanien-turonien, calcaires rudistiques touronien-senonien, calcaires d'éocène) des couches de grès et marne (flish moyen éocène) des sédiments de miocène et pliocène avec des apparences de lignit et aussi de jeunes couches du quaternaire. La tectonique et composition géologique de l'île sont en effet la suite de celles des Ravni Kotari. Son climat est du type transitoire euméditerranéen - subméditerranéen. Les principales stations météorologiques se trouvent à Pag et à Lun, et les stations pluviométriques à Novalja, Vlašići et Barbat. Le nombre des heures solaires à Pag est 2268 par an. La température moyenne annuelle est de 15,3°C (janvier 7,0°C, juillet 24,7°C). Précipitations atmosphériques se situent entre 1050 mm par an à Novalja et

1106 mm à Pag. Ces précipitations sont les plus abondantes dans la période septembre-décembre. Ce qui caractérise cette île ce sont le manque des eaux de surface et la complexité de l'hydrographie souterraine. Il y a quelques marécages (Velo Blato, Malo Blato, Rogoza) et de petits courants d'eau périodiques. Sources, sous-marines, flaques et fontanes sont fréquentes. Pour l'approvisionnement des habitants on se sert de l'eau de Velo Blato et puis on a établi jonction avec la terre ferme. On abreuve les moutons et les chèvres de l'eau de flaques. La végétation de l'île est la répercussion des conditions climatiques de manière que les associations végétales méditerranéennes et subméditerranéennes autochtones prédominent. On y a trouvé 650 espèces dont 45 sont endémiques. Parmi les plus considérables figurent le chêne vert et le pin planté artificiellement. Cependant à cause d'un long et excessif pâturage et des conditions climatiques, les terrains karstiques avec une végétation basse presque font à fait dégradée sont fréquents. Il n'y a que 2% de couverture pédologique.

Attention spéciale est dédiée au développement historique-géographique depuis les temps anciens jusqu'à nos jours. L'île a été habitée dans la préhistoire. La preuve en est "gradinas" libourniennes (agglomérations caractéristiques situées sur les hauts des collines): Gradac à Lun, Gradac à Novalja, Gradašæica, Pustograd etc. Pendant l'administration romaine Kissa était le plus important centre de l'île, qui était lié surtout avec Aenona (Nin). De nombreuses églises et fortifications datant des premiers jours du Christianisme ont été conservées. Les Croates se sont établis dans l'île contemporanément à ceux qui ont peuplé Nin et les environs de Zadar cela veut dire au 7<sup>e</sup> siècle. Le christianisme a laissé de nombreuses petites églises et chapelles. Au moyen âge la majeure part de l'île (sud) était sous l'administration de Zadar et celle du nord appartenait à Rab. Après avoir été conquise par Venise, l'île est devenue connue par ses larges salines, qui sont préservées jusqu'au présent. Tandis que au 13<sup>e</sup> siècle Pag a été une commune indépendante, au 15<sup>e</sup> siècle Venise bâtit un nouveau centre dans la localité où Pag se trouve aujourd'hui.

Après 1948 la diminution de la population est constante dans toutes les trois communes (Pag, Poveljana et Novalja). Les structures de la population montrent des caractéristiques désavantageuses. La partie finale de l'étude comprend les caractéristiques d'une économie frustrée et celles de la superstructure de la société. L'élevage des moutons le tourisme et l'industrie locale montrent le plus de vitalité. L'auteur prend en considération aussi les perspectives et les dilemmes du développement de l'île dans des conditions complexes de la division administrative de l'île en deux comitats.