Proceeding Book of ISESER 2021

O 8. ASSESSMENT OF NATURAL CHARACTER, RIVERSCAPE AND VISUAL AMENITY OF THE TRANSBOUNDARY DOJRAN LAKE

Laura Shumka[1*], Cigdem Ciftci[2], Andi Papastefani[1]

[1*]*Albanian University, Tirana, Albania*
[2]*Department of City and Regional Planning, "Necmettin Erbakan" University, Konya, Turkey*

E-mail: *l.shumka@albanianuniversity.edu.al*

ABSTRACT: The key elements considered for assessment of the naturalness of the lakes and rivers relate to the degree of intactness of the natural elements, patterns, processes, and extent of any physical land use changes or presence of different constructions. The natural character is essentially a measure of the naturalness or modifications of the natural elements, patterns and processes that comprise a water body. The current contribution is based on a process to assess the level of natural character that involves an understanding of the current systems and attributes that contribute to Lake Dojran ecosystem including abiotic, biotic and other factors. This assessment considered imputes data, such as river hydrology and morphology, aquatic and terrestrial ecology, water quality and landscape architecture. This approach is based on field visit carried out in end of March 2021 and further on a desktop review of relevant available data. The second component of this study includes the visual aspect of amenity as recreational values of the Lake Dojran in its full services. The effect of dramatic water level change/decrease (based on historical data of the period 1985-2000) on visual amenity values was correlated to offered recreation values. The survey analyses on the North Macedonian side of the lake revealed that <25% of the lake margins remained at the natural level, while the pressure from different sectors of human presence is steadily increasing.

Keywords*: Lake Dojran, Natural character, biotic factors, land use, water level.*

INTRODUCTION

Rivers and lakes are dynamic and complex features set within a broader landscape context (Boffa Miskell Limited, 2018). At the state they are, they provide a visual, ecological and recreational focus in a landscape as well as providing physical links throughout their catchments (Shumka, 2018). Rivers, lakes and their margins have natural character, amenity and landscape values that require consideration in water allocation decisions particularly relating to how changing river flows and lake levels can affect those values.

Following Abell *et al.,* (2008), Lake Dojran is part of the Vardar (422) freshwater eco-region at the wider European delineation. The lake is a shallow water body with the bottom laying at an elevation of 138 m a.s.l., while the highest recent absolute altitude above sea level of the water surface was 148 m (Bojovic *et al*., 2016). The watershed and the lake itself are shared by two countries, Greece and North Macedonia (Figure 1).

The lake was formed in a karstified basin created by a combination of Tertiary and tectonic activity. The sediments of the lake watershed are composed of mineral-rich ancient alluvial and limestone sediments. A minor part of the watershed on Macedonian side is composed of diluvia clay sediments (Popovska *et al*., 2005; Popovska & Bonacci, 2008; Gesovska *et al*., 2013). The northern and eastern belts of the watershed are rocky and covered with low forests and weeds (Figure 1). Forest and semi-natural areas, including agricultural land, cover most of the catchment. The lake is recharged from direct runoff, small rivers and groundwater and it does not have surface outflow (Sotiria & Petkovski, 2004).

The watershed within the Macedonian territory is characterized with a relatively large annual production of erosive material of about 29.000 m^3/annually, out of which only 323 m^3/annually is transported towards the lake.

The main water flows are situated on the Greek side and they include: Odza Suji (Breska River) with a waterbasin of 94.3 km^2, carrying all the waters from the South slopes of the mountain Belasica, and the river Kavakalaris, with the water basin of 21 km^2. On the Macedonian side, there are 26 smaller rivers,

creeks and springs; the most important ones are: Crn Potok, Pazarli Dere, Suva Reka, and Derven Rama. The water volume is 262 million m^3 which corresponds to the average depth of 6.5 m (maximum depth).

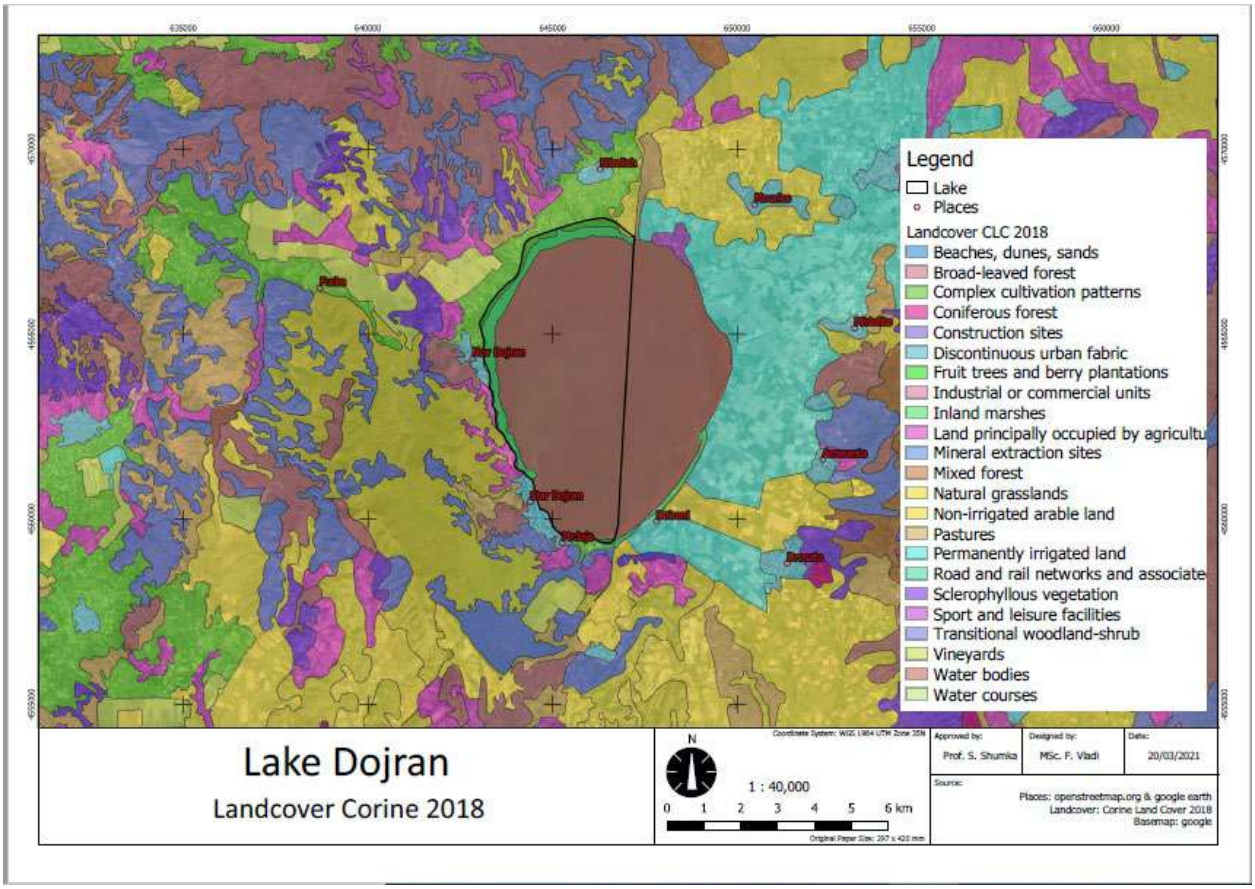

Figure1. Lake Dojran, Corine land cover (state of 2018)

MATERIAL AND METHODS

Assessment Methodology criteria for natural character: Each component of the lake has been assessed separately using a set of attributes that incorporate the abiotic and biotic factors specific Lake Dojran systems as below. The experiential component of natural character has been considered for the complete lake rather than for each component separately (Table 1; Table 3). The field data collection has been conducted in the period of 25th 29th March 2021.

In this assessment:
Active bed: Includes varying lake shore extents for the typical range of lake levels. The landward extent of the active zone is often delineated where permanent terrestrial vegetation meets the bare gravel/rock substrate.
Context: Refers to the wider landscape context of the catchment adjacent to the lake, and considers the land use, landform and vegetation cover that contributes to the overall character of the lake.
Margin: Refers to the strip of land between the active bed and the wider landscape context, including the banks. River processes, patterns and influences will be evident in the margin, such as occasional flooding, historic banks and channel patterns. From locations within the lake margin the active bed is the visually dominant feature. The margin is typically narrow and may incorporate terraces, banks, abandoned riverbed, floodplains, river and tributary confluences and built infrastructure. Generally topographic features define the extent of the margin as they extend between the top and base of banks or terraces. Vegetation type boundaries can also define the margin extent, such as where riparian scrub or planting meets grazed pasture in the landscape context.

Table 1. Assessment methodology criteria for natural character

Lake components	Attribute groupings	Lake Natural Character Attributes
Active bed	Abiotic	Flow regime characteristics and levels, managed or natural flows.
		River channel /lakebed substrate morphology including modifications/ structures e.g. boat ramps, dams, diversions
		Water Quality-if available indicator of ecological health
	Biotic	Aquatic ecology, flora/fauna, habitat, pest species
Margin	Abiotic	Modification and structures- buildings, quarries, bridges roads,
	Biotic	Terrestrial ecology, (also describe braided riverbeds) e.g. vegetation and bird habitat
Context	Abiotic and biotic	Land modification/land use / vegetation. Urban, agriculture
All (focus on active bed and margin)	Experimental	Views, sounds, sense of naturalness, wildness remoteness

A Five-Point scale was used to assign an overall level of natural character to each of the river/lake components.

Table2. The scale used to determine an overall level of natural characters for each of the river / lake components.

Very High	High	Moderate	Low	Very Low
Very High levels of natural character due to Very Low or no levels of modification	High levels of natural character due to Low levels of modification	Moderate levels of natural character due to moderate levels of modification	Low levels of natural character due to High levels of modification	Very Low levels of natural character due to Very High levels of modification

RESULTS AND DISCUSSIONS

The shape of the lake is rather regular with a maximum length of 8.9 km and maximum width of 7.1 km. The volume of the lake at norm is 10.4 m^3. The lake doesn't have surface outflow. The only natural outflow is the lake water surface evaporation. Total watershed area of the lake is 271.8 km^2 out of which 32% belongs to Macedonia. The water surface area of the lake at normal elevation is 42.2 km^2 out of which 63.6% belongs to Macedonia (Popovska *et al*., 2005; Gesovska *et al*., 2013).
In the period of 1990-2010 the Lake Dojran water level decreased seriously. This water declination together with the simultaneous water quality deterioration resulted in biodiversity diminishing and plankton reduction (Gesovska *et al*., 2013).
The Lake Region represents one of the important centers of biodiversity for Western Balkan and SE Europe and has been also recognized internationally for its rich biodiversity and abundance of species, and thus has been proclaimed as an important area for the conservation of European species and habitats (Figure 2). Currently the Lake Dojran is part of different international networks and initiatives for the conservation and protection of nature, such as: the Emerald network of areas of special conservation interest (2002; Bern Convention), North Macedonian important plant areas (2004), the Balkan Green Belt (2004; IUCN), Ramsar site – Wetlands of International Importance (2008; Ramsar Convention), Important Bird Area (2010; BirdLife International), candidate Natura 2000 site (EU Birds and Habitat directives). Since 1977 Dojran Lake has been protected with national law and holds a protected status of a Monument of Nature (Official Gazette of SRM N° 45/1977, Official Gazette of NM N° 51/2011).

Based on researches conducted so far, there are 16 species registered in Lake Dojran, while other authors reported a number of 24 species that do not have established real populations (Kostov et al, 2010). In the basin of Lake Dojran 8 fish species are Balkan endemics (out of 16 species that already have established populations in the Lake ecosystem. The endemics autochthonous fishes from Lake and its catchment area are: *Alburnus macedonicus* (Karaman, 1928), *Barbus macedonicus* (Karaman, 1928), *Chondrostoma vardarensis* (Karaman, 1928), *Pachychilon macedonicum* (Steindachner, 1892), *Rhodeus meridionalis* (Karaman, 1928), *Cobitis vardarensis* (Karaman, 1928), *Sabanejewia balcanica* (Karaman, 1928), *Gobio bulgaricus* (Drensky, 1926). Other species present in the lake include: *Cyprinus carpio* (Linnaeus, 1758), *Perca fluviatilis* (Linnaeus, 1758), *Rutilus rutilus* (Linnaeus, 1758), *Salaria fluviatilis* (Asso, 1801), *Scardinius erithrophtalmus* (Linnaeus, 1758) *and Tinca tinca* (Linnaeus, 1758).

Figure 2. Components of the active bed, margins and context

Table 3. Assessment of Natural character of the Lake Dojran

Natural Characterl_Lake Dojran		**Degree of Natural Character**
Active Bed	• The lake formed in a karstified basin created by a combination of Tertiary and tectonic activity. • Heavily influenced by development of the intensive agriculture activities on both sides of the lake (North Macedonia and Greece). • Water quality affected by various types of pollution, accelerated eutrophication. • In the basin of Lake Dojran 8 fish species are Balkan endemics (out of 16 species that already have established populations in the Lake ecosystem. • The lake is used as a feeding ground from the pelicans. • Recent increase of population of alien and invasive fish and other species.	Low Moderate

	• The lake provides ground for recreational fishing activities that at the current circumstances are beyond its capacities. • Modifications to the active bed include different structure constructed for tourism and recreational fishing, and agricultural activities. • Large water quantity is used for the irrigation purposes on both sides of the lake (North Macedonia and Greece). • There is a lack of waste water treatment facilities. • There is a large number of boats, particularly during the fishing days. • Scenic view notable, particular during spring time.	
Margin	• The eastern lake margin remains actively uses (see Figure 1) for the agriculture purposes. • Southern margins on both sides of the lake are heavily used for housing and tourism purposes.	Low Moderate
Context	• Forest (both low and high forest stands) and semi-natural areas, including agricultural land, cover most of the catchment. • The main water flows are situated on the Greek side and they include: Odza Suji (Breska River) carrying all the waters from the South slopes of the mountain Belasica, and the river Kavakalaris. On the North Macedonian side, there are 26 smaller rivers, creeks and springs; the most important ones are: Crn Potok, Pazarli Dere, Suva Reka, and Derven Rama. • Grazing and hunting are also practiced within Context. • Modifications are minor in proportion to the overall context of the lake.	High
Experimental	• Highly scenic, relatively large-scale open landscape with wide and distant vistas. • Unique combination of water and associated bird species of the lake and sloping gravel beaches. • Presence of winds and waves contribute to a dynamic environment on windy days. • After the dramatic water level drops of two decades ago, there are normal levels of modification • Surrounding landscape is perceived to be of high natural character.	Very High
VISUAL AMENITY - Lake Dojran		**Degree of Visual Amenity**
Nature of views, viewing audience	• Overall, beyond the urban and rural settlements landscape has a very high level of visual coherence. • The unusual combination of water body (water surface) with surrounding mountains slopes it contains high visual and scenic values. • The lake is intensively used, primarily in the summer, for fishing, boating and recreation. The surrounding mountainous landscape means other potential recreational activities. • When lake levels were low, more of the shoreline was exposed which is considered unsightly by some.	High

CONCLUSIONS

Lake Dojran is a shared resource and no action can be taken by one country without impacting the resources and conditions in the other country. So, all further steps including monitoring and survey need to be coordinated among relevant authorities of North Macedonia and Greece.
In this conclusions section we propose 10 steps measures and actions for Lake Dojran conservation with intention improvement of management practices, protection of biodiversity of current and future potential impacts (Table 4). They are connected with building of capacities on both littoral countries in order to: To help conserve globally significant biological diversity and restore important habitat components; To enhance the transboundary cooperation in the Lake Dojran region; To reduce nutrient loads and pollutants to the lake; To increase the overall resilience of the lake ecosystem to the human impacts and climate conditions; To contribute at the local welfare, economic and social prosperity.

Table 4. Summary proposed measures and actions for the conservation of Dojran Lake

No	Measures	Actions
1.	Joint Body for Lake Management	Establishing Joint Lake Dojran Body (it should be composed by representatives of central and local authorities surrounding Lake Dojran, CSO from North Macedonia and Greece)
2.	Joint Agreement	Joint document/Agreement, signed between North Macedonia and Greece by relevant management authorities, in relation to Lake Dojran
3.	Harmonized monitoring program of water quality base don WFD	The monitoring program/protocols should be harmonized with regards to methods, locations and relevant authorities
4.	Improved Lake Data and Share	The Lake data statistics has to be improved, stored with similar approach and regularly shared/exchanged
5.	Joint Biodiversity Assessment	The Biodiversity assessments, surveys and whatever type of monitoring (including scientific ones) has to be integrated considering the lake itself as a unique ecosystem. This will increase the data reliability and serve as real bases for further actions.
6.	Conservation	• Habitat conservation actions; • Action plan for habitat conservation; • Action plan for endemic species conservation; • Conservation action plans per fish species
7.	Abatement plan for the non-native fish species	The abetment plan and any intervention should be done “science based” and jointly agreed by littoral countries (North Macedonia and Greece).
8.	Recreational fishing actions	Jointly agree on recreational fishing management, control of feeding sites, considering the negative impacts to the water quality in a situation of an accelerated lake eutrophication process.
9.	Joint Educational program	• The joint program has to lead reducing environmental impacts of agriculture (pesticides, fertilizers, irrigation water, agricultural waste, support to agricultural associations); Increased awareness of the local communities on fish biodiversity values; • Altering local stakeholder’s reservations towards conservation; minimization of conflicts; establishment of cooperation; involvement of local stakeholders in the management issues of Dojran. • Establishment of Dojran centre for Nature and Human.
10.	Joint Projects	A GEF Full size project would be one the adequate approaches towards integrated ecosystem management, with participation of both littoral countries.

REFERENCES

Abell, R., et al., 2008, Freshwater Ecoregions of the World: A New Map of Biogeographic Units for Freshwater Biodiversity Conservation. *BioScience*, 58 (5): 403-414.

Boffa Miskell Limited, 2018, Natural Character, Riverscape & Visual Amenity Assessments: Clutha/Mata-Au Water Quantity Plan Change- Stage 1. *Report prepared by Boffa Miskell Limited for Otago Regional Council*.

Bojovic, D., et al., 2016, Intergraded Water Resource Management at Dojran Lake in Macedonia-Framework for development of adaptive integrated water resource management plan, *CEPF project Technical Report,* Skopje, 67 pp

Gesovska, V., et al., 2013, Water level, precipitation and air temperature statistical trends-case study Lake Dojran, *Water Management and Hydraulic Engineering WMHE*, Proceedings

Kostov, V. and Nam Der Knap, M., 2010, The collapse of fisheries of Lake Dojran - reasons, actual situation and perspectives, *Conference Proceedings, 4th International Conference Fishery*, Faculty of Agriculture, Belgrade – Zemun, p. 239-246

Popovska, C., et al., 2005, Ecological an dhydrological state of Dojran lake, *Vodoprivreda* 0350-0519, 37: 175-180

Popovska, C. and Bonacci, O., 2008, Ecohydrology of Dojran Lake. In: Hlavinek P., Bonacci O., Marsalek J., Mahrikova I. (eds.) Dangerous Pollutants (Xenobiotics) in Urban Water Cycle. *The NATO Science for Peace and Security Programme,* Springer, Dordrecht: 151-160

Shumka, L., 2018, Considering landscape and water in the Dumrea Region: Challenges for integrated planning and sustainability, *Thalassia salentina,* 40 (2): 147-154

Sotiria, K. and Petkovski, S., 2004, Lake Doiran – An overview of the current situation, *Greek Biotope/Wetland Centre (EKBY), Society for the Investigation and Conservation of Biodiversity and the Sustainable Development of Natural Ecosystems (BIOECO)*. Thermi, Greece.