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Hydrology and Earth System Sciences Discussions

Interactive comment on "Groundwater surface water interactions through streambeds and the role of phreatophytes in identifying important recharge zones" *by* T. S. Ahring and D. R. Steward

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We appreciate the comments from Referee #2 who said that the study was interesting with the caveat being the limited number of wells employed. The referee's comments have been addressed as follows:

Comment #1: The serious caveat of the study is the limited number of wells employed and the resulting groundwater elevation field. Further, it is not mentioned what readings of the wells were used. If summer values are used, they are biased due to the potentially significant localized drawdowns due to irrigation. Rather, winter readings

are much preferred. But truly, the number of wells, as shown in Fig. 1, has low well density per square km (way less than one, guessing from the number of dots). The authors subtract surface elevation from a 30m DEM and the krigged groundwater elevation values with a sampling distance of, maybe a mile (at best), on average. This subtraction may generate large errors. Is there any way to increase the number of wells within the valleys? Typically the river valleys have a much higher number of wells than other areas simply because irrigation tends to exploit the advantages of shallow water table.

Response: The observation wells used to generate the groundwater elevation field were chosen by the Kansas Department of Agriculture, Division of Water Resources so that water table elevations could be accurately mapped. It certainly would be ideal to have more wells, but it is impossible to go back in time and place additional observation wells in 1965, and cost-prohibitive to place them today. The observation well network used for this project still provides what is by far the most accurate water level data on the High Plains Aquifer. These water levels typically change gradually over distance, especially in an unconfined aquifer composed of coarse sand/fine gravel like the Ogallala, so we believe we did the best we could with the data we have. All readings of the wells occurred during the winter recovery period as documented in response #4 for reviewer #1 to minimize the impact of drawdown during irrigation season on the water level readings.

Revision: The manuscript has been modified as requested, with new wording documented in the change #4 for reviewer #1.

Comment #2: Maybe this resolution issue results in finding that phreatophytes flourish in areas with a depth to groundwater more than 20 m!

Response: This study did not identify any areas where phreatophytes flourish in areas with a depth to groundwater greater than 20 m. Line 25 on page 7622 states that at study sites 5 and 6, the trees did not redistribute closer to the river because the

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distance to groundwater beneath the river is greater than 20 m, so there is no significant advantage of a phreatophyte to grow there. Also, the table in Fig. 5 shows no areas with a depth to groundwater greater than 15 m without very great canopy declines, and only one area with a depth to water greater than 10 m without any canopy decline. There were some individual tree locations identified in areas with very great depths to groundwater, and one explanation of this is the possibility of perched conditions in the alluvium.

Revision: The manuscript will be changed as suggested by this reviewer to add the following at the end of page 7622.

"This pattern of low tree numbers in regions with large depth to groundwater is observed throughout much of the study region, and locations where phreatophytes continue to exist with large drops in groundwater elevation suggest the presence of perched conditions in the river alluvium."

Comment #3: Pg. 7619, line 10 with the 1975 photographs needs clarification about color. Were these black and white photos, or in color?

Response: Those photographs were black and white.

Revision: The authors recommend clarifying that the 1975 photographs were black and white on this line.

Comment #4: Claim on pg. 7616, lines 9-10 "The rate of recharge to the Ogallala Aquifer is low . . ." is inaccurate. For example, the Sand Hills of Nebraska is a vital and large part of the Ogallala aquifer, with "high" rate of recharge. A recent study by Szilagyi et al. (2012) in J. Hydrogeology (DOI 10.1007/s10040-011-0769-3) shows a detailed map of estimated net recharge distribution in the Sand Hills, which is very

Response: The authors agree that this statement is vague and that while the recharge rates are low in the study region, as already documented by the reference to Sophocleous, it significantly larger in other regions.

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Revision: The authors recommend changing the line to add the following,

“such as our study site, even though significantly higher recharge occurs in other locations of the Ogallala Aquifer, such as the Sand Hills of Nebraska (Szilagyi et al. 2012).”

Comment #5: The title could be shortened by dropping the “through streambeds” and “important” terms.

Response: The authors agree with this suggestion.

Revision: The authors recommend changing the title as proposed.

Comment #6: Sentence “The distribution of root depth to water . . .” (pg. 7623, line 1) should be clarified. Groundwater?

Response: The authors agree.

Revision: The authors recommend changing “water” to “groundwater” in this sentence.

Comment #7: One line below: “In almost every case, more trees rooted in deep water . . .” As opposed to shallow water?

Response: The authors agree that this statement needs clarification.

Revision: The authors recommend changing the sentence to “In almost every case, trees in 2005 were located in areas with a greater depth to groundwater than in 1965.”

Comment #8: Pg. 7620, line 16: “Techniques similar to those used to map phreatophyte locations in the size study areas were used . . .”

Response: The authors agree that this is poorly worded.

Revision: The authors recommend changing this sentence to “The same techniques used to map phreatophyte locations in the study areas were used to map phreatophyte locations along the entire . . .”

Comment #9: The same page, line 27: “Light Ground”. As opposed to hard ground?

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And what is it after all?

Response: This was simply the nomenclature the authors used to identify different parts of the photographs where trees are not located.

Revision: The authors recommend striking the sentence on line 27 because it is not really necessary and causes confusion. The authors also recommend striking the sentences identifying classes on page 7619, lines 28 and 29.

Comment #10: Table included in Fig. 5 (!): the caption talks about depth to groundwater while the table presents "Mean groundwater elevation". Table should be separated from the figure. The negative values of the depth to groundwater are puzzling. After search, it turns out that the numbers are indeed depth to groundwater relative to channel bottom.

Response: The authors agree that the table causes confusion when included with the figure. The depths to groundwater are relative to the surface elevation, so any negative value indicates an area where the channel bottom is below the water table, so the stream is a gaining stream.

Revision: The authors recommend that the table should be separated from the figure. The authors also recommend including text explaining that depth to water is relative to the surface, and negative values indicate locations where the aquifer is above the stream bed.

Comment #11: There should be "that" instead of "than" on pg. 7614, line 14 and pg. 7624, line 16.

Response: The authors agree that "that" should be "than" on pg. 7624, line 16. There is no "that" or "than" on pg. 7614, line 14. There is a "than" on line 15, but it appears to be used correctly.

Revision: The authors recommend changing "that" to "than" on pg. 7624, line 16.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 7613, 2012.