

## ***Interactive comment on “A freshwater biodiversity hotspot under pressure – assessing threats and identifying conservation needs for ancient Lake Ohrid” by G. Kostoski et al.***

**G. Kostoski et al.**

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We would like to thank Andreas Matzinger for his extensive and very insightful review on our MS. We considered all of the comments carefully and his comments really helped to improve the MS a lot. In the following, we list the comments and our according replies.

1) General evaluation:

I see main gaps in the following points: (i) systematic identification of potential threats: - Threats in section 2 are mixed (in each category) without indication on the quality of the know- how related to these threats. To the reader without local knowledge the

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listed threats seem of equal weight, although some threats are of high concern and relatively well-known, whereas other threats are more speculative and require further assessment. This further assessment cannot be done within this work, but the level of (un)certainty should at least be indicated.

We agree with this and now incorporated statements regarding the quality of the know-how of threats in the text at appropriate places. Additionally, we included in Table 2 a column with a subjective opinion on the know-how of threats using 3 categories. These are “well-known”, “moderately known”, and “less known” (threats).

I suggest restructuring each sub-section in section 2. E.g., each sub-section could be structured along three paragraphs: (a) Known threats, (b) Semi-quantitative indications, (c) Potential but unknown threats (see examples for section 2.1 under specific comments below).

We follow this suggestion and have re-structured the subsections in chapter 2 according to the reviewer’s suggestion.

- The IUCN-evaluation of the threats in Table 1 is not very clear; was the impact assigned subjectively for each category? If not, then impact point calculation should be explained in the text or in electronic supplementary material. If yes, it should clearly be said so, and the table only be used to show that a lot is at stake.

We extended point 2.9 and now explain more explicitly how the scoring was carried out and that a high degree of subjectivity is related to the assessments (as in any assessment of such kind).

In terms of identification of major threats (which is nicely done in the conclusion chapter) the table is not very helpful and may even be misleading, since again badly known threats are mixed with well-known ones.

As in Table 2 (see above), a column with a subjective opinion on the know-how of threats using 3 categories was included. These are “well-known”, “moderately known”,

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and “less known”.

(ii) the identification of gaps in knowledge on these potential threats and (iii) suggested counter- measures - Points (ii) and (iii) are mentioned at different places in the manuscript, mainly section 3, section 4 and section 5, but without clear reference to the threats described before.

We improved the references to identified threats in cases, wherever this was possible. This paper is not intended to provide a general management plan (GMP), which would be beyond the scope of the paper. However, such a GMP already exists but was only very recently implemented.

- Section 3 is a mixture of existing (or past) efforts and future protection/research requirements. To clarify the manuscript for the reader I suggest structuring section 3 again along the threats of section 2, indicating for each threat

We agree that section three might appear as a mixture of former and recent conservation efforts and requirements. This chapter, however, was intended to summarize as extensively as possibly particularly all those different kinds of activities. They are thus naturally somewhat puzzling. We take the suggestion of the reviewer and now included another table (Table 3) in a new section on conservation needs and challenges (see below). This section now includes for the threats identified: (a) existing measures, (b) necessary further research/assessments and (c) suggested conservation measures.

Institutional responsibilities (section 3.1) could then be excluded as an extra chapter.

See above.

In general the part on existing activities (which now dominates section 3) could be shortened.

We shortened the part on existing activities according to the reviewer’s suggestions.

- Section 4 is not so clear in the general structure. 4.1 has some information, which was

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already mentioned in sections 1 and 2. It focuses on observable effects on endemic species, without clear link to the threats (which is also impossible). I suggest to add it to section 1, where these observations are already discussed in less detail or to put it into a new second section, which

We follow the reviewer's suggestion and dissolve the former section 4. Information in the former section 4.1. and in 1 are now condensed and included in an enlarged section 2.9 where now more examples are provided outlining the conservation status of the lake and its biota.

Section 4.2 steers towards actual conservation needs and might thus be partly included in new section 3.

This section is now a new subsection 3.7 including both conservation needs and challenges. It also contains a new table (Table 3) (see above).

- Conclusions (section 5) should emphasize the most important activities/measures. This is already the case in the manuscript. However, some proposed measures are relatively general ("comprehensive conservation strategy" or "General management plan") and might be put somewhat more specifically. Nevertheless, if revised section 3 lists lacking research efforts and necessary measures for each identified major threat the two sections will be complementary.

Given the restructuring (see above), this point is addressed. We also rephrased some of the too general measures, a "General management plan", however, already exists (see above).

## 2) Specific comments

page lines

Abstract 5348 1-7 I suggest skipping the introduction in an abstract

The intro has been considerable shortened.

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8 “the” European suggests it’s the only European biodiversity hotspot? Maybe change for “a major”

Changed.

21-24 The IUCN classes are not very intuitive. I suggest listing the best known threats with highest expected impacts.

Shortened and only major threats identified listed. These threats are now listed in addition to the IUCN classes, which we agree upon are per se not very intuitive.

24-28 This is the outline of the paper, should not be in the abstract

Partly deleted and modified.

5349 1-16 I suggest clearly distinguishing suggested measures (e.g., reduction in phosphorus pollution), research need (e.g., research on lake biodiversity) and most suitable framework (e.g., concerted international action)

Adopted.

1 Introduction 5351 5 “the” European biodiversity hotspot, see above

Changed.

21-end I suggest adding or including research needs (since you cover it in the text)

Added.

2 Threats 5352 21-24 The distinction between (1), (2) and (3) should be clarified, since (1) is typically caused by (2) and (3). . .

We see the reviewer’s point, however, the chapter 2.1. deals with more general and often intermingled impacts vs. rather discrete sources (pollution) in the following 2 subsections. In Chapter 2.1., many different impacts are collected. We have chosen this particular series of chapters since we (subjectively) felt that these concerns cover the major threats to Lake Ohrid. It was intended to combine related issues and to

structure the very complex processes relevant for this lake. We eliminated as much as possible specific information (from 2.2. and 2.3.) in order to avoid too much overlap or redundancy.

5353 general See general comments above. In section 2.1, e.g.,(a) might contain impacts of phosphorus from domestic sources, silt loads from Sateska, destruction of spring areas (major threats), impact of water abstraction (but no major threat); (b) impact from Albanian mines and solid waste clearly needs further assessment and (c) impact of (former) industry is basically unknown (the PCB in fish could stem from generators, stormwater runoff. ...)

Restructured (see above).

7 This is no longer correct, the GEF document was the basis for the extension of the sewer system in Macedonia. There were also plans for a WWTP in Albania?

This value has been adjusted and cited with a new reference. There is a new WWTP already in Pogradec and the collecting system is constantly enhanced.

The issue of untreated waste water is again mentioned on page 5354, lines 5- 11. Should be combined.

Combined.

10 what do you mean by organic and inorganic matter? BOD and sediments?

BOD and sediments. This sentence has been changed and a new study on the recent sedimentation patterns of Lake Ohrid was cited (Vogel et al., 2010).

5354 16 high PCB concentrations?

Changed to “high PCB concentrations”.

19 56000 tons seems a lot; if we assume about 0.5 m<sup>3</sup>/s of flow from the mine areas (which is a high estimate, considering water balance by Watzin and by Matzinger), av-

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erage waste conc would be around 3.5 g/L. ...realistic? Is the amount dumped directly in the lake?

We agree that this value is likely overestimated. We deleted this citation and now refer to another more general observation published by Watzin et al. (2002).

21 Do the heavy metals reach critical concentrations in the sediments?

In certain patches, heavy metal concentrations seem to be higher than expected from natural resources. Thus, they pose potential threats to mainly benthic biodiversity (citation Vogel et al., 2010).

25 do you expect this to be mainly an aesthetic issue, or pollution?

At first sight, the mentioned situation certainly represents a rather aesthetic issue. Given the amount of trash dumped into the lake (or its tributaries), the issue becomes more serious. Sunken trash accumulates over the years and eventually habitats become altered. Divers observe what they call “plastic meadows” on the ground of the lake. Long-term effects of rotten plastics can not be estimated for the time being. Sanitary landfills are also known as source of pollutions that reach Lake Ohrid via its tributaries.

5355 5 northwest would mostly drain in Crn Drim?

Yes. Corrected.

9 is this really quantified?

This statement certainly is kind of an educated guess. We modified the sentence so it is now clearer that an assumption is stated rather than a result based on real data.

11 kg of what? Fertilizer or N? For N this would be normal to high in Europe, for fertilizer this would be moderate. ...

Sentence deleted.

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8-15 rating curves of rivers usually show importance of domestic sewage, as a result works by Jordanoski, Veljanoska-Sarafiloska and Naumoski typically show highest nutrient loads to Lake Ohrid from small streams dominated by domestic sewage. While agriculture certainly has an effect it seems of less importance (until 2006, at least)

Right, but see chapter 2.3. for this issue. It is now clearer what kind of impact strength we attribute to each threat.

16-17 are these old pesticides still in use (lindan, OP)? Banned long ago in EU

Unfortunately, it is not unlikely the case. We cannot judge and thus more explicitly cited the UNESCO ROSTE report from 2004 as source of this information.

21-22 Has this really been found? “Old” pesticides such as DDT could really accumulate, modern ones (even pesticides such as atrazine, which is also banned in EU by now) are typically well-dissolvable in water and have a much smaller tendency to bio-accumulation (and are much less toxic)

This is just a citation of a rather loose statement. See chapter 3 for another discussion on that issue.

5356 3 Is logging a great/well-known problem?

It is certainly increasing.

7 contamination of what?

Contamination with organically highly polluted wastewater.

12 I received some data from statistical institutes at the time, maybe this is still available (otherwise I am happy to supply the data I had received)

The number of 250,000 tourists for the Macedonian part of Lake Ohrid in 2007 has been included in the sentence. Updated (2008) population numbers have been received from the State Statistical Offices of Macedonia and Albania.

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22-27 These threats seem very vague, both regarding extent and impact. ...should be clarified or put in group (c)...

Clarified.

5357 2-4 Do you suggest that waves are the problem? Waves can get very high at the shore of LO naturally.

The waves mentioned are caused in addition to natural waves. It is also an issue of season (summer), when natural waves are rather few.

10 what is the impact of noise emission (apart from the nuisance to people)

There is certainly an impact on breeding birds. It is unknown but not excluded that breeding fishes near the surface in shallow bay parts are impacted. Remember, that unfortunately often the technical and security standard of the boats and vessels is comparatively low.

12 Section: “non-indigenous species” I thought that establishment of non-indigenous species is surprisingly low. . .is that not true? Would you consider the non-indigenous species as a “time bomb” that could explode under changed environment?

The number of non-indigenous species is increasing. Most are yet restricted to certain spots of the lake. However, a changed environment will certainly trigger the success of invasive species along with increased human activities. These species should be carefully monitored.

5358 15-17 Can the extent of destruction of e.g. reed belts be quantified by satellite imagery or by old records/maps?

Potentially yes, but this is beyond the scope of this study. It is difficult to identify sources for such comparative “old data”. We will keep this valuable suggestion in mind.

5359 19-20 maybe a graph with decrease in fish catch per net (former commercial, now scientific fishing) might be of interest

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Unfortunately, we have no useful comparative data available.

5360 16 “. . .if phosphorus load remains constant and warming. . .”

Changed.

19-22 what kind of impacts do you expect from traffic? Runoff of heavy metals, PAH, oil?

All the mentioned substances can easily enter the lakes sensitive littoral in large stretches of the shores of Lake Ohrid.

Traffic seems comparably low around the lake?

Not anymore during the season at least. It will certainly even increase as living standards are improving both in Macedonia and particularly Albania. We specified it as a likely increasing problem.

24 boat accidents might be very important, for endemic species which exist only in small area. . .

Included.

5361 1-14 Please clarify analysis (see comment above)

Clarified and extended.

3 Activities concerning Lake Ohrid protection

General see comments above, I suggest restructuring and extending this section for better clarity and covering of the aims in the title. In general the existing and past efforts might be shortened a bit

See above. Efforts have been shortened.

5366 19-20 This is not evident, what kind of research do you suggest?

Changed to “. . .regarding the impact of recent and future climate change on both the

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ecosystem and species communities and single species.”

#### 4 Status quo and future of lake Ohrid and its biota

General while being well-written, some of the information is already in section 1 or 3. I suggest combining all info on actually observed impacts on species

This chapter does not exist anymore (see above).

#### 5 Conclusions

General see some comments above. Should also be slightly adapted depending on section 3. For instance, it would be nice to contain a short bulleted list on major threats and possible solutions (now partly in the text)

There is now a new Table 3 major threats and possible solutions. The text has been adapted accordingly (see above).

Based on the text and some background I would judge the following threats as well-known and high impact: Domestic waste water (phosphorus), silt from River Sateska, Fishing, Habitat destruction (littoral, reed belts, spring areas). Potentially high impact but uncertain might be (among others) global warming, pollution with hazardous substances (from mines, former industry, agriculture), non-indigenous species. . . .

We agree and stated these threats explicitly in the conclusions section.

16-23 I suggest splitting research needs from conservation needs.

The needs are now split from each other.

#### Tables & Figures

Table 1 The calculation of averages without zero scores does not make sense. E.g., class 3 has now very high impact, but would be lower if moderate oil and gas drilling would exist on Lake Ohrid! Impact is subjective. . . . Domestic & urban waste water is definitely more severe (and better known) than agricultural or industrial effluents. . . .

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We completely agree and recalculated all relevant average scores. In addition, a column was included that gives the maximum scores of each category.

### 3) Technical corrections

The manuscript is very well edited, so I have very few remarks concerning language or technical aspects.

page line

5348 14 ...threats to (endemic) biodiversity of Lake Ohrid

We prefer to leave it as it is.

5350 26 irrigation instead of agribusiness?

Changed.

29 as has been registered recently

Changed.

5353 2 in Figure 1 referred to as Pogradeci River, River Verdova and Grasnica are missing in Figure 1

All mentioned rivers are now in Fig. 1

12 Hoffmann 2010 is missing in ref list

Changed to "Hoffmann, pers. comm., 2010"

5356 3 ...are cause for concern

Changed.

19 maybe clarify: permanently inhabited settlements

Clarified.

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5357 7-8 Suggestion: “This is very important for endemic cyprinid fish species, which spawn at ...”

Adopted.

5358 27 Please indicate where Studencisko blato is located

Now with indication and in figure 1.

5367 25 lakes Ohrid and Prespa. ...(?)

Changed to “lake”.

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Interactive comment on Biogeosciences Discuss., 7, 5347, 2010.

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