Vjosa river: Review of the Main Environmental and Social Impact Assessment (ESIA) for the HPP Kalivaç

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Photo: Piotre Bednarek

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Review of the *"ESIA report for the Kalivaç Hydropower Plant – Main Report - Environmental and Social Impact Assessment"* from an environmental point of view

1 BACKGROUND AND MOTIVATION

This assessment of the Kalivaç ESIA is focusing only on the environmental aspects of the report, not on social ones. Also, this document is based on the English translation of the original Albanian version that was provided by the National Agency for Environment (AKM), conducted by Abkons shpk on behalf of Ayen-Alb.

We assessed this ESIA with special interest, since it is based to a large extent on data that we have collected through scientific fieldwork over the past few years. This applies especially to hydromorphological processes and biodiversity data.

For this reason, we were interested how the authors of this ESIA used our data and which conclusions they drew.

2 KEY FINDINGS

Both, documentation and assessment of the ESIA Report for the Kalivaç Hydropower Project are highly deficient, profound impacts and measures have been poorly assessed or not taken into account at all. Our data has been misused and incorrect conclusions drawn from it. The ESIA is strongly biased and clearly falls short of the minimum scientific and legal requirements for such an examination:

- The documentation of the local environment and baseline of the study area are completely inadequate and seriously deficient
- The evaluation procedure of the current status of the study site is misleading and incorrect
- Central environmental threats and impacts are not covered
- ESIA is based on insufficient data; no quantitative assessments of species/populations and the impact of the Kalivaç dam on these populations has been carried out
- Downstream effects of the Kalivaç HPP have neither been described nor evaluated
- The transboundary effects with Greece have not been evaluated
- Mitigation measures are utterly inadequate
- The residual environmental impact doesn´t reflect the actual negative impact of the HPP
- Cumulative effects with the planned Pocem HPP have not been described.

The construction of the HPP power plant Kalivaç would have serious and irreversible ecological and economic consequences and would lead to an increase of seismic induced hazards:

- Ecological degradation of a large unique river system of European importance
- High economic costs owing to sediment-related problems in the reservoir (e.g. high need for maintenance)
- Increased risk due to earthquake-induced landslides and floods
- Long-term negative impacts on the coastline and tourism in this part of Albania.

3 LEGAL REQUIREMENTS

As a contracting party to the Energy Community Treaty, Albania is obliged to follow the EIA Directive. According to Article 5 of the EIA Directive, the developer shall prepare and submit an environmental impact assessment report. This shall include at least:

> (a) a description of the project comprising information on the site, design, size and other relevant features of the project;
>
> (b) a description of the likely significant effects of the project on the environment;
>
> (c) a description of the features of the project and/or measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment;
>
> (d) a description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment;
>
> (e) a non-technical summary of the information referred to in points (a) to (d); and
>
> (f) any additional information specified in Annex IV relevant to the specific characteristics of a particular project or type of project and to the environmental features likely to be affected. (…)

Further requirements are defined in Annex IV of the EIA Directive.

In the light of the European-wide importance of the Vjosa river, the potential severe impact of the planned dam and Albania´s aspirations to become an EU Member State - it is appropriate to follow also other EU Directives and Regulations, such as the "Birds Directive", the Habitats Directive, the Water Framework Directive and the Eel regulation.

In addition, Albania is obliged to respect the Bern Convention and the Espoo convention. The Eel regulation and Espoo Convention are relevant because of the impact of the Kalivaç on Eel population also in Greece.

4 SUMMARY OF CRITICISMS

The documentation of the local environment and baseline of the study area are completely inadequate and seriously deficient

- Not only long-distance migratory fish are affected as stated in the report. Many fish species undertake migration for several purposes as highlighted in a study by Meulenbroek et al. (2018). The high numbers of anadromous, catadromous, and diadromous fish highlight the necessity of functional connectivity from the sea to the upstream river sections and back. In total ,13 species would completely disappear, including several threatened species, such as the European sea sturgeon (*Acipenser sturio*) or the Adriatic Sturgeon (*Acipenser naccarii*). A special case is the European eel (*Anguilla anguilla*).
- Vegetation surveys and mapping is missing (no vegetation tables, no information/map of the locations). The report does not even indicate in which report/data source such surveys can be found.
- The listings and brief descriptions of the vegetation refer primarily to the surrounding area and in this general form have little relevance to the area affected by the power plant.

The evaluation procedure of the current status of the study site is misleading and incorrect

- A complete evaluation of the actual status based on the vegetation surveys (e.g. number of Red List species, FFH appendix species, protected species etc.) is missing in the report. Crucial endangered species (appendix I) and habitat types (appendix II) occur extensively in the floodplain zone, however, they are not listed in the report.
- The evaluation and area balances of the Red List species (IUCN status) refer to the entire catchment area (incl. surrounding area) and are not specific to the area affected by the power plant in the floodplain zone. Therefore, the statements are hardly relevant for the nature conservation assessment of the power plant.
- None of the hypotheses in the ESIA concerning impacts are supported by any scientific literature. Expectations about the impacts are based solely on the expertise of a consortium of consultants, who do not disclose their source of information.
- The ESIA report states that a large part of the habitats throughout the study area has no high ecological value since it has already been modified, fragmented and disturbed. This is a completely wrong statement. As already published by Schiemer et al. (2020), the value of the Vjosa River system as one of the few remaining reference sites for dynamic floodplains in Europe is outstanding. The floodplain morphology of the Vjosa is characterised by an exceptionally high near-natural state, thus representing an extremely rare reference site for medium-sized rivers in Europe.

Central environmental hazards and impacts are not covered

- There are hardly any serious comments on the fact, that the total change of the type of water body would lead to a total change of the species structure, rapid appearance of non-natives, collapse or disappearance of important species, e.g for *Pelasgus*.
- The effects of the dam in terms of sediment transport are not adequately presented. Downstream reduction of sediment transport due to damming will have a series of serious predictable impacts: the full capture of bed load and a high amount of suspended sediment in the reservoir will lead to river bed incision downstream, loss of habitat dynamics, negative effects on the quantity and quality of the groundwater, coastal erosion in the Narta Lagoon. None of these impacts has not been appropriately addressed in the ESIA.
- Negative effects of sedimentation within the reservoir are not addressed in the ESIA report either. Sediments transported to the reservoir by annual floods will lead to a clogging of the bottom outlet, which is against all international technical standards and safety regulations.
- The Vjosa River Basin is characterised by **high seismic activity**; the section between Tepelena and Poçem is a well-known actively tectonic region. The huge reservoir, on the upper part of the dam, could lead to extreme events due to the landslides and earthquake-induced landslides activities. The landslides volumes could create the anomaly water waves which are very risky for the people living downstream. The ESIA Report does not include a hydrogeological risk assessment and engineering-geological and geophysical studies to evaluate the local seismic response and the seismic amplification factors. These studies are crucial to define the effects of the geological hazards on the stability and the seismic vulnerability of the Kalivaç HPP.
- The evaluation of the impacts on riparian vegetation is incomprehensible and scientifically incorrect. The complete loss of all river and floodplain habitats as a result of flooding is has been assessed as "*low to moderate importance for biodiversity*". With the exception of agricultural areas, almost all of the areas affected by impoundment must be designated as

FFH habitats (FFH Directive, Annex II) and are of high national and international importance (see Egger et al., 2020).

- Important further impacts to riparian vegetation downstream of the dam, such as reduction of morphodynamic, no sediment input etc., are not analysed or considered at all.

ESIA is based on insufficient data; no quantitative assessments of species/populations and the impact of the Kalivaç dam on these populations has been carried out

- Most of the ESIA was based on OUR data. It is important to understand that this data is by no means sufficient for an EIA. A serious EIA in an area like the Vjosa needs 2-3 years assessments in the field, while our data was collected recently in not more than a few months in total**.**
- Field visits to assess additional species data (in addition to literature) were carried out in insufficient time period (e.g. bird only in Sept-Oct 2019).
- Maps and documentation of bank and floodplain specific vegetation units are missing.
- Maps and documentation of the FFH-habitat types are missing.
- There is no comprehensive classification (maps) with regard to nature conservation relevance.
- The comprehensive land cover map only covers the dam area including the surrounding area; the area downstream of the dam is only partially covered. A complete documentation of the entire area influenced by the dam downstream is missing.

Downstream effects (hydropeaking) neither described nor evaluated

- The Kalivaç HPP is planned to produce peak electricity. Therefore, the water will be flushed regularly. This downstream effect is called hydropeaking, a form of flow regulation, with frequent, short duration, artificial flow events to the river. Hydropeaking is one of the worst effects of a hydropower scheme for the river channel and its biodiversity.
- The hydrological alteration by the HPP operation is entirely unclear and not even roughly illustrated. Within the ESIA, even a potential drying up of the river is mentioned several times, which would lead to dramatic losses of internationally protected species. Minimum requirements of an EIA comprise the linkage of hydrology during several development phases and the aquatic environment, whereby seasonal aspects have to be clearly described.

Transboundary effects with Greece not evaluated

- The Convention on EIAs in a Transboundary Context signed in Espoo (Finland), on February 25th 1991 (Albania ratified this Convention in 1991), updated with the 2nd amendment in 2004, requires the state in which a project is planned to investigate and assess the environmental impacts of the project on neighbouring states; specifically any potential significant, adverse, transboundary environmental impacts. Undoubtedly, this is the case in the Kalivaç projects, due to the blockage of migratory fish species from the upstream river ecosystem, including the Vjosa's upper reach in Greece. One example of such a fish species is the European eel. A sufficient EIA must therefore investigate the environmental impacts on Greece and include Greece as an affected party in the EIA process, as stipulated in the Convention and/or the EIA Directive.

Mitigation measures are utterly inadequate

- Mitigations measures are – if at all - only generally stated. No detailed measures are described. It remains unclear, how the mitigations measures will be realized, e.g. modification of sediments, artificial thermal de-stratification, maintenance of egg-laying grounds, fish stocks, etc. International standards require seasonal dynamic hydrological water releases below dams during all development phases.
- The generally formulated mitigation measures in the report are not suitable to reduce or compensate for the permanent loss of riparian habitats in the reservoir and floodplain zone downstream of the dam.
- Within the mitigation measures a "Biodiversity Action Plan (BAP)" is mentioned. The purpose of such a plan is "*to reduce impacts on sensitive biodiversity*...". The generally formulated mitigation measures in the report are not suitable to reduce or compensate for the permanent loss of riparian habitats in the reservoir and floodplain zone downstream of the dam. Also, the mentioned monitoring as well as the further mentioned mitigation measures are not suitable to compensate the permanently destroyed and strongly impacted habitats.
- An EIA should give detailed technical description for the species-specific mitigations measures. A detailed description is a basic requirement for a standard EIA. Specific mitigation measures for vegetation, invertebrate species, amphibian, reptiles, fish (such as a fish bypass which is not included in the present report) etc., must be provided on on species level to prevent biodiversity losses. These are completely lacking.
- There will be negative impacts on all protected sites located upstream and downstream for the above mentioned reasons. The major impact upstream would be the complete blockage of aquatic migratory fish species. After construction of the proposed dam at Kalivaç, 881 km of the 1109 km of permanent river network length would no longer be reachable by migratory fish. It remains unclear in the report what precautionary measures during construction and operation are planned.

The residual environmental impact presented in the ESIA doesn´t reflect the actual impact of the Kalivaç HPP

- The report states that the shallow areas of the reservoirs can create important nutritional bases and may result in an increased number of species. This is incorrect, as it must be compared to the reference status of the river system. Actually, the reservoir is a completely new ecosystem. Within the reservoir, the temperature and discharge regime are completely altered. Fine sedimentation negatively affects most riverine biota, especially macroinvertebrates, leading to a complete turnover of the community and reducing the biodiversity to just a few lacustrine taxa. Biodiversity can be high in littoral habitats, but they suffer regular disturbance, such as artificial water level fluctuations, drawdowns, and floods. By exceeding subtle thresholds, these fluctuations can result in littoral dead zones (Schmutz and Moog 2018).
- The description of predicted impacts on aquatic biodiversity is completely inadequate and unprofessional. The filling of the reservoir leads to highly reduced (if any) flow downstream. This has severe implications for local organisms, such as increased water temperatures, algal growth, reduced water quality, siltation of interstitial habitats. The reduction of the wetted area owing to residual flow is correlated with the loss of biomass downstream. Even short time drying of the river bottom – as stated in the ESIA - can lead to the total extinction of any aquatic species listed in international conventions. The vital question here is where and how far away the nearest populations live and whether repopulation is possible.

- Plausible and detailed answers must be provided by the operator of the HPP within the ESIA, but has been omitted entirely.
- The major impact of HPPs is a disruption of river continuity. Migratory species are blocked from reaching their spawning habitats, genetic exchange is prevented, resulting in genetic 'island populations'. The genetic impoverishment caused by this isolation decreases the health of the entire population by reducing the possibility of better adaption through the random genetic mutation of individuals (Schmutz and Sendzimir 2018). The upstream reaches of the river are affected by the dam itself as a migration barrier. It essentially impoverishes migratory species, including catadromous and anadromous fish species like eels, among others. This habitat fragmentation leads to an impoverished aquatic fauna, including aquatic invertebrates, owing to the isolation of populations and reduced genetic exchange (Monaghan et al. 2002; Zwick 1992).
- The ESIA report states that the fauna and flora will adapt to the new conditions. This statement is absolutely unprofessional, demonstrating the irresponsibility of the evaluation. Long-term effects will change fauna and flora composition entirely and irreversibly.
- The "residual impacts to riparian vegetation after implementation of the mitigation measures during construction and operation phase are rated as "*small*", which is incomprehensible and incorrect. Large areas are classified as priority habitats according to the Flora Fauna Habitat Directive. The complete loss of these habitats cannot be rated as small negative impact.
- A genuine expert knowledge states that this high conservation status would be lost and could not be mitigated by any measures.
- The ESIA contains misleading information about possible flood protection by the Kalivaç reservoir. ESIA postulated that the reservoir will deliver flood security for the downstream reaches. This is untrue for high flood events. With climate change the probability of high floods will further increase.

5 DETAILED COMMENTS ON THE ESIA

The following detailed analysis does not claim to be complete. The page numbers refer to the English translation version (find attached). Furthermore, we haven't listed wrong names for species, which are numerous in the report (in English and Albanian version).

Chapter 2: POLICIES, LEGAL AND INSTITUTIONAL FRAMEWORK		
Page	Text	Comment
42 Table 2-5	The construction activity of the Project does not affect any protected area.	**Wrong conclusion**. There will be negative impacts on natural protected areas such as the downstream Vjosa Delta and Narta Lagoon (under international designation status of IBA and Emerald) and Natural Reserve Pishe-Poro, dependant on the Vjosa river water regime.
45	The development of the Kalivaçi Hydropower Plant is not expected to have any significant negative impact on the aquatic and terrestrial fauna in the Vjosa Delta and Narta Lagoon.	**Wrong conclusion.** See Comment p. 42
56, 57 Table 2-10		**ESPOO Convention is missing.** Convention on EIAs in a Transboundary Context signed in **Espoo** (Finland) on February, 25th, 1991 (Albania ratified this Convention in 1991), updated with the 2nd amendment in 2004, requires the state in which a project is planned to investigate and assess the environmental impacts of the project on neighbouring states; specifically, any potential significant, adverse, transboundary environmental impacts. Undoubtably, this is the case with the Kalivaç/Poçem projects, due to the blockage of migratory fish species from the upstream river ecosystem, including the Vjosa's upper reach in Greece. One example of such a fish species is the European eel. A sufficient EIA must therefore investigate the environmental impacts on Greece and include Greece as an affected party in the EIA process, as stipulated in the Convention and/or the EIA Directive.
63	International best practice standards and guidelines, including IFC performance standards for environmental and social sustainability. This includes guidelines published by… the International Union for Conservation of Nature (IUCN)	**Wrong:** The Kalivaç project would have negative impacts on existing protected areas (i.e. Narta Lagoon). This is clearly against IUCN guidelines. Hydrological and sediment transport studies clearly demonstrate that there will be major changes in the water and erosion regimes in the estuary of the Vjosa river if such large quantities of the sediments are trapped in the Kalivaç HPP reservoir.

83, 90	at this stage it is not possible to give a more accurate definition of the flow regime from the dams.	**Unacceptable sentence:** within an ESIA related to such a large investment, for an HPP planned to be located in such an environmentally valuable are, realistic scenarios of the downstream flow regime have to be developed. The vague sentences in the present version does not allow quantification of the expected downstream environmental effects of the dam operation
Chapter 3: PROJECT DESCRIPTION		
89	The average energy production in an average hydrological year is estimated to be equal to 366.2 GWh accumulated for the power plant	Due to the intense sedimentation in the reservoir, the energy production will decrease in average by 2% per year. **This has not been taken into account.**
89	The operation of the hydropower plant is planned for the peak of daily operation.	No information about the dimension of the daily peak is available. Therefore, **it is impossible to evaluate the impact on nature and people.**
90	At this stage it is not possible to give a more accurate definition of the flow regime from the dams. Environmental and irrigation requirements assessed during the feasibility study must be accurately determined in advance and calculated as constraints on operating rules.	Without knowledge of the accurate flow regime the **impact on the environment cannot be assessed**.
92	The Kalivaç hydropower plant will be built on the Vjosa River, about 16 km2 below the town of Memaliaj.	**Inaccurate sentence:** 16 km2 is not a measure of distance. Many of such inaccuracies are present all throughout the ESIA, creating reasonable doubts in the actual reliability of the key conclusions presented by the ESIA itself
120	The Kalivaç HPP will have a relatively large deposit that will hold more than 200 million m3 of water, which will help mitigate the impact of the flood or at least minimize its impact.	**Generic sentence, when a quantitative analysis is required to draw meaningful conclusions.** Previous figure 4-39 in the ESIA shows that during large floods the daily flow can exceed 1000m3/s for 3 to 4 consecutive days, which can lead to filling the reservoir, even if initially empty (rare situation) in 1-2 days. The reported sentence is very vague and from it no conclusion can be drawn on the actual possibility that the reservoir can mitigate downstream flood risk
162	…some Natural Monuments may b e indirectly affected by the Project.	"May be affected" is an inappropriate wording in an EIA. The purpose of EIA is to assess whether or not an area will be affected.
163	Furthermore, it should be noted that a legally protected area that may have a potential impact from	This is an accurate conclusion, but is **contradictory** to the statement on pgs. 42, 45, 338 etc.

	the Project is the Vjosa - Narta Protected Landscape, also listed under the Emerald Network in Albania (see below), directly under the regime water of the Vjosa River.	
164	**It should be noted that the Vjosa River from the area of Tepelena to Mifoli is considered an almost protected area, specifically the river landscape has been proposed as a National Park.** The biodiversity of the flooded areas of the Vjosa River in its middle part, is one of the most wonderful reproductive ecosystems of the Balkan Peninsula, staying out due to the natural hydromorphodynamic processes of its flow. A wide stream with anabrangs, open grassy bars and protected islands and vegetation, as well as willow shrubs, poplars and tamarisks give the area along the Vjosa an extraordinary distinction. Combined with large pastures and smallscale forests, they build the mosaic of vegetation along the river. This part of the Vjosa River highlights the possible values of a protected area, of a future river national park, which would be the first protected area of this category in Albania.	This is indeed correct, but this conclusion is again **contradictory** to other statements in the ESIA regarding potentially affected protected areas. This paragraph is misleading as it suggests recommendations against the Kalivaç HPP, but then the ESIA concludes otherwise.
167	The methodology for vegetation, flora and biodiversity includes in-office study, which includes a review of the literature, field surveys and data analysis. Field surveys were undertaken during July 2019 and were conducted by a bio-ecologist/biodiversity expert commissioned by Abkons.	**This does not meet scientific standards** as data assessment is insufficient. Also, the information is contradictory, since birds have been assessed in September-October.
Chapter 4: EXISTING CONDITION ON THE ENVIRONMENT		
200	Endangered status of plant species in the region (BNRN / IUCN)	**This does not meet EIA standards** and is **scientifically wrong**. Endangered, rare or otherwise important habitats and species are only listed by names, but they are not placed in the context of their (local), regional and European importance! Without this description, the importance of the Vjosa River and its

		biodiversity for pan-European conservation of biodiversity and landscape morphology cannot be rated. Also, the evaluation of the impacts of the Kalivaç HPP is impossible without a proper assessment of the different population of these species. → FOR DETAILED COMMENTS SEE ANNEX I
211	Little is known about the terrestrial fauna of the highly dynamic Vjosa River system (Frank, 2018).	This is a correct conclusion, but the provision of this data is exactly the purpose of an EIA.
212-229 Chapter Birds	Due to the relatively short duration of the study period (fieldwork was carried out in September-October), the data collected are insufficient to estimate the full number of species present in the Vjosa River Basin. However, the data collected from the field are sufficient to meet the expected results from this EIA study. Information on this assessment was also gathered through discussion with the local community during site visits."	**Wrong: Insufficient timing and period, wrong conclusion.** The ESIA report reaffirms that the time of bird survey was very much limited and it covered only a few days in September. ESIA is missing thus field information on breeding birds and wintering birds. The information on breeding birds is rather crucial for identifying potential impacts, foreseeing mitigation measures and ensuring net gain measure for those species considered either as Globally Endangered, part of Annex 1 of Birds Directive and endangered at the national level. Furthermore, it is contradictory to statement on p. 211. Quantitative data on the size of population and about the effects of the proposed HPP on these populations is needed. Given the enormous value of the braided river system in the planned reservoir and the area below the projected dam, the estimated impacts on biodiversity are not properly supported with data, and field surveys are not sufficient to complement the existing literature data on the area's flora and fauna. Surveying should also take seasonality for all groups into account. In order to thoroughly and completely assess the biodiversity of birds and the corresponding impact of the project, it is necessary to conduct research covering all seasonal aspects of the avifauna of the project area.
212	The golden eagle (Aquila chrysaetos) and the cuckoo horse (Neophron percnopterus) are birds of biological and symbolic importance, but they are rarely found, so they are under protection. The mountain partridge (Alectoris graecai) is widespread in mountainous areas along the valley. Whereas, partridge is rarely	**Information is superficial and lacks in details.** Detailed information is needed on the impacts of the project upon bird species of conservation concern as each species has its own habitat demands and its own distribution area. This is even more needed for those bird species nesting at the river bed including birds nesting in riparian vegetation, those ground nesting birds present in dry areas and those birds nesting in the

	found along the Vjosa and Drino river valleys. The area is also an important place for Sparrows with a very large variety, due to significant changes in topography and habitat. Waterfowl are important in this area as a result of the richness of the area with water bodies and floodplains, such as Poçem, Kutë, Çorrush and Qesarat-Memaliaj.	adjacent cliffs. Furthermore, the area is a foraging habitats for the Globally Endangered Egyptian Vulture which has less than 10 territories in Albania. HPP with cover large parts of the territory of the EV and the species will be faced with extinction. Information on the presence of Sparrows is rather general and it does not reflect the impact upon the feeding grounds of the Lesser Kestrel which has in Qesarat a roosting site of circa 1500-1700 individuals.
238		Macro-Invertebrates: Very limited data set. No description of impact, nor mitigation measures possible. **This does not meet the scientific standard of an EIA.** See critique above about assessment of birds.
238	Isoperla vjosae... Any environmental change that hinders the dynamic conditions of the gravel displacement will seriously endanger this species…, which means nationwide extinction of this … species…"	It could even mean a global extinction, since Isoperla v. has only recently been discovered in the Vjosa and was entirely new to science. However, the statement on page 238 is correct.
Chapter 6: ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT		
305	This issue is more important if river fish species migrate long distances as part of their regular breeding or feeding cycle, for example, European eels**.** Once flooding is established upstream of the reservoir dam this will result in a change of an ecosystem from river to lake. Consequently, changing natural flow regimes and morphodynamical patterns has far-reaching implications, including production, biodiversity, and changes in the functions and services provided by aquatic ecosystems (Nilsson et al. 2005).	This assessment is correct. It clearly points out negative impacts of the project to aquatic ecosystems. However, there are **no recommendations how to overcome this severe impact.**
312	Based on the currently available information, the impact size is considered low to moderate, the area sensitivity is considered low and the impact significance is assessed as small negative."	**Wrong:** The territory of some municipalities, such as Tepelena, Memaliaj, Himara and Vlora, are expected to have a seismic intensity value of IX during an earthquake event. **The seismic risk in these areas are very high** and they can influence the terrain surface, safety of people's lives and the

		vulnerability of all the structures and buildings located in the area.
312	In the event of an earthquake that could destroy the dam the significance of the impact would be potentially major. At the moment it´s not considered likely to happen during the operation scheme, therefore, for this reason it has been assessed as of negligible-minor negative significance.	**Wrong and illogical conclusion**. Seismic risk is of high significance in this region. In the process of creating earthquake resistant cities and constructions in the Vjosa basin, geological, engineering-geological and geophysical investigations became crucial in the evaluation of the subsoil and rock characteristics together with the seismic activity and the exact locations of the active faults. It is not conceivable to project and build big constructions like a hydropower plant in these areas with higher values of the seismic risk, without respecting the distances from the active faults and without making studies on the evaluation of the local seismic response or Seismic Microzonation Studies (hereafter SM). → FOR DETAILED COMMENTS SEE ANNEX IV by Dr Skrame
313	Residual Impacts: Following the anticipated land rehabilitation and restoration, once the dam and infrastructure is removed and the reservoir dries out in the termination phase, the long-term impacts on the flooded geological area are expected to be negligible.	**This conclusion is not based on scientific evidence and is incorrect.** The logic regarding geological effects, landslides and seismic risks is completely misleading: It basically argues, that the remaining threats and impacts are negligible because the whole dam will be removed. What if the dam is not removed?
319	The ecological flow in the Kalivaç dam is assumed to be 28.0 m^3/s. This flow can be used to remove sediments … reducing also the impact on the Vjosa´s delta of less than 10-20% of the current sedimentation.	**The conclusion is wrong:** The point of releasing deposited sediments with the ecological flow can´t be technically implemented. This is based on two physical principles: (i) during low and mean flow, fine sediments are deposited in the reservoir delta with no hydraulic conductivity to the dam, where the ecological flow is released downstream. Thus, (ii) hydraulic dredging can´t be implemented to support this measure, at the hydraulic sucking principle can´t work over kilometers in length as a continuous supply to the ecological flow. Moreover, in regards to high flow, and flood overspill over the dam, the bottom outlet will be clogged with the consequence that the continuous release of deposited sediments is also blocked.
319	In conclusion, the proposed impact mitigation method will reduce the impact from the effects of the Kalivaç Dam in the Vjosa Delta, from 30% to less than 20%."	**This is incorrect.** According to new measurements, the **reduction of sediment transport to Nartan Lagoon will in fact be 80-90% and not 30%!**
321	*The diversion of water from the Vjosa River to the reservoir will have a **major negative impact** as a*	The whole chapter on water quality aspects is **insufficient and incoherent.** The analysis of predicted impacts is insufficient and not

	result of the significant reduction of the amount of water available downstream of the Kalivaç Dam…	detailed enough (e.g. nutrient release of fertile agricultural land after flooding, methane production, organic load downstream etc.) to allow a serious discussion on mitigation measures. Mitigation measures are inadequate and are described as miraculously leading to an improvement from "major negative impact" to "low to negligible impact". **This could be considered as fake!**
322	By applying the mitigation measures described above,… the impact is low to negligible….After the foreseen land rehabilitation and restoration, after the dam and infrastructure have been dismantled and removed and the reservoir is drained in the closure phase, the long-term impacts on the flooded area are expected to be **negligible**.	
328	In the Project footprint, no internationally recognized areas of conservation importance, or nationally recognized areas with high biodiversity value, that meet the criteria for the Management of Protected Areas according to IUCN are located.	**This is incorrect.** In fact, the scientific findings underline the outstanding biodiversity value of the Vjosa, especially of those parts that would be directly affected by the Kalivaç HPP.
328	Seven priority types have been registered in the catchment area (European Commission, 1992), all endangered and with high floristic values.	**The indicated number of priority habitat types and their areal shares is wrong.** In fact, there are eight different habitat types covering 75% (2345 ha) of the total study area. The highest percentage (20%, 644 ha) is comprised by type 3250—Constantly flowing Mediterranean rivers with Glaucium flavum. The second largest proportion is of type 6210—Semi-natural dry grasslands and scrubland facies on calcareous substrates. The following four types together make up a proportion of less than 5%. They are only located in small areas but these areas are distributed throughout the investigation area: 3230—Alpine rivers and their ligneous vegetation with Myricaria germanica (1.42%); 3240—Alpine rivers and ligneous vegetation with Salix eleagnos (2.1%); 91E0—Alluvial forests with Alnus glutinosa and Fraxinus excelsior (0.25%); and 92C0—Platanus orientalis and Liquidambar orientalis woods (1.09%). The 'running water' habitat types of the Habitat Directive include sections of water courses with natural or semi-natural dynamics where the water quality shows no significant deterioration (European Commission 2007). In the Vjosa, the river areas bordering the river channels are assigned the FFH types 3220 and 3250.

328	River and stream habitats (92A0), including aquatic habitats, freshwater marshes and riparian forests) are considered high value environments.	**Wrong,** as they are in fact even Priority EU habitats! Priority for conservation, as listed in the Annex of the Habitats Directive.
329	Large part of the habitats throughout the study area, has no high ecological value because it has been regularly modified, fragmented and disturbed.	**This statement is utterly wrong:** As already published by Schiemer et al. (2020) the value of the Vjosa River system as one of the few remaining reference sites for dynamic floodplains in Europe is outstanding. The floodplain morphology of the Vjosa is characterised by an exceptionally high near-natural state, thus representing an extremely rare reference site for medium-sized rivers in Europe.
330	a diverse range of butterfly species was recorded	**This description is too vague**, and as such not valid for an EIA report.
333	Impact during Operation Phase • Habitat degradation for all bird species particularly ground nesting birds and songbirds in riparian and adjacent vegetation • The project will threaten the ecological status of the area as a stopover site for migratory birds.	The ESIA does not mention at all the habitat loss of sensitive species due to the flooding of the area. This "neglection" aims to downgrade the level of impact and to demonstrate that the project does not have severe consequences upon wildlife when indeed it is the contrary.
334	…shallow areas of the reservoirs and withdrawn areas can create important nutritional bases for ducks, waterfowl, etc.	**Wrong**: as it must be compared to the reference status of the river system. Actually, the reservoir is a completely new ecosystem. Within the reservoir, the temperature and discharge regime are completely altered. Fine sedimentation negatively affects most riverine biota, especially macroinvertebrates, leading to a complete turnover of the community and reducing the biodiversity to just a few lacustrine taxa. As the reservoir, a standing water body, deviates contrastingly from the braided Vjosa, this is a clear degradation of the ecological status from a high status to much worse!
334	The vegetation of the flooded area contains about 860 ha of forests on hilly slopes and soil with sparse shrubs… They are rated **as of low to moderate importance for biodiversity"**	**Absolutely wrong.** Large areas are classified as priority habitats according to the Habitat Directive. The complete loss of these habitats cannot be rated as low negative impact. FOR DETAILED COMMENTS SEE ANNEX II by Dr Anton Drescher and Dr Gregory Egger
334	The final rating (of the project impact on wildlife) is small negative impact (considering the potential habitat restoration for waterbirds).	**Wrong:** The impact should be highlighted as moderate to high. And the mitigation measures for such an impact are simply missing. HPP reservoirs serve to a limited number of waterbirds, mostly to diving birds. In similar examples of HPP reservoirs the number of bird

		species using the reservoir is very limited and the abundance of each species is generally low. On the other hand, the number of species losing their breeding and foraging grounds is extremely high. Riparian vegetation will be lost and it is very likely that it will not be compensated elsewhere considering the high fluctuation of water levels in similar HPP reservoirs. Instead of proposing measures for first mitigating the impacts and secondly ensuring net gain on species triggering PBF and CH (in accordance with EBRD Performance Requirement 6), the ESIA does not propose such measures at all. Indeed, it delegated this duty to the Biodiversity Management Plan which is not a document attached to the ESIA.
335	The value of terrestrial habitats in the project area is estimated as low-moderate. The overall impact on terrestrial vegetation and plant biodiversity is estimated to low negative.	**Absolutely wrong:** → FOR DETAILED COMMENTS SEE ANNEX II by Dr Anton Drescher and Prof Gregory Egger.
335	River extensions are likely to have some remnants of solid aquatic species, which are able to migrate to groundwater-fed streams or other permanent water bodies… It should be remembered that the fauna and flora of the middle section of the Vjosa river will adapt to such conditions.	**Absolutely unprofessional statement** and demonstrates the irresponsibility of the evaluation. Long-term effects, especially, have the potential to change fauna and flora composition entirely and irreversibly.
335	The report rightly points out that similar ecosystems are found in some of the tributaries, but it wrongly claims that those ecosystems will not be affected by the project.	The major point of criticism here is that the continuity of the whole river system would be lost, leading to major loss of exchange processes in the metapopulations of the fauna and flora (see e.g. Funke et al, 2015). The river reaches both downstream and upstream (including tributaries) would also be markedly impacted by the HPP. The major impact upstream would be the complete blockage of aquatic migratory fish species, such as the critically endangered European eel. After construction of the proposed dam at Kalivaç, 881 km of the 1109 km of permanent river network length would no longer be reachable for migratory fish.
336		Interestingly the report states that during the operation phase a major negative impact on aquatic life and fish production is expected. It remains unclear why the final rating here is only a moderate negative impact.

336		Concerning the mitigation measures for fluctuation of river flow, only very general measures are indicated. No information on operation mode, residual flow, amplitudes, ramping rates etc. are given, factors which are crucial for the survival of many internationally protected species. Ironically, the EIA states that that drying up of the Vjosa may only affect some aspects of biodiversity!
336		To mention that measures should be taken to reduce the supply of nutrients in the created reservoir is not enough for an EIA. These mitigations measures need to be described and should not be limited to fish, but include also other groups!
337		**The sentence that indigenous species can adopt better to lake conditions makes no sense**. No rheophilous indigenous species lives in standing water bodies! The sentence that follows, in turn, is correct. ("It is very likely that the reservoir will be invaded by non-native species".)
337	The value of possible new fish developments in the flooded area is rated as medium-high. Losses of river fish and biodiversity opportunities compared to the values of the new reservoir situation can be summarized in a moderate positive impact on fish and aquatic biodiversity. The final evaluation is a small positive impact.	**This conclusion is wrong.** It is ridiculous to evaluate a positive impact on the aquatic fauna based on the wrong assumption of an increased diversity of aquatic habitats and increased fish production. It is also contradictory to numerous points mentioned in the report. According to the WFD, any deviation from river type-specific communities has to be evaluated. Additionally, expected increase in the fish biomass does not mean biodiversity will be higher too. On the contrary, it is reasonable to assume that lower diversity, increase in populations of invasive species and the cascade of those changes will impact other species.
337	…it is likely that the construction of reservoirs with fish reserves supposedly increased in the reservoir could create new and even better conditions for the otter population…. The combination of river habitat loss and the creation of new reservoir habitats is assumed to have a small positive impact on the otter population. The final assessment is a small positive impact, so mitigation measures will not be necessary.	**This conclusion is wrong.** The deep reservoir behind the high dam, with high fluctuations of water levels and lack of vegetation along the banks of the water reservoir due to water level fluctuations (as is the case for example with the Fierza lake along Drini river), does not provide a suitable habitat for otters, and it is expected that the otter population in Vjosa river, upstream and dowstream of Kalivaç dam will sharply decline.
337, 338, 341		The paragraphs on interruption of the fish migration route reveal several shortcomings.

		1. “The drying up of the river will interrupt the migration of fish”**. A drying up of the river is not acceptable and would cause many more impacts than only the interruption of the migration route.** 2. **Not only long-distance migratory fish are affected, unlike stated in the report.** All fish species undertake migration for several purposes, as highlighted in a study by Meulenbroek et. al (2018). The high numbers of anadromous, catadromous, and diadromous fish highlight the necessity of functional connectivity from the sea to the upstream river sections and back. In total, 13 species would completely disappear, including several threatened species, such as the European sea sturgeon (*Acipenser sturio*), the Adriatic Sturgeon (*Acipenser naccarii*), and the European eel (*Anguilla anguilla*). The latter has been reported to occur in the entire Vjosa/Aoos River and its tributaries, both in Albania and in Greece. Furthermore, longitudinal connectivity is also crucial for all other riverine fish species, as they all migrate to a certain extent. Dispersal is crucial for population persistence as it contributes substantially to ecological, behavioural, and evolutionary processes (Jungwirth et al. 1998; Lasne et al. 2007; McMahon and Matter 2006). 3. **A valid EIA should give detailed insights into mitigations measures such as a fish bypass.** In principle, fish bypasses have the potential to mitigate this upstream blockage to a certain extent. Based on the literature (e.g., BMLFUW (2012), FAO (2002)), the most important challenges include ensuring findability (optimal positioning of the entrance in relation to the transverse structure, sufficient discharge in relation to the river size, sufficient flow velocity of the current leaving the fish bypass, and bottom connection), guaranteeing passability and checking the passability of the bypass exit (fluctuating upper and lower water levels, suitable location, bottom connection, protection of the bypasses’ entrance and exit against bed load and alluvial deposits). These factors are of essential relevance for the construction and operation of bypasses. In the present case of the Kalivaç HPP, with a height difference of 37 m between the head- and tail waters, and its location in a canyon, the most suitable bypass type is a technical fish

		bypass such as a vertical slot bypass. Vertical slot passes have comparatively higher construction costs and high maintenance costs. According to the Austrian Guidelines for the construction of fish bypasses (BMLFUW 2012), a maximum water level difference between the basins of 13 cm and a minimum basin length of 250 cm must be adhered to. This produces a total number of 285 basins with a total length of more than 700 m. Alternatively, according to the guidelines of the FAO (FAO 2002), a maximum water level difference between the basins of 20 cm and a minimum basin length of 140–200 cm would be necessary, resulting in a total length of only 260–370 m. If sturgeons are considered, the total length increases to 925 m. **Planning and constructing such a long migration facility, however, entails major challenges and costs. It would be one of the longest bypasses worldwide and therefore limited experience is available regarding its functionality**
338		All protected sites located upstream and downstream will be negatively impacted for the above-mentioned reasons. It remains unclear what precautionary measures during construction and operation are planned.
338-341		The whole chapter 6.7.3. (Mitigation Measures in Terrestrial and Aquatic Ecology) is only a list of obscure measures to mitigate possible impacts. A detailed description is a basic requirement for a standard EIA. It is not enough to state that a Biodiversity Action Plan (BAP) will be developed in the future and implemented afterwards, as it cannot be proved and verified now. It remains unclear how the other mitigation measures will be realized, e.g. modification of sediments, artificial thermal de-stratification, maintenance of egg-laying grounds, fish stocks, etc.
345-353		The pages on Waste Management Impact Mitigation Measures (6.8.1.1) are exactly the same for the construction and operation phase. This is just **ONE example of copy and paste** of the exact same text to enlarge the report.
402	To understand the project or activities, the overall contribution to the impacts within the Kalivaç HPP and the wider region… a Cumulative Impact Assessment (CIA) is required to be undertaken	A CIA has not been conducted, so contradicting the own statement. Table 6-75 only contains some single impacts copied from previous parts of the report.

	within the scope of the full ESIA Report.	The EIA also contains significantly misleading reporting about a possible flood protection function of the Kalivaç reservoir. In the EIA, it was postulated that the reservoir will deliver flood security for the downstream reaches. This is wrong, especially in case of extraordinarily high flood events and can be simply calculated with the recorded discharge data for the period 1950 – 1990 (see Figure 1). ➔ An average annual flood contains a flow magnitude of about 1000 m3s-1. This means a flood volume of 3,600,000 m3 per hour and 86,400,000 m3 per day. For extraordinarily high flood events those numbers are obviously higher. Thus, there is a high risk that the retention effects of the reservoir dampen only the increasing limb of the flood wave, and that the peak magnitude of catastrophic flood events will not be affected, since the retention capacity is already depleted at the beginning of the flood wave. Coastal erosion as a result of blocked sediment flow to the sea is not mentioned in the EIA, neither as an ecological (Nartan lagoon) nor an economic threat (tourism) for the Albanian state. Thus, in the future the Albanian state and people face double costs incurred by the reservoir: (i) for the removal of sediment from the reservoir when it is full (probably within 30 years); and (ii) for the degradation of the coast line, with indirect (loss of nature) and direct costs (missing tourism).
403	There is a potential for a development that will lead to reduced inflows into the Vjosa Delta, especially during the summer, when the need for irrigation water is much higher. The project will result in a more sustainable water supply to the Vjosa river downstream of the Kalivaç dam. Seasonal storage will reduce the risk of flood damage in the wet season and the more stable and higher average flow in the dry season. The risk of flood damage will be reduced and more water will be available during the summer	The EIA also lacks in looking on combined impacts of the reservoir construction. Due to the full capture of bed load and a high amount of suspended sediment in the reservoir, **river incision** and depletion of the groundwater in the downstream section will follow. It is well known, that river incision accompanied with catastrophic flood events may lead to unpredictable channel avulsion. This means unpredictable erosion of agricultural land, bridge piers, channel embankment and buildings in the flood plain areas. Moreover, accompanied with the flood flows through the reservoir (obviously included into the project due to the spillway design) fine sediments will be transported for every flow

	season. The impact on creating a more sustainable flow model is assessed as large positiv. The final evaluation is a big positive impact.	through the reservoir (almost annually predicted) and deposited immediately upstream of the dam. The EIA is not addressing this very important aspect, as from the first year of operation this may lead to problems with the bottom outlet (clogging). Such a clogging of the bottom outlet is against all international technical standards and safety regulations. Especially, the close fault lines and risk of earthquakes are superimposing the risk of a non-functional bottom outlet, which are not addressed in the EIA.
404	It is recommended to use the hydro-suction method to remove sediments from the area relatively close to the dam, about 2-3km., where the deposited sediment can be removed from the bottom of the reservoir relatively close to the dam, while the dam is operating normally.	**Wrong recommendation.** The hydraulic dredging can´t be implemented to support this measure, as the hydraulic sucking principle can´t work over kilometers in length as a continuous supply to the ecological flow. Moreover, in terms of high flow and flood overspill over the dam, the bottom outlet will be clogged with the consequence that the continuous release of deposited sediments is also blocked.
403, 404	Sediment Transport, Vjosa Delta and Narta Lagoon	403 and 404: **Wrong data, wrong assumption and wrong impact assessment** concerning the downstream water flow, basin erosion and sediment transport to the Delta and Narta Lagoon. → FOR DETAILED COMMENTS SEE ANNEX III by Prof Hauer
405		There are no mitigation measures planned, although the final evaluation on Biodiversity and Nature Conservation of the Vjosa Delta and Narta Lagoon is classified as a major negative impact.

All these arguments confirm the conclusion that the ESIA Report in its present form does not fulfil the minimum requirements for an EIA.

6 Appendix

Annex I

Endangered species NOT listed in the ESIA report

Scientific name of species	Albanian vernacular name	Status Albanian Red List	Status IUCN Red List	Trend Europe/Med.
Anacamptis laxiflora	–	–	LC	unknown
Iris pseudacorus		VU / A2b	LC	stable
Listera ovata	–	–	LC	unknown
Platanus orientalis	Rrapi	VU	VU	decreasing
Populus alba	Plepi i bardhë	VU / A2b	LC	decreasing
Salix alba	Shelg ?	–	LC	stable
Salix amplexicaulis	–	–	LC	unknown
Salix eleagnos	–	–	LC	stable
Salix triandra	Shelg trithekës	VU / A1b	LC	stable
Scorzonera doriae	Skorzonerë e Dorias	DD	–	–
Tamarix parviflora	–	–	LC	unknown
Traunsteinera globosa	–	–	LC	unknown
Typha minima	Shavari i vogël	CR / C1	DD	decreasing
Typha shuttleworthii	Shavar i Shutleurthit	EN / A1b	DD	decreasing
Ulmus minor	Vidhi	VU / A2b	DD	unknown

Endangered habitat types NOT listed in the ESIA report

Mapping unit	Characteristics	FFH-Annex I/ Natura 2000[2]	EUNIS habitat classification 2004/2012[4]	EU REd List	Conservation status/Vjosa
Gravel/sand bars	highly dynamic, regularly flooded	3220 Alpine rivers and the herbaceous vegetation along their banks	C3.62 Unvegetated river gravel banks	VU	Favourable
	fairly dynamic, regularly flooded	3170 Mediterranean temporary ponds	C3.42 Mediterraneo-Atlantic amphibious communities	?	?
Initial vegetation	highly dynamic, regularly flooded	3250 Constantly flowing Mediterranean rivers with *Glaucium flavum*	C3.553 Mediterranean river gravel habitats	VU	Favourable
Pioneer shrub, Willow shrub	highly dynamic, regularly flooded	3240 Alpine rivers and their ligneous vegetation with *Salix elaeagnos*	F9.14 Gravel bank thickets and woods	VU	Favourable
Tamarisk pioneer shrub	fairly dynamic, annually flooded	3230 Alpine rivers and their ligneous vegetation with Myricaria germanica	F9.31 Oleander, chaste tree and tamarisk galleries	CR	Favourable

Annex II Detailed comments on pages 334-335 on Terrestrial Vegetation and Aquatic Ecology

by Dr Anton Drescher and Dr Gregory Egger

The description of the status quo, the potential impacts and the ratings are absolutely wrong.
Large areas are classified as priority habitats according to the Habitat Directive. The complete loss of these habitats cannot be rated as low negative impact.

- The documentation of the vegetation is limited to 53 vegetation surveys (according to Braun-Blanquet) and to a comprehensive assignment of "land cover classes".

- Vegetation surveys and mapping is missing (no vegetation tables, no information/map of the locations). The report does not even indicate in which report/data source such surveys can be found.
- There are no complete analyses in the report for the evaluation of the actual status based on the vegetation surveys (e.g. number of Red List species, FFH appendix species, protected species etc.). Essential endangered species (appendix I) and habitat types (appendix II) occur extensively in the floodplain zone are not listed in the report.
- The comprehensive land cover map covers the dam area including the surrounding area; the area downstream of the dam is only partially covered. A complete documentation of the entire dam affected area downstream is missing.
- The land cover units primarily refer to the surrounding area in the catchment area and do not adequately represent the riparian vegetation in the affected floodplain zone.
- The listings and brief descriptions of the vegetation refer primarily to the surrounding area and in this general form have little relevance to the area affected by the power plant.
- Maps and documentation of the bank and floodplain specific vegetation units are missing.
- Maps and documentation of the FFH-habitat types are missing.
- There is no comprehensive classification (maps) with regard to nature conservation relevance.
- The evaluation and area balances of the Red List species (IUCN status) refer to the entire catchment area (incl. surrounding area) and not specific to the area affected by the power plant in the floodplain zone. Therefore, the statements are hardly relevant for the nature conservation assessment of the power plant.
- The evaluation of the impacts on riparian vegetation is incomprehensible and scientifically incorrect. The complete loss of all river and floodplain habitats as a result of flooding has been assessed as "*low to moderate importance for biodiversity*". With the exception of agricultural areas, almost all of the areas affected by impoundment must be designated as FFH habitats (FFH Directive, Annex II) and are of high national and international importance (see Egger et al., 2020).
- Important further impacts to riparian vegetation downstream of the dam, such as reduction of morphodynamic, no sediment input etc. have not been analyzed or considered at all.
-
- Within the mitigation measures a "Biodiversity Action Plan (BAP)" is mentioned. The purpose of such a plan is "*to reduce impacts on sensitive biodiversity*...". The generally formulated mitigation measures in the report are not suitable to reduce or compensate for the permanent loss of riparian habitats in the reservoir and floodplain zone downstream of the dam. Also the mentioned monitoring as well as the further mentioned mitigation measures are not suitable to compensate the permanently destroyed and strongly impacted habitats.
- The residual impacts after implementation of the mitigation measures during construction and operation phase are related as "*small*", which is incomprehensible and incorrect.

Insufficient description of predicted impacts on aquatic biodiversity during the construction phase.

This description is completely inadequate and unprofessional. The filling of the reservoir leads to highly reduced (if any) river flow downstream. This has severe implications for the organisms living

there. The residual flow leads to higher water temperatures, algal growth, reduced water quality, and to the siltation of interstitial habitats, thereby considerably reducing the overall abundance of oxygen-dependent organisms and of certain functional feeding types, such as grazers. The duration and seasonality of the residual flow is decisive in determining which organisms will survive and to what extent. The reduction of the wetted area owing to residual flow is correlated with the loss of biomass downstream. Even a short time **drying of the river bottom** – as stated in the EIA - can lead to the total extinction of any aquatic species listed in international conventions. The vital question here is where and how far away the nearest populations live and whether repopulation is possible. Plausible and detailed answers must be provided by the operator of the HPP within an EIA, but these are not stated anywhere. As the Vjosa is outstanding (Schiemer et al. 2020), an occurrence of specific internationally protected species anywhere else in Albania is highly questionable. Mitigation, such as the exact seasonal minimum residual flow considering the remaining wetted area and flow dynamics, must be implemented to assess the impact on biodiversity, which is completely lacking. Further, seasonal adapted flow dynamics during any stage of development have to be clearly defined within the mitigation measures to prevent organisms from local extinction.

Incomplete list and insufficient description of predicted impacts on aquatic biodiversity during the operation phase.

The major impact of HPPs is a continuum disruption. Migratory species are blocked from reaching their spawning habitats, genetic exchange is prevented, and the creation of genetic 'island populations' is supported. The genetic impoverishment caused by this isolation decreases the health of the entire population, by reducing the possibility of better adaption through the random genetic mutation of individuals (Schmutz and Sendzimir 2018). The upstream reaches of the river are affected by the dam itself as a migration barrier. It essentially impoverishes migratory species, including catadromous and anadromous fish species like eels, among others. This habitat fragmentation leads to an impoverished aquatic fauna, including aquatic invertebrates, owing to the isolation of populations and reduced genetic exchange (Monaghan et al. 2002; Zwick 1992). The reservoir is a completely new ecosystem. It is not comparable with the river itself, as flow is the decisive parameter, responsible for oxygen content and sediment distribution among other factors.

Within the reservoir, the temperature and discharge regime are completely altered. Fine sedimentation negatively affects most riverine biota, especially macroinvertebrates, leading to a complete turnover of the community and reducing the biodiversity to just a few lacustrine taxa. Biodiversity can be high in littoral habitats, but they suffer regular disturbance, such as artificial water level fluctuations, drawdowns, and floods. By exceeding subtle thresholds, these fluctuations can result in littoral dead zones (Schmutz and Moog 2018). The large-scale destruction of the semiterrestrial bank and floodplain habitats owing to damming is particularly relevant in the case of the planned Kalivaç HPP, where the entire valley floor will be flooded. Because of the stagnant waters within the reservoir and the enhanced sedimentation of organic material, eutrophication is a frequent phenomenon. In contrast to running water, self-purification processes are strongly reduced, and the water quality therefore deteriorates quickly, especially at the bottom where there is little dissolved oxygen. The water in reservoirs is therefore frequently classified as poor or bad quality (Commission of the European Communities 2000; Ofenböck et al. 2011).

The implementation of HPPs in rivers and the associated creation of reservoirs can lead to an alternate state or a total shift in ecosystem, because dams alter the flow regime, a major influence in rivers, and influence the hydromorphology, nutrient cycles, and species distribution of the river (Baxter 1977; Poff et al. 1997). Species that show migratory or rheophilic traits, and/or are dependent on habitats formed by fluvial processes suffer heavy losses. Damming in rivers leads to increased water temperatures in the impounded sections, which might lead to colonisation by species adapted to warmer temperatures. This is called potamalisation, or a shift from rhithral to potamal communities (Jungwirth et al. 2003). The highest biodiversity in reservoirs can be found in

littoral environments (the shoreline), because of their better and more diverse feeding opportunities, shelter, and habitat. However, owing to the general water level fluctuations in reservoirs, littoral fauna and flora might be exposed to more physical stress (Agostinho et al. 2008). The reduced flow patterns in reservoirs lead to increased sedimentation and the clogging of interstitial spaces. Moreover, this filling up of the reservoir with sediment leads to decreased water storage, and thus to decreased potential energy storage.

Sections downstream of the reservoir are also seriously affected, as hydrological dynamics are dampened considerably during HPP operation. In combination with sediment trapping in the reservoir, this leads to the incision of the riverbed, changing the geomorphological characteristics and habitat availability completely. As delta areas are dependent on substrate input from upstream, the hampered sediment supply can change these areas considerably. Nutrient cycling and food web alterations within the reservoir, combined with changes in water temperature, influence the composition of the whole community downstream of the barrier. Although frequently ignored, the downstream effects of HPPs pose equal or even greater threats to aquatic and semiaquatic species, than their upstream effects.

Dams heavily modify the natural flow regime of the river downstream. They adversely affect floodplain ecosystems because the latter are dependent on fluctuations in discharge, especially on extreme events (floods and droughts). These flow alterations have a significant influence on downstream communities. Less lateral connectivity between the river and the riparian vegetation leads to hydromorphological alterations. Owing to the lack of sediment and reduced hydromorphodynamic effects, the progression of the vegetation increases and the riverbed becomes overgrown with vegetation. Particularly, the proportion of young succession phase habitats, like gravel bars, pioneer vegetation, and pioneer-shrub vegetation, will diminish in the short- to mid-term. The loss of spawning, nursing, and juvenile habitats leads to higher mortality amongst young fish (Agostinho et al. 2008). In addition to the blockage of the up- and downstream migration of fish, the altered flow patterns can increase downstream drift and cause the stranding of young fish and macroinvertebrates (Zhong and Power 1996).

The interruption of the sediment regime and the retention of sediment upstream leads to a depletion of sediment downstream of the barrier. Some negative effects of reduced sediment load in a river are channel incision through the erosion of bed-material and habitat loss for shoreline species, owing to the erosion of fine material and the large grain sizes of the remaining substrate (Kondolf 1997). Riverbed incision weakens lateral connectivity. Combined with reduced flow-fluctuation, floodplain habitats face reduction and fragmentation (Schmutz and Sendzimir 2018). As delta areas are dependent on substrate input from upstream, the hampered sediment supply can change these areas considerably. Nutrient cycling, food web, and water temperature changes within the reservoir influence the composition of the whole community downstream of the barrier. Additionally, changes in thermal regimes owing to hypolimnetic or surface water releases can extirpate stenothermal species (Edwards 1978; Vanicek 1970).

Sediment accumulation in the reservoir results in the need to flush intake basins periodically, which leads to increased turbidity and the clogging of the river bottom downstream with fine sediment. This can lead to a breakdown of fish populations and especially affects interstitial-dwelling macroinvertebrates like *Xanthoperla apicalis* (Gabbud et al. 2019).

HPP operations produce variable and short-term changes in hydrology, according to power demand. This so-called hydropeaking frequently causes the drift (owing to increased hydraulic forces) and stranding (owing to the reduction of the wetted area) of fish and macroinvertebrates, considerably reducing biodiversity and biomass in the downstream sections of the river (Greimel et al. 2018; Schülting et al. 2016).

Annex III Detailed Comments on pages 403-404: Sediment Transport, Vjosa Delta and Narta Lagoon

By Prof Dr Christoph Hauer (University for Natural Resources and Life sciences, Vienna)

403 and 404: **Wrong data, wrong assumption and wrong impact assessment** concerning the downstream water flow, basin erosion and sediment transport to the Delta and Narta Lagoon. In a recent study, Hauer et al. (2019) investigated sediment transport and morphodynamics in the Vjosa River and highlighted several economic and ecological constraints. In the following, a summary of their work and conclusions is presented:

1.) 'The filling up of Vjosa reservoirs with sediment is calculated to occur within 30–40 years for Poçem and 45–60 years for Kalivaç'.
2.) Owing to the high sediment transport rates of the Vjosa, an annual reservoir loss of about 2% in the case of Kalivaç and > 2% in the case of Poçem is forecasted. These numbers are more than twice as high as global average annual storages losses (0.87% per year).
3.) 'High economic costs are expected for sediment management and treatment'. The numerical modelling of the planed reservoir in Kalivaç clearly showed that frequent (annual) flood events in the range of >1000 $m^3 s^{-1}$ would create currents in the reservoir, which would transport the suspended load through the reservoir with various stages of deposition in the impounded sections. Those currents, induced by frequent flooding, would (with a high certainty) cause severe problems at (i) the bottom outlet and (ii) the intakes to the turbines, owing to deposition. To overcome these issues, costly dredging would be necessary from the first year of operation.
4.) Riverbed incision will be the consequence if the sediment transported by the Vjosa is trapped in hydropower reservoirs. This incision would result in (i) changes in downstream groundwater levels (i.e. problems for agricultural land use and floodplain vegetation), (ii) a risk of uncontrolled channel avulsion in the event of floods (i.e. loss of agricultural land and ecological degradation in the long-term).
5.) 'Coastal (Lagoon) erosion will increase owing to a lack of sediment transport'. The interruption of the sediment continuum would have severe consequences for the coastline in this part of Albania. As previous studies have already shown, the erosion of the coastline is already in progress and will accelerate drastically if dams hold back the sediment in the Vjosa. This erosion is of high socioeconomic relevance to the Albanian state and poses a high risk for infrastructure in the event of Adriatic storms (comparable to Hurricane–coastline experiences in the US).
6.) 'Degradation of ecology and loss of European sea-side tourism as well as of eco-tourism in the Vjosa catchment must be expected'. This has not been directly assessed in the present study; however, the expected severe degradation in the Vjosa catchment as a result of all four points mentioned above will inevitably lead to socioeconomic consequences related to tourism for the coastal part of Albania, as well as to a loss of potential for eco-tourism along the Vjosa. Infrastructure projects along the coastline will be at risk and marine resources related to the lagoon will disappear.

Based on (1) and (2) it can be concluded that the construction of dams (reservoirs) in this specific river and particularly in this section of the river system (huge catchment area and high sediment loads) is a problematic concept in terms of energy generation and profitability. Dams (reservoirs) are created to capture rainfall and runoff on a daily, weekly, or annual basis. In addition to high annual losses in storage volume, the frequent overspill of flooding will cause severe operational problems. Since the interactions between instream hydraulics, sediment transport, river

morphology, and ecology are not adequately understood (from a process perspective), implementation of sustainable sediment mitigation measures in river management plans is missing. Furthermore, there is a lack of standardised evaluation methods for detecting disturbances in sediment regimes. In summary, there is the risk of a 'lose-lose-lose situation':

- Loss 1: High economic costs owing to sediment-related problems in the reservoir
- Loss 2: Ecological degradation of a large, unique river system in Europe
- Loss 3: Long-term negative impacts on the coastline and tourism in this part of Albania.

Annex IV Detailed comments about the chapter 4.12; 4.13; 4.14 and 6.6.1 about the geological hazards, such: seismic activity, landslides, erosion process and sediment transport

By Dr Klodian Skrame (Polytechnic University of Tirana (PUT))

On chapter 4.12 (pages 153-157), the authors treat the **erosion process and the sediment transport** settings referring to the dated research paper such as: Pano, 1984; Pano, 1978; Leka, 1996; Pano, 1997 and Eftimi, 2003. As they explicitly write:...*Specifically, measurements of suspended solids in the river flow were performed for the stations in Bridgearshova, Përmet and Lekli Bridge (from the stations under consideration). The observation period began from the opening of the Dorez station in **1959 until 1990**, **when observations ceased***.
Unfortunately, the situation in the Vjosa River basin has changed a lot and in worst, during the last decades, because of many factors.
The main factors are connected to the Geological settings of the Vjosa River catchment. The geological bedrock of the Vjosa River basin is composed by thirty-five (35) geological formations of different lithologies and ages. The basin is dominated by the flysch deposits, which cover more than 47% of the catchment, limestones (around 25%), clastic sediments (17%), sandstones (8%), metamorphic rocks (around 2%) and igneous rocks (less than 1%) as shown on recent studies, as Skrame, 2020. Considering the fact that the Vjosa River is fed for 69.5% of the total flow by surface water and only 30.5% by groundwater activities (Koçi, 2014), the geological formation cited above plays a key role on the bed load and suspended sediments production on the Vjosa River. As shown by Hauer et al., 2019, the high values of the suspended sediments came from the flysch deposits, which cover almost half of the entire river catchment. Instead, the high values of the bed load sediments derived from the limestones, clastic sediments and sandstones formations. The grain distribution curves of the 86 bed load sediment samples, obtained from the sampling stations at the Poçem Bridge, define a high presence of the sands and gravels sizes (Hauer et al., 2019).
Mediterranean climate with extremely variable temperature and precipitation regime and large amount and high intensity rainfall in short times are the natural factor for the intensive development of the erosion processes on the Vjosa River catchment.
Instead, human activities have had and continue to have a huge and negative impact on the environment with, sometimes, irreversible consequences. This, because the main activity of the population has been and remains agriculture, this is also applied in the medium and upper stream of the Vjosa River basin, where bids for arable land is very limited. Therefore, for this purpose are opened new lands in the slopes, even in large sloping slopes. Constantly forests have been cut over their growing capacity, and there have also been abusive forest cutting. All this has constantly reduced the area of the forest and have degraded them. Another factor is

the prevalence of the field crops of cereals bread, which leave the ground without protection in the period of the year with high precipitation.
These causes have changed, almost completely, the situation on the Vjosa River catchment. **To have a better view of the entire situation of the Vjosa River basin, we would recommend the authors to refer to the most up-to-date research studies such as: Hauer et al., 2019 or at least to recommend and/or to project and make detailed studies, such: sedimentological, geological, hydrogeological and hydrological for a period of four years, at least.**

On chapter 4.13 (pages 157-160) and 6.6.1 (pages 307-315), the authors make a deep reflection on the **geological hazards**, especially on the **seismic activity** of the area of study. Referring to the historical earthquakes occurred on the Vjosa River basin, the author widely describe the seismic event of November 26, 1920, of M 6.4 and seismic intensity of IX (MSK-64 scale). This seismic event killed 36 people and injured 102 persons. It caused damage to the ancient fortress of the city of Tepelena and destroyed around 2500 buildings in the city of Tepelena and the surrounding villages of Memaliaj, Bënça, Dhemblan, Turan and many others. The earthquake sequence produced a large number of seismic events with high magnitude. The activation of the faulting system produced many phenomena connected to the local soil conditions such as: surface fractures and earthquake-induced landslides. Surface fractures of length of several hundred meters and widths of 50-150 cm were observed on the Bënça Mountain. Earthquake-induced landslides have been activated on the limestone formations of the Mount Trushnica, near the village of Bënça. Other earthquake-induced landslides were observed along the national road Vlora-Gjirokastra.

Furthermore, based on different earthquakes catalogue, the city of Tepelena has been hit by two other strong earthquakes; in March 1701 and April 1868. The seismic event of October 10, 1858, instead, destroyed many buildings in the city of Gjirokastra. Historians claim that these earthquakes had a huge impact on the economic life of the cities and the region.
On the Geological Hazard Map and the National Seismic Hazard map of Albania, both in 1:200.000 are shown the epicenter of the earthquakes occurred in the Vjosa River basin, the extension of the active faults and the contour lines that identify, on a regional scale, the areas that manifest homogeneous seismic intensity, in MSK-64 scale, during an earthquake event. Most of the municipalities of the Vjosa River basin show for their entire territory or only in some sectors of it, a seismic intensity value of VIII. Only the municipality of Libohova shows a seismic intensity value of VII in the entire territory. Unfortunately, the territory of some municipalities, like Tepelena, Memaliaj, Himara and Vlora, are expected to have a seismic intensity value of IX during an earthquake event. The seismic risk values in these areas are very high and they can influence the terrain surface, safety of people's lives and the vulnerability of all the structures and buildings located there.

In the process of creating earthquake resistant cities and constructions on the Vjosa River basin, geological, engineering-geological and geophysical investigations became crucial in the evaluation of the subsoil and rock characteristics together with the seismic activity and the exact locations of the active faults. It is not conceivable to project and build big constructions and/or strategic structures, like: hydropower plant, in these areas with higher values of the seismic risk, without respecting the distances from the active faults and without making studies on the evaluation of the local seismic response or Seismic Microzonation Studies (hereafter SM).

SM are an important tool in correct urban planning and seismic hazards mitigation and prevention. The main goal of SM is to delineate areas, at a municipality level, with homogenous seismic response in terms of stratigraphic and topographic amplification, as well as areas of earthquake-induced phenomena such as landslides, liquefaction and sinkholes (Skrame et al., 2020).
These kind of studies are made for the areas with the highest values of peak ground acceleration, agR, corresponding to the reference probability of exceedance PNCR=0.10 in TL=50 years, or equivalency to a reference return period of TNCR≈ 475 years. A one and two-dimensional numerical modeling analyses based on the modification of the reference seismic signal due to the specific site conditions is needed to quantify the local amplification, the dynamic analysis of slope instability and the liquefaction susceptibility.
Unfortunately, the territory of some municipalities, like Tepelena and Memaliaj are expected to have a seismic intensity value of IX, in MSK-64 scale, during an earthquake event. The seismic risk values in these areas are very high and it can influence the terrain surface, safety of people's lives and the vulnerability of all the structures and buildings located there.
Considering the fact that MSK-64 scale is a macroseismic intensity scale used to evaluate the severity of ground shaking on the basis of observed effects in an area of the earthquake occurrence, the author firmly believes that the area from Tepelena to Memaliaj (that manifested homogeneous seismic intensity of IX, in MSK-64 scale, during the seismic event of November 26, 1920, of M 6.4) could be extended because of many reasons. In 1920 the surrounding areas were not developed and there were only some small houses. So, during the seismic event of November 26, 1920, most of the damaged have been in the big cities, like: Tepelena and Memaliaj. For this reason, the only area with the seismic intensity IX is considered the one between these cities. But, the most important aspects are connected to the geology settings. The geological formations on the surrounding areas are the same of the areas mentioned above and the active faults (which generate the earthquake of 1920) continue until the village of Sevaster. Based on Aliaj et al., 2010, the values of peak ground acceleration, agR, corresponding to the reference probability of exceedance PNCR=0.10 in TL=50 years, for the villages of Kutë (ag = 0.244) and Qesarat (ag = 0.245) are higher than the ones of Tepelena (ag = 0.241) and Memaliaj (ag = 0.241).
Based on detailed engineering-geological and geophysical models of the subsoil, we recommend the authors to project and make the evaluation of the local seismic response and seismic amplification factors of the entire territory interested by the Kalivaç Hydropower Plant. We strongly recommended the study of the activity and the correct extension of the active faults that connect the city of Tepelena to Sevaster. These studies are crucial to determine the stability of the existing buildings and the hydropower plants.

On chapter 4.14 (pages 160-162) and 6.6.1 (pages 307-315), the authors describe very well the **landslides activities** and their negative effects.
Landslide, as a movement of a mass of rock, wastes or soil down a slope, when the erosion stress exceeds the bearing strength of the material, poses a typical geological hazard that must be seriously considered during project design and especially in engineering works such as Hydropower Plant.
Most of the landslides are generated on the flysch deposits and could be classified as slides with a rotational and translational type of movement. As mentioned above, the sector from Tepelena to Poçem is an active tectonic region. The presence of so many landslides next to the active fault alignments could produce the well-known phenomena of the earthquake-induced

landslides that the authors don't treat in their work. Especially in a condition with a huge reservoir on the upper part of the dam (around 200 million m^2) could create an extreme event that could create anomaly water waves very risky for the people living downstream.
We recommend the authors to define the exact volume and the activity of these landslides, and the conditions of creating the earthquake-induced landslides which are crucial for the safety of the people life and for their goods.
To this reason the studies would require an interdisciplinary approach, involving engineering geologists, geophysicists and seismologists getting together and focusing on the way that local geological, geotechnical and geophysical characteristics of soils can condition the ground motion at site scale, thus modifying incoming seismic waves during an earthquake event, and influencing the seismic vulnerability of hydropower plant by creating the earthquake-induced landslides.

Considering the facts that the authors clearly shows:
*…The study region, morphologically belongs to the hilly-mountainous relief, where the hills and mountains are connected respectively with **flysch** and limestone terrains. The soil is composed of fine particles (**clay** and sludge) and is composed of geological formations: (a) silty, b) diluvial and c) alluvium….. The relief of the flysch is represented by low hills (300-550 m above sea level)…**The hill slopes are generally steep towards the river valley**… During the operational phase of HPP Kalivaç, **reservoir levels** may fluctuate in accordance with climatic conditions and rainfall. This **can have a negative effect on the stability of the side slope**, changing the water pressure regime…*

and the studies that the authors recommend:
*...Carry out **a geomorphologic study** focusing on slope stability to take adequate measures to protect river banks and reservoirs from erosion. These measures may include erosion control structures, vegetation protection, reforestation, landscape, reproduction and specific erosion control measures. etc…. The detailed measures will have to be determined at the design and construction stage of the project…*
… It is deemed necessary and a special study should be carried out to verify such potential risks of erosion or landslides before the start of reservoir excavations…

We strongly believe that a detailed engineering-geological, geotechnical, hydrogeological and geophysical studies could be crucial for the 3D engineering-geological and geophysical modeling of the subsoil and the geological formation in outcrop. The obtained geotechnical and geophysical data together with the geo-mechanical studies could help the authors on the slope instability analysis in static and dynamic conditions. These studies are very important to understand the nature of the geological formation and to be sure that situation like the Vajont history will not be repeated in Kalivaç.

Furthermore, hydrogeological risk assessment together with engineering-geological, geotechnical, sedimentological and hydro-morphological studies need to be done to better understand the hydrogeological instability activities, as: landslides, intensive erosion and floods and to save human lives and material as well as to reduce economic losses of the communities living on the Vjosa River basin.

LITERATURE

Aliaj, Sh., Koçiu, S., Muço, B. and Sulstarova, E. [2010]. Sizmiciteti, sizmotektonika dhe vleresimi i rrezikut sizmik në Shqipëri. *Akademia e Shkencave e Shqipërisë, Tirana.*

Hauer, C., Aigner, H., Fuhrmann, M., Holzapfel, P., Rindler, R., Pessenlehner, S., Pucher, D., Skrame, K. & Liedermann, M. [2019]. Measuring of sediment transport and morphodynamics at the Vjosa River / Albania, 85 pp.

Koci R., [2014]. Tarracat lumore tregues të lëvizjeve tektonike nga pleistoceni i mesëm sot.

Skrame, K. [2020]. Study/Inventory of the current land-use patterns of the Vjosa River Basin area, 43pp.

Skrame, K., Muçi, R., Simionato, M., Benigni, M. S., Gaudiosi, I., Giuffrè, M., Mancini, M. & Moscatelli, M. [2020]: New seismic microzonation studies in Albania: from the past to the future. *First Break*. Vol**.** 38, Issue 8, August 2020: 39-45.