AN ECOLOGICAL APPROACH FOR THE ASSESSMENT OF THE WETLAND COMPLEX OF KUNE-VAINI (LEZHA): MAIN OUTCOMES

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ABSTRACT

Despite the strong changes over the years, the Kune-Vaini wetland (Lezha, Albania) still preserves special scientific and economic values, as well as a very attractive landscape between land and sea. During our bimonthly monitoring approach (July 2018-July 2019), relatively high nutrient load (nitrogen and phosphorus) were observed in lagoons, and relatively poor biological quality. Unusual winter peak of phytoplankton, chlorophylls and zooplankton was observed in Merxhani. Phytoplankton was dominated by toxic algae which are unhealthy both for the ecosystem and humans. Microplastics were found in water and crabs, etc. **Hydrological regime** and tide water exchange could be considered poor and scarce in lagoons, especially in Ceka and Merxhani. The existing ecological conditions call for a continuous maintenance of the water exchange that would in return help enhancing the biodiversity and primary production, preventing also the dystrophic conditions. The Management Plan revision is recommended, addressing an ecosystem-based adaptation (EbA) approach to climate changes, and other concerns, like water exchange, sea erosion and related hydrotechnical works, Drini River rehabilitation, flood control and management. Other important aspects would be the unsustainable urbanization and tourism infrastructures, water pollution and solid waste, eutrophication and harmful algae, reforestation and plant nurseries, fishing, aquaculture and hunting, etc.
Keywords: Coastal ecology, Lezha wetlands, lagoons, hydrological regime, Ecosystem-based Adaptation (EbA)

1. INTRODUCTION

Kune-Vaini wetland complex is situated in the northern part of the Albania's Adriatic Coast, west of Lezha plain (Fig. 1). It is formed under the influence of Drini and Mati rivers. The complex consists of these four main water bodies: Merxhani and Knalla (in Kune, northern part of Drini), and Ceka and Zaje (in Vaini, in the south). The related Management Plan (CEIA, 2010) was approved by DCoM432/2010; the Kanalla pond was excluded, and the coastal area of Tale and the related lagoon was included within Kune-Vaini-Tale Nature Reserve (IV Category); the total area covers about 44 km^2 (http://akzm.gov.al/) of which 12.5 km^2 are covered with water. Miho *et al*., (2013) said that the remains are swamps, reed bed, forests and shrubs, and sandy dunes.

The Department of Biology and the Department of Chemistry of the Faculty of Natural Sciences of the University of Tirana, Albania, have jointly applied a Master Program focused on the ecological approach of the wetland complex, financially supported by the Kune-Vaini Project (Law 33/2016). Important chemical and biological components were assessed as topics of a number of master theses under our supervision and expertise. The most important outcomes are here briefly discussed.

2. MATERIALS AND METHODS

The sampling and other field investigations were bimonthly carried out, respectively in July, September, November 2018 and January, March, May, July 2019. At least 5 representative stations were visited: three in Ceka, and one in Zaje and Merxhani (Fig. 1). The parameters measured and discussed in separate master theses were: physical-chemical parameters, heavy metals (Cu, Pb, Cr, Fe, Mn) (Muçaj, 2019), nutrients (N and P) and chlorophylls (Ramaj, 2019), phytoplankton and toxic algae (Kola, 2019), submersed macrophytes (Gjata, 2019) and zooplankton (Lika, 2019). It was further extended to other topics such as diatoms in periphyton (Qevani, 2020), flora and vegetation (Bici, 2019; Sanxhaku, 2020), wintering and breeding waterbirds (Selgjeka, 2020), microplastics (Cani, 2020), etc. Detailed data on material and methods, and results obtained can be found in each thesis. Some data will be presented in more details in WEPSD-2020; meanwhile a separate volume with all the data is under the preparation.

3. RESULTS

The three lagoons represent some notable differences based on their **physic-chemical** conditions (Muçaj, 2019). The waters in Zaje were less salty (8-18‰) (mesohaline), due to water exchange with the Drini River; Ceka's waters represented average salinity (polyhaline, 18-30‰), whereas the waters of Merxhani were generally of higher salinity (25-40‰; euhaline). A narrow sandy belt separates the Merxhani lagoon with the sea; two or more times per year, the seawater overflows and mixes with the lagoon waters. Values of oxygen saturation (DO%) were generally below 100%, mainly in Ceka and Zaje. Certain pollution with copper and chromium was observed (Bratli, 2000).

As expected, **nutrient (N & P) content was significant** (Ramaj, 2019) due to close interconnectivity the lagoons have with the surrounding watershed and the sea: Ceka with the pumping station in Tale; Zaje with the Drini delta; Merxhani with the pumping station in Shengjini Island. Urban and agriculture wastes are discharged into drainage channels and then in the respective lagoons.

The average of the total phosphorus (TP) for September 2018-July 2019 was 88.91 µg/L for Ceka, 66.31 µg/L for Zaje, and 56.57 µg/L for Merxhani, exceeding several times the limit values reported for Mediterranean countries by Poikane *et al*. (2019). In addition, the PO_4average was 2.87 µmol/L in Ceka, 2.14 µmol/L in Zaje and 1.83 µmol/L in Merxhani; all belong to the category 'bad', according to the EEA criteria for nutrients in transitional, coastal and marine waters (Crouzet *et al.*, 1999).

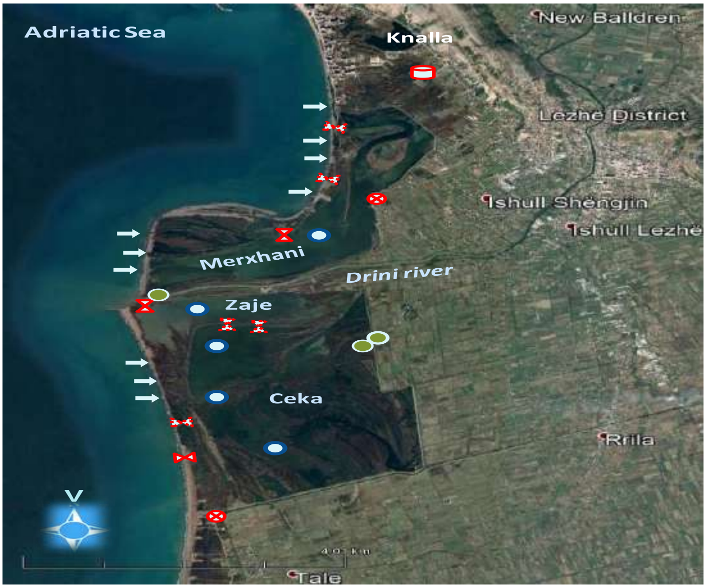

Fig. 1. Satellite view of the Kune-Vaini wetland complex. The arrows show the coastal beach under erosion; Wastewater Treatment Plant; pumping stations; tide inlets; blocked inlets; **O** sampling stations; only periphyton samples (from Google Earth 2020).

Moreover, the average content of total nitrogen (NO_2 + NO_3) was higher than the 'very high limit (>8 µmol/L)' set by EEA (2017): 10.72 µmol/L for Ceka, 21.59 µmol/L for Zaje, and 9.90 µmol/L for Merxhani. Combined with the dense presence of green algae (*Ulva* species), tolerant to pollution (known as nitrophyl species) (Gjata, 2019), and low IPS values calculated by Qevani (2019), all is an evidence that the surrounding zone has a significant impact on all three lagoon systems.

Different types of **vegetation** are well expressed in Kune-Vaini area, from submersed vegetation, reed, halophytes or psamophytes, up to aquatic shrubs and typical Mediterranean forest and sandy dunes. The forest area, shrubs and aquatic vegetation extend in 13.4 km^2; the most important and most sensitive is the Mediterranean alluvial mixed forest, dominated mainly by alder (*Alnus glutinosa*) and narrow-leaved ash (*Fraxinus angustifolia*), often mixed with white poplar (*Populus alba*), *Ulmus minor* and *Quercus robur* (Bego *et al*., 2013). The dominant aspect of the dune vegetation is the cultivated of pines (*Pinus pinaster, P. pinea, P. halepensis*), that spreads along the coast in Kune and in Vaini areas.

More than 270 species of **higher plants** were reported (Miho *et al*., 2013), most of them flowering plants. About 18 species such as *Pancratium maritimum, Matthiolatricuspidata, Juniperus macrocarpa, Ammophila* *arenaria*, *Stachys maritima*, which are mainly sound on sandy dunes and gradually less in coniferous forests (Bici, 2019), belong to the endangered species. Sanxhaku (2020) said that 10 priority habitat types of Natura 2000 list have been identified; 3 in coastal dunes, and 7 habitats within the wetland zone of Kune-Vaini.

The bottom of the lagoons is often inhabited by the **submersed plant species** (**macrophytes**); extended meadows of the grass *Ruppiacirrhosa* in Ceka; and scarce spots of *Zostera noltii* in Zaje (Gjata, 2019). The grasses were mixed mainly with green algae (*Chaetomorpha*, *Cladophora*, *Ulva*, etc.), and red algae (*Gracilaria*, *Polysiphonia*, etc.). In the littoral parts with less salinity, various *Potamogeton* and *Myriophyllum* species grow up too (i.e. in Drini delta; Qevani, 2020). Large areas are covered by reedbeds, dominated by hydro-hygrophyte species (*Phragmites australis, Typha angustifolia, Scirpus* spp., etc.), which extend largely in the littoral parts (especially in Ceka, Knalla), along the riverbanks, drainage channels, etc.

About 100 species of **microscopic algae** were found in phytoplankton (Kola, 2019) and about 200 species of **diatoms** in periphyton (Qevani, 2020). In total, there are known 310 species of microscopic algae; ca. 280 species are diatoms, including those found previously in phytoplankton by (Miho and Mitrushi 1999). Around 10 species belonging to genera *Skeletonema, Amphora, Pseudo-nitzschia, Dinophysis, Prorocentrum, Oscillatoria*are known as potentially toxic. **An unusual winter peak of phytoplankton was observed in Merxhani** (7,525 cells/ml in January 2019) dominated mainly by *Skeletonema costatum*, and *Oscillatoria* species, known to be toxic (Hallegraeff *et al.*, 2004). The same peak was observed with photosynthetic pigments (30.61 µg/L Chl *a*, 2.49 µg/L Chl *b* and 16.89 µg/L Chl*c*) (Ramaj, 2019), and zooplankton (105.8 ind./L in January 2019) (Lika, 2019). The one-peak growth provides a clear evidence to the poor state of ecosystem, scarce water exchange and nutrient circulation.

Ca. 32 taxa of **zooplankton** were found for the first time in Kune-Vaini (Lika, 2919); copepods were the most abundant. The quantity was generally higher in Zaje (average value 154.3 ind./L), slightly lower in Ceka (113.7 ind./L), and much lower in Merxhani (83.6 ind./L). The rotifer *Brachionus plicatilis*, was abundant in Ceka, known as indicator of eutrophic state.

More than 340 **animal species** have been reported in years (Miho *et al.*, 2013), 23 mammals, 196 birds, 59 insects, 58 fishes, 10 reptiles. However, the studies are limited in number and sporadic. In addition, they do not cover all taxa. About 190 species are in the Albanian Red List (Order 1280/2013), especially 33 species of birds and 4 species of mammals that belong to the IUCN Red List (2007) as globally threatened species. The most common fish species are mullets, eel, sea bass, sea breams, sand smelts, torpedo, leer fish, shidrum, bogue, sole and Atlantic horse. Both Vaini and Kune are mentioned for their high diversity of waterfowl species. Reed beds, especially in Vaini, are important habitats for wintering birds; from 196 species of birds recorded in years, 59 species were permanent nesting birds, 65 migratory wintering, 51 summer migratory, and 21 vagrant birds (Miho *et al.*, 2013).

The heron colony in Kune was one of the largest in Albania and the Western Adriatic as well. It started to collapse in the 70s, and almost disappeared after the radical hydrological changes of the system in 1991. We observed for the first time **the revitalization of the colony**, represented by 5 species (550-570 nesting pairs in 2019 and 420-600 pairs in 2020). The little egret (*Egrettagarzetta*) was the largest (68%), then the squacco heron (*Ardeolaralloides*), the pygmy cormorant (*Microcarbo pygmaeus*), the cattle egret (*Bubulcus ibis*) and the black-crowned night heron (*Nycticoraxnycticorax*) (Selgjeka, 2020). Wintering waterfowl was at a higher rate in Vaini (mostly in Ceka) than in Kune in January 2020.Despite the positive aspects observed, again **the trend remains negative compared to the previous years**. Based either on the literature or in our observations, anthropogenic activity is concerning.

4. DISCUSSIONS

The Kune-Vaini wetlands shelter **sensitive and fragile ecosystems**, like sandy dunes and river deltas, Mediterranean coniferous, alluvial and mixed riparian forests (Bego *et al.*, 2013; Miho *et al.*, 2013). But it has undergone severe hydrological changes over decades until present.

The system is **closely dependent upon the influence of Drini and Mati rivers**. Since 1963, the Drini in Shkodra (known as Drinasa) has been fully diverted to the Buna River, avoiding flooding of Zadrima plain and Lezha town. Drini of Lezha represents nowadays mostly a drainage channel of the Zadrima and Kakarriqi plains. Knalla pond was originally in close hydrological connectivity with Merxhani lagoon, but blocked after 1990s, due to heavy urbanization of the zone that still continues, and left also outside PA (DCM 432/2010); for the same reason was also blocked the Kularitide channel in the northern part of Merxhani lagoon. The channels connecting Zaje with Ceka were also blocked for fishing purposes. A dike was built some years ago on the south side of Drini mouth. A new inlet channel was constructed in Ceka in August 2018 by the Project support (GBA, 2017), connecting the lagoon directly with the sea (Fig. 1); it was soon blocked by sediments. Several artesian wells (ca. 30 to 35 L/s) were important part of the hydrographic network, drilled during 1973-75 (Pano, 1998; Kallfa, 2014); they provided freshwater in several parts of the whole wetland area, necessary for wildlife (e.g. waterfowl and waterbirds). But, water pressure in the last 20 years has dropped down, due to the impoverishment of the aquifer, overuse of groundwater for irrigation, damage or blockage of the wells, etc. (Eftimi, 1998).

Totoni *et al.*, (2010) as experts on drafting the Kune-Vaini-Tale **Management Plan** (CEIA, 2010) make recommendations on sustainable tourism. They stated that the tourism opportunities and environmental features are strongly related. **Mass tourism is not encouraged**. **Uncontrolled and unsustainable urbanization and tourism infrastructures have continuously increased** in the surrounding areasof Lezha, Shengjini and along the Shengjini beach. Some residential or service buildings are also located within the Vaini reserve, and others continue to be built within the boundaries of the Kune reserve. Paved road was extended close to Kune reserve after 2000s; recently (yr. 2020), paved roads cross through Vaini Reserve, too. Schonewald-Cox and Buechner (1992) and NRC(2005) reported that motor vehicles are not environmentally friendly, and have adverse effecton its high native biodiversity.

Beside the support given in years (CEIA, 2010; UNDP, 2013; Ligji 33/2016; GBA, 2017), combined effect of all these stressors has led to **severe consequences on the lagoon hydrological regime, coastal erosion (inward rate ca. 2-4 m/year) (Fig. 1), wetland biodiversity and ecology, and ecosystem services,** further exacerbated even by global warming. Extreme events such as heavy rain, floods and droughts are already causing habitat loss and fragmentation.

The Convention on Biological Diversity (CBD, 2009) recommends the **ecosystem-based adaptation (EbA)** for the conservation, sustainable management and restoration of ecosystems, including coastal wetlands. Hence, the main goal of the Kune-Vaini project was focused on building the ecosystem resilience of wetland complex, addressing the climate change risks (i.e. coastal erosion, hydrological regime, etc.) (GBA, 2017).

To our opinion, the four water bodies (Ceka and Zaje in Vaini, Merxhani and Knalla in Kune), pumping stations (in Shengjini and Tale), the related tidal inlet channels, and the Drini River must be considered as one integral hydrological system and be assessed and managed through a common ecosystem-based approach. Improved **hydrological regime and water exchange of the wetlands** is one of the most important determinants of primary productivity, the basis of the great biodiversity that the system holds; wetlands in stagnant state have low productivity; species richness, at least in the vegetation community, increases when water exchange increase; it is as a stimulus to diversity, caused by its ability to renew minerals and reduce anaerobic conditions (Mitch and Gosselink, 2007).

Therefore, **continuous efforts to keep the tidal exchange** in Kune-Vaini are unavoidable. Ceka and Merxhani lagoons may be considered with scarce water exchange. Hydrological regime could be enhanced, if the existing tidal inlets are constantly deepened and maintained. Reopening the communication channels between Ceka and Zaje is necessary for a better water exchange between both lagoons, and with Drini delta, in addition to the reopening of the Kulari tidal inlet in Merxhani, and the restoration of Knalla communication with the northern marsh of Merxhani. The biodiversity and primary production, up to higher levels (fish and waterbirds) would enhance as well, preventing the dystrophic conditions observed in the lagoons.

We strongly suggest the **rehabilitation of Drini River (Lezha)**, through partial and controlled diversion of the waters from Drinasa to the former Drini river (Lezha). It would help to prevent the significant coastal erosion, and also keep healthy the whole wetland complex. We are not sure if the dike built in the southern part of Drini outlet was an adequate practice (confirmed also by Gjini, 2015). The same could be said for the new tidal inlet in Ceka in 2018 (GBA, 2017). A group of experts, hydrologists and ecologists, can work together to face with issues of hydrological regime and erosion along the coast, and find out the proper hydrotechnical interventions that would better face with climate changes, as well.

Relatively high nutrient load (nitrogen and phosphorus) and trophic level was observed in lagoons (Ramaj, 2019; Qevani, 2020). Regular collecting and **wastewater treatmen**t, along with the strict control of the wastewater discharge into the surrounding drainage channels or Drini are an emergency. Worth to mention the water pollution in drainage channels (Ramaj, 2019; Qevani, 2019) and solid waste immense sparse in channels, beach and river delta. Microplastics (< 5 mm) were found in all water column and crabs (Cani, 2020). Further studies are needed to unravel the possible toxic effects and the profound impact that water-borne pollution could have on lagoon biota and ecosystem health. The current and future plans for urbanization and tourism infrastructures, as well as solid waste management need a strict control.

About 7 hectares of degraded areas including dune rehabilitation have been reforested with *Tamarix* sp., *Pinus* sp., *Quercus robur* and a green fence with *Nerium oleander* (in northern embankments of Merxhani) (GBA, 2017). Planting with beachgrass *Ammophila arenaria* (UNDP, 2013) would be not a proper EbA measure to reduce coastal erosion in Vaini. Nevertheless, we strongly support reforestation in the whole area, to prevent erosion, flooding and improve the wildlife in general. **Forest nurseries** must be supported in Lezha, as a long-term practice to provide native plant seedlings, large-scale and continuous reforestation activities; volunteering reforestation activities can also be encouraged (Mullaj *et al*., 2017).

We hope that our data and considerations will assist PA Administration, local decision-making and local environmental expertise in the conservation and ecological restoration of the wetland complex. **The revision of**

Management Plan is highly recommended, addressing its major concerns; urbanization and tourism, pollution, eutrophication and harmful algae, lagoon tidal inlets, erosion and related hydrotechnical works, Drini rehabilitation, reforestation and plant nurseries, fishing, aquaculture and hunting, etc.

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REFERENCES

Bego F, Mullaj A, Kashta L, Zotaj A. 2013. The status of the habitats of European Conservation Interest along the Adriatic Coast of Albania: 10 pp.

Bici M. 2019. Flora dhe habitatet natyrore të dunave ranore në bregdetin e Lezhës. Mikrotezë, DB, FShN, UT. 56 p.

Bratli LJ. 2000. Classification of the Environmental Quality of Freshwater in Norway. Hydrological and limnological aspects of lake monitoring. Heinonen et al. (Ed.). John Willey & Sons Ltd. 331-343.

Cani M. 2020. Karakterizimi i mikroplastikës në kolonë nujore dhe biotën e lagunës së Kune-Vainit dhe analizimi i saj me metoda spektroskopike dhe mikroskopisë me dritë të polarizuar. Mikrotezë, DB, FShN, UT. 48 pp.

CBD. 2009. Connecting Biodiversity and Climate Change Mitigation and Adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change. Montreal, Technical Series No. 41, 126 pp.

CEIA. 2010. Management Plan of Kune-Vain Marshland. Integrated Water and Ecosystem Management Project. IDA/WB/GEF Project, ID. P075156, Tirana.

Crouzet P, Leonard J, Nixon S, Rees Y, Parr W, Laffon L, Bøgestrand J, Thyssen N, Izzo EG, Bokn T, ETC-MC, Bak NJ. 1999. Nutrients in European ecosystems, Environmental Assessment Report, 4. European Environment Agency. 82 pp. http://reports.eea.eu.int/.

DCM/VKM 432/2010: Për zgjerimin e kufijve të Rezervatit Natyror të Menaxhuar Kune-Vain–Tale. http://www.fao.org/faolex/results/details/en/c/LEX-FAOC113049/.

EEA. 2017. Nutrients in Transitional, Coastal and Marine Waters. Office for official publications of the European Communities. European

Environmental Agency-https://www.eea.europa.eu/data-and-maps/indicators/nutrients-in-transitional-coastal-and-4/assessment

Eftimi R. 1998. Conservation and wise use of wetlands in the Mediterranean Basin. Focus on Kune-Vaini Lagoons. Hydrogeological and Geological Study, MedWet, ECAT Tirana.

GBA (Ed.). 2017. EIA Report Assessment of environmental impacts of the SCCF project's interventions "Building the resilience of Kune-Vaini Lagoon (KVL) through ecosystem-based adaptation (EbA)". Gran Business Albania: 148 f https://kunevain.com/wp-content/uploads/2018/09/VNM-Repor-Anglisht-ilovepdf-compressed.pdf

Gjata I. 2019. Assessment of aquatic macrophytes in the lagoon system of Kune-Vaini, Lezha. Master theses, FNS, UT.

Gjini J. 2015. Addressing the impacts of human induced activities, including climate change in Drin River delta ecosystem. Act4Drin Collective & Collaborative Learning Workshop. Lin, Albania. 17 pp. https://act4drin.net/wp-content/uploads/2015/04/04_Gjini_Drin-Delta_.pdf.

Hallegraeff GM, Anderson DM, Cembella A.D. (Eds). 2004. Manual on Harmful Marine Microalgae. Second revised edition: UNESCO, Paris: 793 pp.

KallfaA.2014. Karakteristikat spektrale të fitoplanktonit dhe varësia reciproke nga faktorët mjedisorë dhe eutrofikimi. Doktoratë. FShN, UT. 191 f. http://www.doktoratura.unitir.edu.al/wp-content/uploads/2015/01/Doktoratura-Anni-Kallfa-Fakulteti-i-Shkencave-i-Natyrore-Departamenti-i-Bioteknologjise.pdf.

Kola M. 2019. Assessment of phytoplankton in the Kune-Vaini lagoon system, in Lezha. Master theses, FNS, UT. 90 pp.

Law/Ligji 33/2016: Për ratifikimin e marrëveshjes së bashkëpunimit ndërmjet Këshillit të Ministravetë Republikës së Shqipërisë dhe Programit Mjedisor të Kombeve të Bashkuara (UNEP) për Fondin Global Mjedisor, për Projektin me madhësi mesatare të ripërtëritjes së lagunës Kune-Vaini, nëpërmjet Përshtatjes së bazuar në Ekosistem.

Lika R. 2019. Zooplankton dynamics in Kune-Vaini Lagoon system Lezha. Master theses, FNS, UT. 81 pp.

Miho A, Kashta L, Beqiraj S. 2013. Between the Land and the Sea - Ecoguide to discover the transitional waters of Albania. Julvin 2, Tiranë. 462 f. http://www.fshn.edu.al/home/publikime-shkencore.

Mitch JW, Gosselink GJ. 2007. Wetlands. 4th Edition. John Wiley & Sons, Inc., Hoboken. 582 pp.

Muçaj D. 2019. Karakteristikat fiziko-kimike dhe vlerësimi i cilësisë së ujërave të kompleksit lagunor të Kune-Vainit. Mikrotezë, FShN, UT. 67 pp.

Mullaj A, Hoda P, Shuka L, Miho A, Bego F, Qirjo M. 2017.About green practices for Albania. Albanian *Journal of Agricultural Sciences*. Special edition, Agricultural University of Tirana, ALBANIA: 31-50.

NRC (Ed.). 2005. Assessing and Managing the Ecological Impacts of Paved Roads. Effects of Roads on Ecological Conditions. National Research Council (U.S.). Committee on Ecological Impacts of Road Density. 324 pp.

Order 1280/2013: Urdhër për miratimin e Listës së Kuqe të Florës dhe Faunës së egër. Ministria e Mjedisit; 2013. http://extwprlegs1.fao.org/docs/pdf/alb144233.pdf

Pano N. 1998. Hydrological regime of Kune Lagoon. Conservation and wise use of wetlands in the Mediterranean basin. Focus on the Kune-Vaini Lagoon, Lezha, Albania. Technical reports.

Poikane S, Kelly GM, Herreroa SF, Pitt Jo-A, Jarvie PH, Claussen U, Leuja W, Solheim LA, Teixeira H, Phillips G. 2019. Nutrient criteria for surface waters under the European Water Framework Directive: Current state-of-the-art, challenges and future outlook. *Science of the Total Environment*, **695**: 133888. ISSN 0048-9697; https://doi.org/10.1016/j.scitotenv.2019.133888.

Qevani L. 2020. Alga silicore (diatome – Bacillariophyceae) nga kompleksi lagunori Kune- Vainit, Lezhë. Mikrotezë, MSc. Biologji Mjedisi, FShN, UT.

Ramaj U. 2019. Vlerësimi i gjendjes trofike të kompleksit lagunortë Kune-Vainit (Lezhë) gjatë periudhës shtator '18 - korrrik '19. Mikrotezë, FShN, UT. 65 pp.

Sanxhaku V. 2020. Flora dhe habitatet natyrore të ligatinave bregdetare të Kunes në rrethin e Lezhës. Mikrotezë, DB, FShN, UT.

Schonewald-Cox C, Buechner M. 1992. Park Protection and Public Roads. In: Fiedler P.L., Jain S.K. (eds) Conservation Biology. Springer, Boston, MA. https://doi.org/10.1007/978-1-4684-6426-9_15.

Selgjekaj L. 2020. Vlerësimi i suksesit të riprodhimit të shpendëve ujorë në kompleksin lagunor të Kune – Vainit, Lezhë. Mikrotezë, DB, FSHN, UT.

Totoni (Lilo) R, Mulla FE, Dindi E. 2010. Sustainable development of tourism in Kune–Vain wetland system. *Journal of Studies in Economics and Society*, **2/1**: 299-311. http://see-articles.ceon.rs/data/pdf/2078-1725/2010/2078-17251001299T.pdf

UNDP (Ed.) 2013. Identification and Implementation of Adaptation Response Measures in the Drini-Mati River Deltas. UNDP Albania.

https://www.al.undp.org/content/albania/en/home/operations/projects/environment_and_energy/identification-and-implementation-of-adaptation-response-measure.html.