

## Review of Manuscript Number: bg-2010-159, submitted to BG

### Title:

A freshwater biodiversity hotspot under pressure – assessing threats and identifying conservation needs for ancient Lake Ohrid

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### 1) General evaluation:

A concise listing of threats and conservation needs for the unique endemic fauna and flora of ancient Lake Ohrid is long overdue and an important contribution to future protection and research activities on this important lake watershed. Since the manuscript presents a (very elaborate !) review of known, expected and potential issues for this lake ecosystem, rather than a strictly scientific approach it is placed very well within this special issue of biogeosciences on the Balkan lakes Ohrid and Prespa. The value of the contribution lies also in the combination of information from scientific literature as well as local sources not available to most readers.

I see the main contribution of the work (also following the title) in (i) the systematic identification of potential threats, (ii) the identification of gaps in knowledge on these potential threats and (iii) suggested counter-measures. However, I recommend that the structure and content of points (i) to (iii) be improved to increase the impact of the paper. 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 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. 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).
- 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. 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.

#### *(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.
- 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 (a) existing measures, (b) necessary further research/assessment and (c) suggested measures (at least for well-known threats). Institutional responsibilities (section 3.1) could then be excluded as an extra chapter. In general the part on existing activities (which now dominates section 3) could be shortened.
- Section 4 is not so clear in the general structure. 4.1 has some information, which was 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 contains all info on impacts on species (now in 4.1 and 1). Section 4.2 steers towards actual conservation needs and might thus be partly included in new section 3.
- 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.

So, in summary the paper is of high interest to researchers and practitioners dealing with Lake Ohrid. In my opinion, one issue with conservation efforts in the past was the attempted integration of many important aspects in a very general form, which turned out to be difficult to handle. As a consequence, this paper could have great value in breaking down the problems of Lake Ohrid into pieces which can be handled by future efforts.

As a result I would like to greatly encourage the authors to improve their manuscript as suggested above, since clearer structuring of threats, associated knowledge gaps and counter-measures may not only render the manuscript more readable but also more useful for future, problem-oriented research projects and protection efforts of Lake Ohrid.

## 2) Specific comments

page	lines	
<i>Abstract</i>		
5348	1-7	I suggest skipping the introduction in an abstract
	8	“the” European suggests it’s the only European biodiversity hotspot? Maybe change for “a major”
	21-24	The IUCN classes are not very intuitive. I suggest listing the best known threats with highest expected impacts
	24-28	This is the outline of the paper, should not be in the abstract
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)
<i>1 Introduction</i>		
5351	5	“the” European biodiversity hotspot, see above
	21-end	I suggest adding or including research needs (since you cover it in the text)
<i>2 Threats</i>		
5352	21-24	The distinction between (1), (2) and (3) should be clarified, since (1) is typically caused by (2) and (3)....
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....)
	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? The issue of untreated waste water is again mentioned on page 5354, lines 5-11. Should be combined.
	10	what do you mean by organic and inorganic matter? BOD and sediments?
5354	16	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), average waste conc would be around 3.5 g/L....realistic? Is the amount dumped directly in the lake?
	21	Do the heavy metals reach critical concentrations in the sediments?
	25	do you expect this to be mainly an aesthetic issue, or pollution?
5355	5	northwest would mostly drain in Crn Drim?
	9	is this really quantified?
	11	kg of what? Fertilizer or N? For N this would be normal to high in Europe, for fertilizer this would be moderate....
	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)
	16-17	are these old pesticides still in use (lindan, OP)? Banned long ago in EU
	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)
5356	3	Is logging a great/well-known problem?
	7	contamination of what?
	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)
	22-27	These threats seem very vague, both regarding extent and impact....should be clarified or put in group (c)...
5357	2-4	Do you suggest that waves are the problem? Waves can get very high at the shore of LO naturally.
	10	what is the impact of noise emission (apart from the nuisance to people)
	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?
5358	15-17	Can the extent of destruction of e.g. reed belts be quantified by satellite imagery or by old records/maps?
5359	19-20	maybe a graph with decrease in fish catch per net (former commercial, now scientific fishing) might be of interest
5360	16	"...if phosphorus load <b>remains constant</b> and warming...."
	19-22	what kind of impacts do you expect from traffic? Runoff of heavy metals, PAH, oil? Traffic seems comparably low around the lake?
	24	boat accidents might be very important, for endemic species which exist only in small area....
5361	1-14	Please clarify analysis (see comment above)

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

### *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
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### *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) 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....
	16-23	I suggest splitting research needs from conservation needs. The suggestion of protection areas is very interesting

### *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
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waste water is definitely more severe (and better known) than agricultural or industrial effluents....

### 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 <b>of Lake Ohrid</b>
5350	26	irrigation instead of agribusiness?
	29	<b>as</b> has been registered <b>recently</b>
5353	2	in Figure 1 referred to as Pogradeci River, River Verdova and Grasnica are missing in Figure 1
	12	Hoffmann 2010 is missing in ref list
5356	3	... <b>are</b> cause for concern
	19	maybe clarify: <b>permanently</b> inhabited settlements
5357	7-8	Suggestion: "This is very important <b>for endemic cyprinid fish species, which</b> spawn at ...."
5358	27	Please indicate where Studencisko blato is located
5367	25	lakes <b>Ohrid and Prespa</b> ....(?)