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ABOUT THE ISLANDS IN THE REPUBLIC OF MACEDONIA

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INTRODUCTION

Republic of Macedonia (25.713 km²) is landlocked continental country with 3 large natural lakes (43-350 km²), 5 larger reservoirs (5-15 km²) and dozens of small reservoirs. The major river is Vardar with length of 301 km (388 km total length to the mouth in Aegean Sea), while other rivers are much smaller (Gaševski, 1979). It was previously considered that the island Golem Grad ("Big Town") in southwestern part of Lake Prespa is the only island in the Republic of Macedonia (Panov, 1976; Stojmilov, 2004). However, according to the mostly used criterion of 0,01 km² (1 hectare) area as the threshold size of the typical island, it turns out that the Golem Grad is just the largest island in the country. There are number of other islands on the rivers and reservoirs, and some of them are also quite interesting.

METHODOLOGY

In Macedonian geography, only the island Golem Grad in Prespa Lake is considered as a such. Several river islands are shortly mentioned in geomorphological or hydrological studies (Manakovic et al., 1998), but without clear statement about its island nature. For this work, detailed preview of high resolution Google Earth satellite imagery is made, using also image history tool which usually go back to 2005-2002. When islands are find and selected through the country, even more detailed orthophoto imagery of 0,5 m resolution (acquired from the State Agency of Cadastre of RM) is pre-viewed. Measurements and analyses are made in Global Mapper v.14 which is very fast for opening such large datasets. Also, for the topographic features, 100k and 25k were used together with 15 m digital elevation model of Macedonia. Historical imagery, older orthophoto and topographic

maps was used for determination of islands genesis, changes and evolution, or to exclude some very inpermanent ones.

LAKE ISLANDS

The Golem Grad island is well known and researched (Stojadinovic, 1968). It is located near the triple border between Macedonia, Albania and Greece, 2 km away from the Konjsko peninsula and 4 km from the village Golem Grad on the Prespa coast. The length of the island from north to south is exactly 700 m, and the width in the west-east direction is 450 m. The shores of the island are very steep and represent typical cliffs up to 30 m high, formed by long action of lake waves on limestone rocks. Only a few places along the shoreline are with gentle slope and easy access inside the island. The total length of coastline is 1.8 km, while the total area of the island is 0.23 km² or 23 hectares (56 acres). The highest peak on the island is 900 m asl or 50 m above the lake level and it is located in the northeast part. Today the island is uninhabited, but is exceptionally rich in endemic plants, many rare species of reptiles and birds, different groups of animals etc. Numerous remains of old buildings (mostly churches) with some other records and findings indicate that the island was inhabited longtime ago. Due to the large number of different types of snakes on the island (mostly non-venomous), Golem Grad is known also as Snake Island. Because of the overall natural landscape, as well as valuable cultural-historical and archaeological objects, this island has been proclaimed as a strict nature reserve. Since 2008, the island Golem Grad is open for tourists who coming here in growing number each year and leave it with unique impressions.

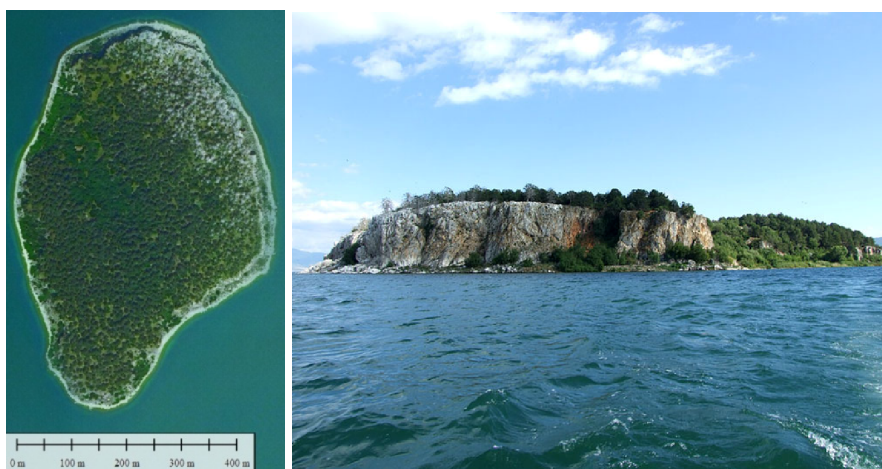


Fig. 1, Golem Grad island on Prespa Lake.

The other natural lakes in Macedonia do not have typical islands. But there are several reservoirs with almost permanent islands during its life-time. Two of the most interesting islands are located in Tikves Lake and Kalimanci Lake. These islands appeared after formation of the reservoirs in the valleys of Crna River and river Bregalnitsa in 1969. The greater is the island in Tikvesh Lake called Gradiste Island, located in the northern part of the lake, west of the village Resava. The shortest distance from island to the coast (to the east) is 120 m. The island has an irregular rectangular shape, of a width of 140 to 160 m, an area of 2.3 hectares, while the highest point on the island is usually about 20-30 m above the lake (286 m asl), depending on the water level in Tikvesh Lake. The total length of coastline is about 550 m. Gradiste island is composed by schists covered with bushes and woody vegetation, with many species of birds, reptiles and other animals. On the top some remains of an old building are find from which the name Gradiste (old building site) originate. The island is rarely attended, usually by the fishermens, travelers and adventurers.

Island in the lake Kalimanci called Kalata is located in the middle of the lake. It is extremely elongated in the northeast-southwest direction, with a length of 290 m, width of 75 meters, and height of usually 15-25 m, depending on the water level. The area of this island is 1,6 hectars on average, while the coastline length is about 650 m. From the coast, this island is usually 100-150 meters away. But unlike the Gradiste island in Lake Tikvesh, during the dry seasons and low waters this island is connected with land and for that short time it is peninsula. That is because of large fluctuation of the water level in the reservoir during the year because of intensive irrigation of rice fields in Kochani Plain. Island Kalata is composed by very old mica-schists, covered with oak trees and bushes. There are some old archeological remains, but however it is rarely visited by people.



Fig 2, Gradište island (left) in Tikveš Lake and Kalata island in Kalimanci Lake (right).

RIVER ISLANDS

There are 10 river islands in Macedonia larger than 0.01 km² (1 hectare), all on the Vardar River downstream of the confluence of Pchinja. These river islands appear on earliest satellite images from 1975 to the present (Landsat TM), as well on older topographic maps. During that time, their shape and size is not significantly changed. There are dozens of other smaller ephemeral islands with very changeable shape and short lifespan, but these are not taken into consideration. The islands in Vardar river are created mostly by high downstream deposition of previously eroded material. Namely, Vardar river is torrential with severe erosion rate in the watershed (Djordjevic et al., 1993) and huge discharge variations from extreme floods (more than 1000 m³/s) to shallow water (below 50 m³/s) and about 140 m³/s in average near Gevgelija gauge station (Gaševski, 1979). For that reasons, Vardar river rise its downstream riverbed which in turn significantly change its course, constantly creating and evolving of meanders. Thus, another way of forming the islands is by cutting off highly convex downstream meanders during the high waters and floods.



Fig. 3, Largest river islands in Macedonia on the river Vardar near villages of Udovo (left) and Ulanči (right).

From the 10 relatively permanent river islands, the largest one is near the v. of Udovo with area of 6 hectares and a coastline length of 1.4 km. Beside him, a sizable is Ulanči island and the island in Demir Kapija gorge (4.8 hectares both). Further follow-largest river islands near the village of Tremnik (3.9 ha), island in Taorska Canyon (3.4 ha), island in the village of Gradec (3 hectares) and others. According to the length, the longest is Tremnik island and Udovo by 700 m, and the highest relative height has a island near the v. Pepeliste (6 m). All 10 river islands are low (up to 6 m above the river) and because of that partly or rarely completely flooded dur-

ing the high waters of the Vardar. Most of the islands are off the coast with in 15-30 meters, which is a problem for their visit (age depth of the islands, often exceeding 1 m). However, almost all have river-like vegetation and diverse fauna. They are poorly attended, usually from fishermen, although very attractive and interesting trip, residence and recreation in nature, adventure and other tourism purposes.

Unlike Golem Grad island which is pretty old and formed by tectonics and coastal erosion, other islands are mostly created before several decades. The islands in the reservoirs do not show typical coastal landforms not only because they are still young, but also since the size of the waves is small and the water level is too changeable during the year. Thus, Gradishte and Kalata islands have only steps-like micro-terraces and micro-cliffs with size of few centimeters. However, there are visible effects of the coastal process on these islands which will increase in the future.

Table 1, Islands in the Republic of Macedonia.

NAME	Type	P (km ²)	P (ha)	L m	W m	Sh m	Di m	Hmn m	Hmx m
Golem Grad	L	0.23	23.1	0.7	0.47	1.85	2150	843	898
Udovo	R	0.06	6.0	0.65	0.12	1.39	10	67	71
Ulanci	R	0.05	4.8	0.49	0.14	1.13	30	133	134
Demir Kapija	R	0.05	4.8	0.55	0.12	1.19	25	86	89
Tremnik	R	0.04	3.9	0.73	0.07	1.52	6	105	106
Taor	R	0.03	3.4	0.59	0.08	1.23	25	187	190
Gradec	R	0.03	3.0	0.61	0.08	1.25	4	72	77
Demir Kapija	R	0.02	2.8	0.47	0.11	1.02	18	77	82
Basino	R	0.02	2.4	0.41	0.1	0.91	15	164	166
Pepeliste	R	0.02	2.4	0.37	0.11	0.81	24	114	120
Gradiste (Tikvesh)	L	0.02	2.2	0.18	0.18	0.56	110	263	283
Kalata (Kalimanci)	L	0.01	1.6	0.29	0.07	0.65	120	510	520
Janitash (Veles)	R	0.01	1.6	0.52	0.05	1.07	22	155	159

CONCLUSION

From about 20-30 islets on the surface waters in the Republic of Macedonia (6 on lakes and more than 30 on the rivers), 13 can be assumed as typical islands larger than 0.01 km². The total area of all these 13 islands is 66 hectares or 0.66 km² (0.05 km² per island), and the total length of their coastline is 14.6 km. All of these small islands are uninhabited, but with richness of biodiversity and some of them even with archaeological re-

mains. Only the Golem Grad island on Prespa Lake is the largest, oldest and most permanent one, recently protected as a strict natural reserve. However, all of the islands have touristic potential for a limited number of visitors.

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ЗА ОСТРОВИТЕ ВО РЕПУБЛИКА МАКЕДОНИЈА

Ивица Милевски

ИЗВОД

Во досегашната географска литература, главно се сметаше дека Македонија има само еден остров: Голем Град на Преспанското Езеро. Од друга страна, според релевантната светска литература, за остров најчесто се смета копнена површина поголема од 0.01 km^2 (1 ha) опкружена со вода. Деталните анализи на сателитските снимки и дигитални модели на релјефот, покажуваат дека според тој критериум, во Македонија има 13 типични острови. Од нив, најголем е Голем Град на Преспанското Езеро со површина од 23 ha, за кој веќе има доста информации во литературата. Останатите природни езера немаат острови, но ги има на вештачките акумулации: Тиквешкото (остров Градиште) и Калиманското Езеро (Калата). Во Македонија има и 10 речни острови поголеми од 1 ha, сите на реката Вардар низводно од вливот на Пчиња. Овие 10 речни острови се појавуваат на сателитските снимки и топографски карти од 1975 година до денес, а нивната форма и големина не е значително изменета. Најголем е островот кај с.Удово, со површина од 6 ha и должина на брегова линија од 1,4 km. Покрај него, доста голем е островот кај с.Уланци и островот во Демиркаписката клисура (по 4,8 ha). вкупната површина на сите 13 острови во Македонија изнесува 66 ha или $0,66 \text{ km}^2$, а вкупната должина на нивните брегови е 14,6 km.