Review of Mgr. Jan Altman PhD thesis

Tree-ring reconstruction of forest disturbances: evaluation of methods and past changes on forest dynamic

PhD thesis of Jan Altman deals with interesting and important topic of applying dendroecological methods in reconstruction of forest dynamics in Central Europe, Korea and Japan. PhD thesis consists of six chapters and four papers. Three of the papers in the thesis were already published and Jan Altman is a first author on all of the papers. Mgr. Altman has shown in his thesis high level of scientific skills.

Below I provide the list of comments to presented thesis.

Chapter 1

1. Chapter 1 focuses mainly on technical aspects of the dendroecological reconstructions of past disturbance dynamics. However since the presented thesis focus also on the important ecological questions as for example in Chapter 5, which focuses on the effects of disturbance severity on the tree diversity in the Japan. Therefore this introduction part would benefit if short focus on those topics would be also presented.

2. I personally miss in this review deeper insight into the general disturbance theory reconstructed by dendroecological methods. Many papers have shown, that not only release, but also open canopy recruitment (gap recruitment) represents important pathway how tree access the canopy. Focusing only on releases could therefore present a bias in the disturbance reconstruction.

3. Freelich and Lorimer who are often considered as a "guru" of dendroecology used other approaches which should avoid biases in the disturbance reconstruction. For example they have used to define: canopy accession events and also construct the disturbance chronology not based on the number of trees but amount of disturbed canopy. Could you comment on those and explain advantages and disadvantages of those approaches?

Chapter 2

Very nice paper and tool which will help many researches. How does it work with the analysis of the tree growth pattern and tree recruitment? The papers shows example of four "ideal" tree growth pattern, but it is really so simple and all tree falls into those categories? For the analysis of the tree establishment, what does it tell us and how does this differ from the open canopy recruitment?

Chapter 3
Very interesting contribution to our understanding of this traditional type of management on the forest dynamics, especially on the growth dynamics of the oak trees. Could you clarify how the oak standards have reacted to the coppicing? It is possible that the oak standards were in the canopy with bellow layer of the young sprouts and then when the sprouts were removed, they have reacted with major release? This would mean that major in this case of oak trees was not caused the removal of the overtopping trees but by the removal of the competing lower layer vegetation? What kind of implications this could have for disturbance history reconstruction?

Chapter 4
This is very nice study published in high quality journal. Why only oak trees were analyzed in the presented study? Were the studied forests single species forests or were they more similar to forests analyzed in Chapter 5?

Chapter 5
This study was not published yet, so I will concentrate on it and provide more detailed comments.
1. What kind of conclusion can be made from single 1 ha plot in case of studied phenomena? How would be possible to overcome such a problem?
2. The chapter 4 presented increase typhoon severity in the past 100 years. Does the analyzed plot support this evidence?
3. You have applied one type of criteria to wide spectrum of tree species, which probably include also wide variety of the light requirements. Given the review in the Chapter 1, how this could affect your results?
4. You have analyzed the recruitment age, but why only this, and not open canopy recruitment for the disturbance reconstruction? How do these two types of analyses differ? If you would analyze the growth pattern of the recruiting tree, you would be able to distinguish, whether they have established below the closed canopy or open canopy – would this help with interpretation of your results?
5. Fig. S1 clearly shows a shift in the species composition in the studies plot? Or if not a shift in species composition, lack of recruitment of oak, which was the dominant canopy species in the forest? Since there are not basic structural data presented in the paper, it is difficult to conclude how the current structure of the stands looks like. How do you explain the lack of oak recruitment in the last 150 years and how this could fit to story which you tell? Fig. S1 shows species "Ps", but this species in not listed below the figure? The color which you use in this figure does not really allow distinguishing between the species, since some of the colors have similar shade.
6. Could you briefly describe your conceptual Fig. 6? I do not get the point you are trying to make with this figure.

Chapter 6
I have no comments for the final concluding chapter.

Conclusions
Phd thesis of Mgr. Jan Altman fulfills all the requirements and therefore after successful defense I recommend the thesis for acceptance.

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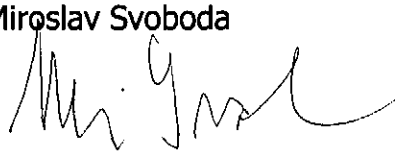

Review of Altman PhD thesis: Tree-ring reconstruction of forest disturbances: evaluation of methods and past changes on forest dynamic

I have thoroughly read Jan Altman's PhD thesis and can conclude that this work is worthy of defense. Jan's work demonstrates both breadth and depth involving both methodological and empirical work. His empirical work, in particular, covers a large biogeographic region, by applying dendroecological methods in Central Europe, Korea, and Japan. This experience has undoubtedly given Jan a broad appreciation of general forest process and pattern, which is a valuable asset for PhD level work. I also believe that his work in Asia on typhoon disturbances represents an important empirical contribution to the literature on disturbance-forest dynamics and global change-forest dynamics. While most of the thesis has already passed the criticism of international peer review, below I list a number of comments that Jan may think about in both defending his PhD and in his future work on the topic.

Chapter 1.

Page 3: I would be careful about underemphasizing the interest in tree age; often the age structure of a forest can reveal more important information about past dynamics than growth patterns, depending on the forest type and disturbance regime.

Page 12, 2.7: I agree that sampling design in dendroecological work is crucial, and likely to be even more important than the approach used for release detection, which is covered in great depth in this thesis. As such, I was a bit surprised that more attention was not given to this in section 2.7. I find a good reference regarding sampling concerns to be Lee Frelich's book (Forest dynamics and disturbance regimes, 2002). Plot size, plot number, placement of plots, which trees to core and how many, etc. These decisions are very important and need to be linked to the study questions; there are no universal rules here, other than more plots and more cores are better in heterogeneous forests with complex disturbance regimes, yet this is almost never possible, so sampling always involves tradeoffs.

Page 14, 2.8: I am grateful that you pointed out the importance of visually checking cores from the automated output of release detection. I have found this to be very important in my own work. However, it is very important to check each core independently from the others to ensure that a bias does not develop from an emerging pattern of synchronous releases in a sample.

There are several very important methodological concerns that are either missing or given very little attention in the introduction and in the empirical work done for the thesis. They include distinguishing "canopy accession" from general releases, rapid early growth in gaps as evidence of disturbance, and the belief that major and moderate releases indicate disturbance intensity or gap size. Below I briefly describe each of these.

1). Canopy accession: The vast majority of release based reconstructions of disturbance history simply use the number or percentage of releases in a sampling area and report this data in a chronology. This is perfectly fine, but it is essential to note that this approach gives an overestimate of actual disturbance severity if no care is taken to remove releases from canopy trees caused by removal of neighboring trees.

In other words, if one canopy tree dies in a disturbance, all the other canopy trees around it may react with a release, thereby inflating the number of releases in a chronology. Typically, what we are interested in is a better estimate of the area damaged in a stand, or the number and size of gaps created. This can be approximated with releases if one if careful to only include releases that indicate canopy accession, namely, releases that occurred in suppressed understory trees after an overtopping canopy tree was removed. This is typically done by only counting the first release before a tree reaches a diameter threshold when there is high probability that it is already in the canopy. This approach was developed by Frelich and Lorimer and is well documented in several papers.

2). By the same reasoning used above, many trees (especially shade intolerant spp) in a forest access the canopy as newly established seedlings in gaps that are never closed by neighboring trees. As such, the age of these trees should be included as a canopy accession event and be treated the same as a release. Not doing so would potentially underestimate disturbance or cause confusion where trying to interpret tree recruitment patterns in relation to past disturbance.

3). Moderate and major releases: While many studies split the magnitude of releases into major and moderate, most of this is simply doing what others have done before without really thinking if it's ecological meaningful. In my own work, I have found this split to be of no use when reconstructing disturbances and at worst, it can be misleading. For example, it is more likely that moderate and major releases have much less to do with gap size than the individual situation of each tree regarding its position in the stand relative to the gap, the amount of diffuse and direct light it receives, its neighboring competitors, etc. A poll sized tree without neighboring competitors that is suppressed below the canopy may respond with a major release if the tree directly above it is removed, even if the gap is small. In contrast, many large gaps created over a stand from a higher severity event may cause moderate releases of trees growing in the shaded understory simply by increasing diffuse light levels. In short, I think this distinction is misleading and not necessarily a good proxy for gap size or disturbance severity. Using an approach based on canopy accession with mapped trees would be a better way to reconstruct gap sizes.

Chapter 2.

This is a very useful too for the dendro community.

Chapter 3.

This study on coppice history facilitating recruitment of oaks is a nice empirical study of how this historical process maintained oak. There seems to be mounting evidence that oak would have a hard time coexisting in European forests without either relatively severe natural disturbances or significant human intervention.

Chapter 4. The typhoon study is nicely done, particularly because it examines a latitudinal gradient and connects real meteorological data with disturbance history data from tree rings. After reading the paper, my main question is what does this mean for forest community dynamics? Will there be a shift in composition if either

the frequency or intensity of these events increases? I realize this is not part of the study, but this is what we really want to know.

Chapter 5.

This study is perhaps the most interesting of those carried out in the thesis, yet I also find the conclusions to be the most unsupported. Briefly, I have doubts about relying too much on the distinction between moderate and major releases as indicators of gap size, even with the mapped data and spatial analyses. The conclusion that large gaps may facilitate increased competition from bamboo and inhibit tree regeneration is interesting and novel for bamboo dominated forests, but it is very risky to make such a general statement from one 1 ha plot. What is interesting is that the authors could have easily employed a canopy accession approach and reconstructed the size of gaps created during past disturbance events given that they had mapped tree locations. I find it a bit odd that this was not done in such a way as it would be a much more robust indicator of past gap size. Nonetheless, I think this is an interesting study with potentially important findings, but the caveats should be addressed.

Chapter 6.

The synthesis is good.

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Ljubljana, 28.11.2014

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The review of Ph.D. dissertation of Jan Altman titled "**Tree-ring reconstruction of forest disturbances: evaluation of methods and past changes on forest dynamic**"

Jan Altman's dissertation consists of 6 chapters. Chapter no 1. gives the general introduction to the topic of the whole work. Following chapters are 4 separate articles:

1. **Altman, J.**, Fibich, P., Dolezal, J. & Aakala, T. (2014) TRADER: a package for Tree Ring Analysis of Disturbance Events in R. *Dendrochronologia*, **32**: 107-112

2. **Altman J.**, Hédl R., Szabó P., Mazůrek P., Riedl V., Müllerová J., Kopecký M. & Doležal J. (2013) Tree-rings mirror management legacy: dramatic response of standard oaks to past coppicing in Central Europe. *PLoS ONE* **8(2)**: e55770

3. **Altman J.**, Doležal J., Černý T. & Song J.S. (2013) Forest response to increasing typhoon activity on the Korean peninsula: evidence from oak tree-rings. *Global Change Biology* **19**: 498–504

4. **Altman J.**, Dolezal J., Fibich P., Leps J., Uemura S. & Hara T. Impact of typhoons on forest dynamic over 230 years: spatiotemporal analysis of past disturbances and tree Establishment (submitted manuscript)

The last 6th chapter presents conclusions of the whole dissertation.

The General Introduction is very informative. In the beginning the author describes dendrochronology as a scientific discipline, which is based on the analyses of tree-rings. The rest of the Introduction in the major part is related to the methodology. The author presents a detailed review of the methods which have been used for the determination of past

disturbances. In the literature there are a lot of examples how to detect the disturbances in the tree ring series. An abrupt increase in tree-ring width is called release and often indicates a disturbance event. The author not only gives examples of many procedures of calculation of releases but also shows the evolution of these techniques. He presents a critical evaluation of the methods. The limitations of the methodology are discussed as well. The procedures which are sometimes quite complicated have been presented in a very clear form and in details.Their description can be treated as a useful manual.

The whole Introduction is strongly dominated by methodological description and considerations. What is missing in this part of dissertation is a broader ecological context. Why the knowledge of disturbance history is so important? How different types of disturbances, different intensity and frequency influence the forest structure and forest dynamics. What are conceptual models of forest dynamics? Some answers are already presented while discussing dendrochronological techniques, but in my opinion these aspects should be emphasized in a separate sub-chapter of the Introduction. Something like a "disturbance in forest ecology" sub-chapter should present an ecological background.

The first paper published in Dendrochronologia describes a new, interesting tool for dendroecological analyses called TRADER (Tree Ring Analyses of Disturbance Events). This is an open source software package for statistical program R. TRADER was developed by the Jan Altman and co-authors to provide an analyses of tree growth history, and especially to reconstruct disturbances. The whole idea of the detection of past disturbances in tree-rings is not new. It is rather well documented conception based on the assumption that tree which survives a disturbance (windthrow, fire etc.) grows better in subsequent years due to decrease of competition. Such an event is visible in tree-ring series as a release. The problem is when to define an increase of radial growth as a disturbance. The paper by Rubino and McCarthy published in Dendrochronologia in 2004 presents a review of 30 various methods used by different researchers for the detection of disturbance events. The later publications show another several methods. These papers inspired Jan Altman and co-author to prepare a practical tool which enable a fast calculation of releases according to these different definitions. The most useful in dendroecology are methods developed by Nowacki and Abrams (1997) and Black and Abrams (2003) as well as later published an absolute increase method by Fraver and White (2005), and radial growth averaging combined with boundary line presented by Splechtna et al. (2005). All these techniques are imported to the TRADER. The program enables the fast calculation of releases and their comparison among different

methods. The software is described in details and clearly. The way the authors consider the most important and crucial methodological problems of calculation of releases shows that they are very familiar with the topic. In my opinion there is a high probability that the program created by Jan Altman and his co-authors will become soon a standard procedure in dendroecology and it will be commonly used for the reconstruction of disturbance history based on releases.

In the second paper, the authors presented the reconstruction of the history of the coppice woodland dominated by hornbeam and oak in southern Czech Republic. They used mentioned above method of Black and Abrams (2003) for the detection of releases to determine coppicing events. Past coppice harvest was then linked to the changes in the forest: recruitment of oak and growth of neigbouring trees. They confirmed by the tree rings the coppice cuttings known from historical sources in years 1895 – 1899 and 1935 – 1939. The increase of growth of newly recruited oaks was observed after these events. Decrease of competition for light and water after coppice events were responsible for the growth increase but also for the oak recruitment. Interesting conclusion concerns the probable high contribution of man management in preservation of oak in the European forests. This idea, that oak is a species closely related with human activity was confirmed also from the other forest complexes like Białowieża Primeval Forest in Poland.

The authors indicate a limitation in light access as a main factor of decline of oak recruitment. Maybe it would be worth to complete the discussion with the presentation of the other potential factor that could influence the regeneration process. Grazing animals in the past and ungulates in last decades could be important element. In relatively warm and dry conditions the anthropogenic or natural fires could contribute the oak regeneration in the past as well. Is there any information about the fire history in the region? It would be also interested to know the frequency of mast years.

Next two papers present the results of studies conducted in East Asia forests, respectively in South Korea and Japan. The topic of the first one was to examine how three weather characteristics related with typhoon activity: maximum hourly and daily precipitation and maximum wind speed affected old-growth oak forests. The study was conducted in three plots from south to ~~east~~ north of South Korea reflecting the decrease of typhoon activity. The trends in the reconstructed release events corresponded to spatiotemporal gradients in maximum wind speed and precipitation. A high positive correlation was found between the maximum

values characteristics and the proportion of trees showing releases. A higher proportion of disturbed trees was found in the middle and southern part of Korea, where the intensity of the typhoon is the highest. The tree-ring reconstruction showed that the rate of disturbances increased rapidly in the last century (1880 – 1979). This suggests that the disturbance regime of forests may be changed considerably in the future. The authors showed that frequency of typhoons is not the main factor affecting forest structure. The most important is typhoon intensity. This is an excellent example where the authors demonstrated the high potential of tree-ring analyses in the study of climate change scenario.

When making a reconstruction of natural disturbances on the basis of releases in tree rings there is always a concern if study site is really natural, without human influences. I understand that releases were most likely related with typhoon activity (because of correlation between these variable) but I am wondering how the authors "can certainly exclude human disturbances" in a densely populated country, where wood was always a base material? In relatively warm and humid climate cut stumps or logs can decay probably quite fast and blur the signs of past human activity e.g. selective cuttings.

The last paper (enclosed in a form of manuscript) presents a reconstruction of forest dynamics under typhoon regime in Hokkaido Island in Japan. For several reasons it is a very interesting work. The authors survey quite complicated system: multispecies forest composed with deciduous broad-leaved species and conifers with the total number of 19 tree species. Stand is influenced by the disturbance factor of different intensity and various severity. Additionally the regeneration is strongly obstructed by specific ground cover – dwarf bamboo. Tree-ring reconstruction covers relatively long period over 200 years. Spatial pattern was analyzed as well on the area of 1 ha of permanent plot. The authors identified four main severe and intermediate disturbance periods followed by higher rate of tree establishment. Spatial pattern analyses showed that higher density and diversity of recruitment was associated with small gaps and undisturbed forest, while large gaps were dominated by dwarf bamboo instead of tree recruitment. This is a very important result, because it shows the negative dependence between severity of disturbance and the extend and diversity of forest regeneration. It may be very significant finding, especially as many climate change scenarios predict an increase of typhoon severity.

Discussion is quite long and touches many different aspects. The work would benefit if the main conclusions would be emphasized in a separate "conclusion" chapter in the end. The diagram presenting the long-term forest dynamics is very informative and helpful in the

understanding the author's conception. The authors mentioned about the importance of dead wood for the regeneration process, but in my opinion too briefly. It has been documented that elevated stumps and logs are very often the only substrate accessible for the recruitment in the forest dominated by dwarf bamboo. This aspect could be discussed more in details.

Such a complex and well designed study as presented in Jan Altman's paper is definitely rare in the ecological literature. I am sure that manuscript will be published soon in a good journal. The manuscript needs still some editing like the mean temperature of winter months is given in Fahrenheit or should be 11,5 degrees below zero (page 65).

In this review I would like to underline a very good selection of references in all papers. Jan Altman and co-authors based their work on a current state of art. They cite mostly very fresh publications and all the most important "classical" papers.

Papers (except the submitted one) were published in good, high impact journals, indexed by the most popular databases. This guarantees reliable peer review process made by at least several competent referees and editors.

According to the JCR "**Global Change Biology**" is classified in three categories and in all it is ranked in the first quartile. It is ranked in 1, 6, 4 position in categories respectively: Biodiversity Conservation (number of journals in category - 42), Ecology (141) and Environmental Sciences (216). It means that on the bases of bibliometrics this journal represents top level of scientific titles.

"PLoS ONE" is a new, internet platform publishing papers on very broad topic. It is one of the peer reviewed journals which publishes the highest number of articles, thus it is not very selective. However high impact factor (3.534) and open access form make this journal very influential. In Journal Citation Report it is classified in the category "Multidisciplinary Sciences" in 8^{th} position (number of journals in category – 55).

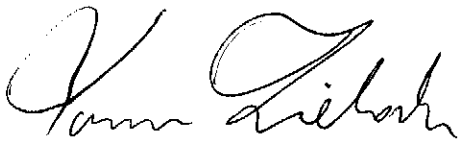
"Dendrochronologia" (IF = 1.697) is ranked in 16 place for 64 journals in the category Forestry. This is the most important and "classical" journal for dendrochronologists.

The best measure of the influence of the publication on science is the number of citations. Papers from this dissertation are too recent to be cited frequently, however, two of them from 2013 have been already cited in Web of Science 4 and 7 times for respectively Global Change Biology and PLoS ONE. This is a very good result for a first year of their life.

Conclusion

After studying Jan Altman's dissertation I have no doubts that he demonstrated very high skills in scientific work. He is the main, correspondence author of 4 publications responsible for the writing and all consecutive steps of experiments. Jan Altman showed a competence to analyze data, to present results properly and to lead essential discussion. Finally, his work was evaluated positively and accepted by the excellent, international and high impact journals. His work makes a significant contribution to the science. During his PhD studies Jan Altman was working with an excellent researchers in international environment. He not only had a chance to increase his scientific experience but also he exhibited good cooperation skills which are very important in the modern science.

I recommend Jan Altman's Ph.D. dissertation to the further stage of defence.



Kraków, 29.11.2014

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