THE ASSESSMENT OF BIOLOGICAL AND ECONOMIC CAPACITY FOR THE PARK OF VIROI, GJIROKASTRA, ALBANIA

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Abstract

The park of Viroi is situated in the northwest of Gjirokastra city, covering an area of 30 ha. The area structure comprises three elements: artificial lake (18.75 ha), natural karst monument of Mema e Viroit (source of the lake) (1200 m^2) and the bordering territory (about 11.13 ha) with a biological diversity and anthropological access. Due to the karst geological structure and climate conditions (the average multi-year temperature 11^0C and mineralization degree 400 mg/l), the aquatic environment of the park of Viroi, constitutes the main habitat of reproduction and provision of perennial conveyer of fish and fishing in Drino river. This study aims to assess the biological diversity, identification of the kinds/species which constitute a direct and indirect economic source, as well as the interactive possibilities of the integral tourism of the park of Viroi. The methodology for this study is based on expeditions, accumulation, designation, and observation of biological cycles, also the application of Removal method for the assessment of population dynamics. Through the synergic research of these components, it has been found: firstly, its biodiversity (flora 250 species/52 family, fauna 27 family/72 invertebrate kinds, 16 families/28 invertebrate kinds) and the dynamic communication interchanging with Drino river; secondly, analytical assessment (quantity, dynamism, distribution, the manipulation ways) of the kinds with a direct economic impact (fish and frogs), shows the existence of a qualitative and quantitative economic source assessed in 7 kinds of fish (Chondrostoma nasus ohridanus, Barbus meridionalis petenyi, Leuciscus cephalus albus, Gobio gobio, Cobitis taenia ohridanus, Cyprinus carpio, Anguilla Anguilla) and two kinds of frogs (Rana balcanica, Rana dalmatina); thirdly, diversity of ecosystems, types, geography and infrastructure (roads, bars etc), transform the park into a fishing, sport, and walking place, i.e. a touristic spot.

Key words: biological diversity, economic, touristic, kinds, ecosystems

Introduction

The park of Viroi situated on the north-east of the town of Gjirokaster with a surface area of about 30 ha represents a biological, morphofunctional, geomorphological and bioclimatic symbiosis. The morphofunctional continuity among the lacustrine environment, the surrounding environment and the flow of the Drino river re-dimension the importance of investigating this environemnt, with the aim of presenting the biological variety, the assessment of the relationship of the organisms in time and space, the highlighting of the fusion mechanisms among the individuals, habitats and its ecosystems and beyond. The biology of the park and its building for recreational purposes enable the multidimensional use, not only as a natural environment but also as farming , recreational, economical environment etc.

Geological, hydrological, and climatic considerations of the park of Viroi.

The topographic structure of Viroi is made up of: the source of the mother ($1200m^2$), natural monument, the biggest karst spring in the Gjirokaster region, having an irregular fontal pattern, with carbonated geological structure of the Eocene, Paleocene and Cretaceous, with limestone, flintstones and clay-jasper alternations, which lies on the northern side of the park and coincides with the horizontal crossing of the vertical declivity of the eastern side of the Wide Mountain. The source of the lake originates at an elevation of 194.5m, it is siphon-like with a depth of 65m and a deficit of $16m^3$/sec. The average temperature over a long period of years is 11^0C, with a mineralization rate of 400mg/l and according to the physical-chemical characteristics it is categorized as typical carbonated water, type III. The artificial lake (18.75 ha) is fed by the mother of Viroi, with a depth of 2-4 m and hydrographic pattern quite contrastive. The third constituent element of the park is the surrounding territory (about 11.13 ha) with floristic and faunal diversity, and anthropological access. The park is characterized by continental mediterranean climate, minimal temperature 7.8^0C in January and maximal temperature 28.8^0C in June. The recorded average annual precipitation is 1885 mm, while the maximal daily intensity is 254 mm/precipitation. The duration of vegetation is about 246 days, 20 March-22 November. The sum total of annual temteratures is 4347^0C (Shkurti, R. 2009).

Methodology of study.

To realize this study we have carried out field trips by observing the behavioural pattern of the lake, gathering, and determining the biological material of the representatives of the genus Pescea and Amphibia. The duration and the timeline of the field trips have been realized according to a calendar drafted preliminarily based on the biology of the representatives of these two genera, and also on the concrete climatic conditions. The taxonomic determination has been based on determination key and the existing studies. The asessment of the dynamics of the populations under study has been made according to the modified Removal method. The method consists in taking the adult inidviduals, survey and the photographing of surface area where the fries are raised, of the place where the eggs and the larvae of the frogs are deposited. The

recognition of the biodiversity of the park has been realized by the faunal and floristic study literature and also by the conditions at the time of survey.

The Results of the Study.

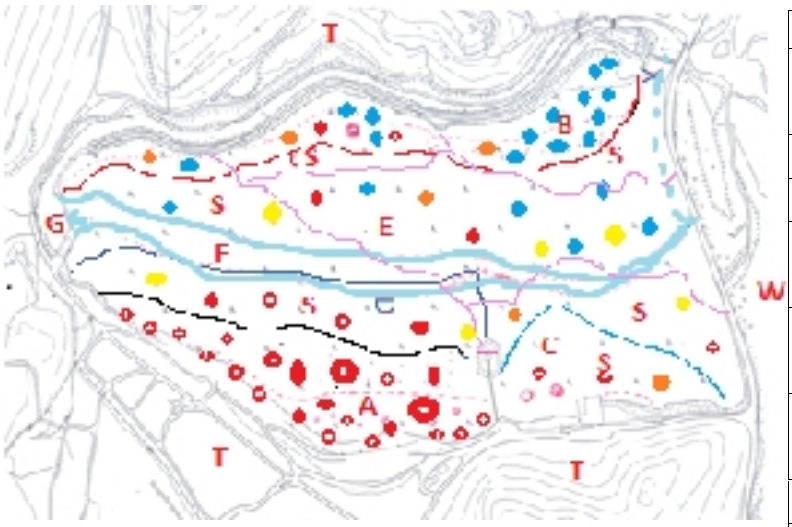
The Biodiversity of the park of Viroi.

Harmonisation of the geoclimatic factors and the existence of the biocorridor with the Drino river, determine the presence of a biological diversity in kinds, habitats, biotopes and ecosystems. The determining factors of the physiognomy of biodiversity and of the ecological dynamics are the morphometrical features, the lithology of the environemnt, pedology, climate, precipitation pattern, evapotranspiration, continuity, the rhythm of recharge, the anthropological impact, etc. In the park of Viroi there exist over 250 plant species which belong to 52 families. The plant species according to the humidity pattern are: hydrophile, dominated by Chlorophyta and Ranuculus trichophyllus which in spring cover about 40-55% of the total surface of the lake; hygrophyla like genera Salix, Rumex, Polygon, Ulmus, Juncus, Agrostis, Festuca, diversity of Graminaceae, etc; mesophile represented by Leguminosae, Compositae, Cruciferae and xerophyte which constitute over 70% of the vegetation with their typical representative the genera Prunus, Paliurus, Cercis, Rosa, Spartium, etc (Gjini, S. & Demaj, E, 2007., 2009). Besides the natural vegetation can also be seen the cultivated vegetation, mainly the wood vegetation (Pinus halepensis) and in the insular surface, where in almost 60 m^2 exist over 30 kinds of hydrophile, hygrophyla, mesophile, xerophyte and cultivated plants. The correlation between flora and fauna is highlighted in the faunal diversity where permanently or seasonally there exist over 72 kinds of invertebrates, representatives of 27 families and 28 kinds of vertebrates which belong to 16 families. The most typical kinds belong to Pieridae, Satyridae, Nymfalidae, Scarabidae, Viperidae, Colubridae, Anguidae, Lacertidae, Testudinidae, Ranidae, Cyprinidae, Cobitidae, genera etc (Hasani, L. & Oruci, S., 2007)).

The diversity, dynamics and the size of the fish polulations

The environment of the area and the communication with the river flow creates very good development possibilities for the fish. The fish of Viroi area are the same as those that are seen along the Drino river. They enter the lake due to the fact that the water is rich in oxygen and contains large quantities of phyto food (algae). The kinds of fish caught and recognized in the lake are: carp (Cyprinus carpio, Linne 1758), barbs (Barbus meridionalis petenyi, Heckel 1874) (R), ide, chub (Leuciscus cephalus albus, Bonoparte 1838), gudgeon (Gobio gobio, Karaman 1924) (R), spined loach (Cobitis taenia ohridanus, Karaman 1924) (T), eel (Anguilla anguilla, Linne 1758), common nase (Chondrostoma nasus Karaman 1924) (Peja, N., 2004): Peja, N. & Smalji, Rr., 2001), Poljakov, G.D., Filipi, ND., Basha, K., & Hysenaj, A., 1958). Two quality aspects have been highlighted in the dynamics of the fish of the lake. First, the presence of a high number of cyprinidae related to the hydrography of the area, where the powerful flows are missing, by attracting many fluvial individuals, second the quantitative assessment according to the Removal method shows a large presence of the carp, chondrostoma and chub species. The fish position themselves on different levels of the food chain, something which enables the

classification based on the food diet, which can be exclusive or diverse, constant for the whole life or limited for a stage of the development. Some physical factors of the habitat turn out to be absolutely conditioning for different stages of the life cycle of the fish fauna, especially for food and reproduction (Biol 541., 2003). The analytical assessment is based on the concept of food pyramid and economic importance. First**,** the most populous species which is seen almost during the entire Spring –Summer period, found in great numbers in 1/2 of the northern axis of the lake and present in the entire surface area, is Cobitis taenia ohridanus, in small size, feeds on worms, insects, crustaceans, etc, but is a good proteinic food source for bigger fish, especially carp. A good inhabitant of the most oxygenated area (The Mother) and where the water flows rapidly is gudgeon (Gobio gobio ohridanus), a good food source for bigger fish. The gudgeon is a rheophile species and is reproduced in Spring – Summer, is seen on the eastern side (B) initially in the entire length, by moving gradually towards the source where the temperature is lower (G), where there exist developed underwater vegetation and quite oxygenated water, so the species features positive migration. It is a non-economic species but a food source for the other species. Today it is included in the group of protected species having EN status. On the northern and north-eastern bank of the lake the Mediterranean Barbel is seen (Barbus meridionalis petenyi), which in the role of biomonitoring indicator, is not seen on the periphery of the island (I), where organic matter and construction aggregate can be found as a result of the anthropogenic impact. Being very sensitive to pollution and change of habitat, typical rheophile, is seen almost in sector F, where the water flow is present, but with the change of the lake pattern it moves in the Drino river (Poljakov, G.D., Filipi, ND., Basha, K., & Hysenaj, A.,1958).



The biological survey of the lake

Legend
A – Zone of the amphibians (eggs, larvae, adult)
B – Zone of Cyprinidae (>> fry)
C – Poor amphibian zone (< larvae)
D – Zone of adult amphibians (<<< eggs & larvae)
E – Current zone with adults (all the fish)
F - Permanent water zone (fish + frogs)
G – Mother of Viroi (<< gudgeon)
X- Discharge point (migrating)
S- Plant surface (>>> ranuculus)
T- Bordering lacustrian territory

Spring in the lake is very rich in representatives of the species Chondrostoma nasus, which are seen on the northern and western side, and less on the east one, where are fed and reproduced during the whole spring, by exploiting the depth, lithology, oxygenation and food. The increase of temperatures and the lack of O_2, despite the fact that the food source is quite rich (algae,

worms, vegetation), make it possible for these fish to move in the river where they are seen in large numbers during the entire summer (Murat, Xh., 2001). A good inhabitant of the lake regarding food and reproduction is the chub (Leuciscus cephalus albus), which is seen usually in March-April-May (Fico, L., 1984). Characteristic is its presence in schools hereby making possible fishing, as it is very tasty and nutritious. One of the permanent inhabitants of the lake is the eel (Angiulla anguilla, Linne 1758) (Kottelat, M. & Freyhof, J., 2007). This fish enters the lake upon its recharge in Autumn and leaves when it dries up completely. It can be found in the entire surface of the lake which ensures it enough food, but recently due to the anthropogenic activity on the southern side the number of the highlighted individuals is quite small. The inhabitant which is of a great economic interest is the carp (Cyprinus carpio) (Fico, L., 1984). It is almost seen during the entire period when the water is present in the lake. Usually enters the lake during Autumn (October-November), and when the temperatures drop and it goes into benthic lethargy. The presence of crustaceans, insects, larvae, phyto sapplings, fish and amphibians' eggs, especially of the moluscs Limnea which accompany Ranuculus create the most attractive environment for their growth and development during the entire stages of life cycle. Individuals of different sizes have been fished at any given time in the entire lake surface, except for southern section (A) (Biol 541., 2003). The assessment of the size of the fish populations has been based on the charting of the lake surface during the spring period where the combination of the Removal method with photographing and counting of the fry, enables their quantitavive assessment. In a time period of 5 years (2009-2013) on the peripheral surface have been modelled samples of fish used as food source (carp, chub, chondrostoma), because their catching and the assessment of the juvenile fish is related to some lacking fishing means and techniques. The number of the samples varies between 18-25 with an average size of 2870-3150 individuals. The total size of the fish population (fries) calculated approximately in February is 2,597,900 individuals. It is worthwhile to say that the ratio of the fish to the monthtly Spring flow is in a negative correlation. The factors which explain this are the positive and negative migration of the fish in general, and also the increase in temperature, the reduction of the O_2 content, the anthropogenic impact which stresses out the food conveyer.

Table nr. 1. The number of surveyed squares and the number of fish.

Nr	1	2	3	4	5	6	7	8	9	10	11
amount	112	20	620	470	370	7500*	4800*	2800	8000	10012	980**
Nr	12	13	14	15	16	17	18	19	20	21	22
amount	1750	2234	132	74	32	15230*	8340	6734	5320	111	232

Total 75874 average = 3448

*- dominating fish chondrostoma and chub

** - fish of other kinds

The assessment of the productive capacity of the lake is estimated to be 3448 x 600 = 2,068,800-3,127,000 individuals. The food chain, the relationship within the life cycles, food and climatic

patterns, and different zoonoses have led to an increase in the number of fish which migrate, this number varies between 670,000-721,200 individuals. Beginning from the end of March and onward the fish of the lake together with the fish of the river start the negative migration due to the increase in temperature and the decrease of the water flow. This makes it possible for the adult fish and the juvenile fish to move in schools almost throughout the entire Drino river where the oxygenation rate is higher. In this way the number of adult fish is greatly reduced. The evaluation of the indicator of changeability in the water basin of the lake based on practical obervations and study references shows average values (56%) which are estimated in minimal parameters during the August-October (5-8%). In the meantime the evaluation of the dominance indicator highlights the presence of critical points during the year, due to the fact that the basin is not supplied continuously with water and because of the upset of the bioecological equilibrium of the species present (Biol 541., (2003). The ratio of these parametres shows that the species' equilibrium is not constant, while the plant pattern is big the water fauna is greatly reduced (Miho, A., 2012). This discrepancy has been used for fish farming in the lake so as to benefit from the plant biomass.

The aquacultural pattern of Viroi lake

The food pattern of fish and the amount of biomass produced during Spring, enables the use of the lake environment for the raising of carp, the raising capacity is 70,000 fries, with a loss of about 10%, and annual product 270 ql or translated in financial terms ALL 9,450,000. But currently in the period 20 February -10 March 14,000 units of carp fries are released by private enterprises, which is used in two ways: first, in the form of recreational fishing as well as for economical reasons by amateur individuals throughout Spring until the lake dries up, by fishing on average 2 fish per day per individual or about 15 fish per day. The complete fishing of the fish raised there occurs in August-September, following closely the decrease rate of water level by utilizing cast nets placed in the lake dam (X). The harvested production is estimated to be about 52 ql fish destined for the internal market. The environments of inland waters, especially lacustrian ones, are more vulnerable by human activity due to their capacity. This highlights the importance of exploring and studying the biology and ecology of freshwater species, the situation of the water ecosystems, to avoid biologically and economically unrepairable environmental situations.

Variety, numerical dynamics and the economical value of frogs

In Viroi lake two frog species are seen, respectively Rana temporaria Linnaeus, 1758 (T) and Rana dalmatina Fitzinger in Bonaparte, 1838 (C) (Hasani, L. & Oruci, S., 2007). Whereas in the surrounding humid wood environment Hyla arborea (K) is seen. Rana lays about 100-400 eggs covered in 1 or 2 gelatinous and spherical material for a successful fertilization. Incubation lasts 3-4 weeks, depending on elevation and temperature (Bianco, P.G., 1987).

The determination of the dynamics of their population has been realized based on two independent but functionally related with-each other indicators in the study. Firstly, by estimating the number of gelatinous capsules and also the number of eggs in each of them, and

secondly by estimating the number of larvae per surface area unit (Journal of wildlife management 1958). For this goal has been used the modified Removal method, where the sample has been selected in a random field. In the 5 field trips realized in the period 2009-2013, with respectively 25, 27, 32, 30 and 35 reproduction units, distributed 17-20.4% in the E zone and 79.6-83% in the A zone of the topographic map have been estimated about 10,769 – 19,746 eggs. The surveyed surface is 10 m^2, so in total the lake produces on average 762,875 frogspawn. In the same time period but with three successive field trips the dynamics of the number of larvae has been estimated , respectively 18, 23, 20, 21, 28 samples with a size of 0.5 m^2, (114,750) the population of frog larvae is estimated to be about 114,750. The number of adult individuals is estimated to be 72,000, which translated in money means ALL 360,000. Although the frog has economical and nutritional values, fishing them requires the execution of some scientific rules given the fact that today this species is considered an endangered species.

The assessment of the eco-touristic capacity of the Viroi park

Fishing and aquaculture constitute important branches of the economic development in Albania, where fishing in inland waters, like lakes, watersheds and rivers occupies an important place. The economic assessment of the kinds of fish and frogs of the area constitutes the primary aspect of the profitability of its use. But the Viroi park is characterized by several resources conceived in biodiversity, landscape, recreation, economic, scientific, environmental, sport, educational values, etc. In a surface of about 30 ha, there exist in a functional relationship elements of karst springs, artificial lake, "amphibian", fluvial influence, xerophyte territory, functional economic aspects with a great zonal and vertical variety.
The Viroi area since early has been at the centre of the attention of the community for its landscape and functional aspects. So, since 1940 the embankment of the spring has been built by creating environmental, relaxing, entertaining value, etc. The systemization of the spring and the building of the artificial lake, the creation of an attractive and functional vista, made it posssible for the viroi area to attain the status of Tourist Attraction in 1982. This status enables investments in infrastructure, environment, etc. Today this area is used by about 35 thousand inhabitants of Gjirokaster town as a recreational area and at the same time as direct economic source (fishing, cafes, business) and indirectly by the products which are consumed.

Conclusions and recommendations

The study highlights some inherent elements for the use and good management of Viroi park, where the relationship of environment and anthropological factor has reached critical point. First, the park as a combination of natural environment with the artificial one displays functional biodiversity. Second, it serves as a place where the Drino river accumulates and at the same time it feeds it, and switch sides with each-other, constituting in this way the food and moreover the reproductive reseve of the ichthyofauna of freshwaters. Third, it constitutes the most functional and attractive environment for the naturalized aquaculture, by not negatively impacting the bioecology of the environment. Fourth, it is an economic source and with great vlaues for the community and beyond. Last, the harmonization of refief-forming elements gives the park attractive, sport, entertaining, observational values, etc.

The preservation of the interacting environment equilibria between the anthropogenic and biological factors requires: first, the preservation of the permanent pattern of the water-retaining ability of the lake; second, the protection of the natural monument of the mother of Viroi from the fluvial sediments; third, the regulation of constructions in the area and the systematization of the water used by the industry to preserve an environment ecologically clean; fourth, a planned intervention regarding the renewal of the biodiversity and of the landscape by planting trees and bushes which have functional characteristics with the ecosystem of the area; finally, fishing and raising of species should be complementary with their status, by balancing the scientific and economical aspect. Going by this code is not an altruistic effort but of vital importance for the biodiversity and the community.

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