Palynological reconstruction of 1700 years vegetation dynamics in suburban Urmia, northwestern Iran: the role of climate and humans

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Extended Abstract
Introduction
Palynology is the most important biostratigraphic tool for Quaternary palaeoecology (Ortu et al., 2008), but until now data to reconstruct past environmental conditions in northwestern Iran are only available fragmentarily. This paper provides new palynological insights on the Late-Holocene vegetation history of Urmia as a function of climate and anthropogenic impact.

Materials and Methods
The study site, the Ganligol (Fig. 1; GNL; 37°35'34.7" N; 45°06'43.6" E) wetland near Urmia city, consists of a central shallow lake with marginal peat deposits. Half the lake surface is covered with *Potamogetoncrispus* while the marginal vegetation is predominantly of *Sparganiumerectum*, *Typha* spp. and *Phragmitesaustralis*.

A 5-m core was retrieved from the northern section of the site in 2013 using a Russian type chamber corer. This paper presents the palynological results of the upper 2.6 m. Palynological samples (0.5 cc) at 10cm intervals prepared following Fægri and Iversen (1989). Counting was carried out with an Olympus CX31 microscope with 400x magnification. Pollen-morphological types are displayed in the text by small capitals in order to distinguish them from plant taxa (Joosten & de Klerk, 2002). Pollen and spores were identified following Moore et al. (1991) and

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Beug (2004). The computer program Tilia 1.7.16 (Grimm, 2011) was used for calculating and presenting the palynological data.

The pollen percentage ratio C/A (Chenopodiaceae/Artemisia) was used as a rough index for reconstructing the dry and wet phases in the area (cf. El-Moslimany, 1990).

For age determination, two samples were sent to the AMS radiocarbon lab of National Taiwan University (Table 2). Radiocarbon ages were calibrated into calendar years BP (calBP) with the Bacon 2.2 package (Blaauw & Christen, 2011) using IntCal13 (Reimer et al., 2013).

Results and Discussion

Based on the Bacon age-depth model, the record approximately covers the last 1700 calibrated year BP. In average, 185 pollen grains originating presumably from upland vegetation (AP+NAP) were counted per sample depth. The entire record is overwhelmingly composed of Chenopodiaceae(C-A) and to a lesser extent Artemisia. The arboreal pollen mainly comprised of Quercus shows very low or virtually no values in all the records. Among the wetland pollen types, Poaceae and Cyperaceae prevail in most spectra. The GNL pollen record (Fig. 2) was visually divided into three pollen assemblage zones and one sub-zone as follows:

GNL-A (260-175cm; 1700-1121calBP) is characterized by high values of Artemisia in the midst of the zone and of C-A, particularly in the lower and towards the upper parts. Wild grass group and Cyperaceae are abundantly present. C/A ratio is ranged from 0.5 to 1.

In zone GNL-B (175-95cm; 1121-579calBP), AP disappears in the lower samples and then produces a small peak in the middle. Artemisia abruptly declines both in the onset and close to the upper boundary of the zone. Single grains of Juglans and Plantagolanceolata were encountered. Rumexacetosa produces a prominent peak in the middle of the zone, where Senecio and Lactuceae are also abundant. C/A ratio varies between 3 and 6.

GNL-C (the upper 95cm; since 579 calBP), may be divided into two subzones, GNL-C1 and GNL-C2. In the first subzone (95-35cm; 579-168calBP), C-A remains the most ubiquitous pollen type. Artemisia is the second most abundant type. Quercus and Centaureasolstitialis create continuous low-value curves. Cyperaceae produces prominent peaks in the lower half, where Typhalatifolia shows trivial increase, but gradually decreases towards the upper subzone boundary. Close to the border of the next subzone, Senecio reaches its highest values throughout the entire record. C/A values are ranged from 2 to 3.5.

Subzone GNL-C2 (the uppermost 35cm; since 168calBP) is distinguished from the lower subzone by higher values of C-A. Artemisia progressively decreases towards the topmost sample. Remarkable is the peak value of Plantagolanceolata in the mid-part, where Ribes rubrum and Plantagocoronops slightly rise. Both Poaceae and Cyperaceae prevail in the lower spectra. Lemna makes a conspicuous peak near to the uppermost spectrum. Another important constituent of this subzone is Lactuceae. C/A ratio fluctuates between 3 and 7.

The overall high values of Chenopodiaceae and Artemisia indicate that their corresponding taxa must have been important components of the vegetation in suburban Urmia over the last 1700 years. However, changes in regional and local vegetation have been frequently recorded and can be interpreted as the changes in climate, local hydrology, and human impact. The rather low values of the C/A ratio during the period 1700-1121 BP may indicate a relatively wet period. A similar wet condition has been postulated for southwestern Lake Urmia (Talebi et al., 2016), Lake Nar in central Turkey (Woodbridge & Roberts, 2011) and central northern Iran (Ramezani et al., 2016). Alternatively, Djamali et al. (2009a) addressed a comparable increase of Artemisia in Almalou site (NW Iran) to the intensified agro-sylvo-pastoral practices during the Sasanian Empire. The replacement of Poaceae by Cyperaceaeat around 1430 BP not only indicates a prominent change in wetland vegetation composition but also a hydrological change in the wetland system. A change in the lithology of the core, i.e. the input of clastic material into the sediment (Table 1), may indicate more human activity in the catchment of the wetland.

The substantial rise of Chenopodiaceae (C/A=3-6) and the disappearance of AP pollen in the first half of the next period (1121-886BP) presumably refer to climate deterioration. El-Moslimany (1990) claims that a C/A ratio above 4.5 may indicate increased aridity in western Iran. Talebi et al. (2016) similarly proposed a cold and dry environment for southwestern Lake Urmia for the period 1100-850 BP correlative with the Medieval Climatic Anomaly. Anthropogenic activity in the area is evidenced by findings of Juglans pollen and a prominent peak of Rumexacetosaat 830BP.

The more frequent occurrences of Centaureasolstitialis, Juglans and Plantagolanceolata pollen during the period 590-180BP probably indicate intensified human impacts in the area. The re-expansion of reeds in the wetland fringes, possibly following a fall in water level, can be inferred from the substantial values of Cyperaceae, and, to a lesser extent, of Typhalatifolia and Sparganiumerrectum pollens.

The substantial decline of Artemisia since 180BP while Chenopodiaceae still maintains its predominance may refer to progressively increased aridity (C/A ratio: up to 7) in the most recent time. This, together with rather high values of Lactuceae pollen, is signals of development of steppe-desert vegetation in the area. However, recent intensification of human impacts, as evidenced in this record by the prominent peak of Plantagolanceolataat ca. 110BP which is further supported by other studies in northwestern Iran (e.g., Talebi et al., 2016), undoubtedly has been a major driving force in shaping landscapes in the area.

Conclusion

Our pollen records provide information on the Late-Holocene vegetation dynamics of suburban areas of Urmia city under the influence of climate change and human impact. *Artemisia* and chenopods must have the major constituents of regional vegetation in the entire period covered by the records, while sedges, grasses and other reeds have shown to be the most abundant wetland plant taxa.

Keywords: anthropogenic activity, holocene, palaeoclimate, pollen ratio, vegetation history.