

The impact of buffer zones on the water quality of East Mediterranean streams

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ABSTRACT

The effect of three most commonly practiced vegetative buffer zones along the reconstructed Jordan stream and drainage canals on landscape biodiversity and water and ecosystem quality was examined. The area is characterized by three different buffer zone habitats; low harvested grasses, high perennial mixed-reeds (*Phragmites australis*), and perennial grasses with woody species. The shallow groundwater at the third buffer zone was sampled at 6 different sites and analyzed for total dissolved P, chlorite, nitrate and sulfate. The flora biodiversity was determined by field survey along a 10 m transect parallel to the stream and canals. A total of 37 species were recorded at all sites where most of the species were defined as low grasses or forbs, with an average cover of 57%. The average cover of high perennial species was 38% and 5% of trees. The six dominant species that covered 80% of the area were *Cynodon dactylon*, *Phragmites australis*, *Sorghum halepense*, *Nerium oleander*, *Malva nicaeensis* and *Conyza albida*. The woody habitat exhibited greater number of species compared with the other buffer zones ($P = 0.05$). No significant differences were found in nutrient concentrations of shallow groundwater draining the fields and water samples taken within the buffer zones. These results suggest that the buffer zones serve mainly as enriching habitats for nesting birds and small mammals and are important for thriving ecotourism industry in this area but they do not serve as an affective hydrochemical barrier between farmlands and waterways.

Figure 1: The Hula altered Wetland (Present & Past) and locations of sampling

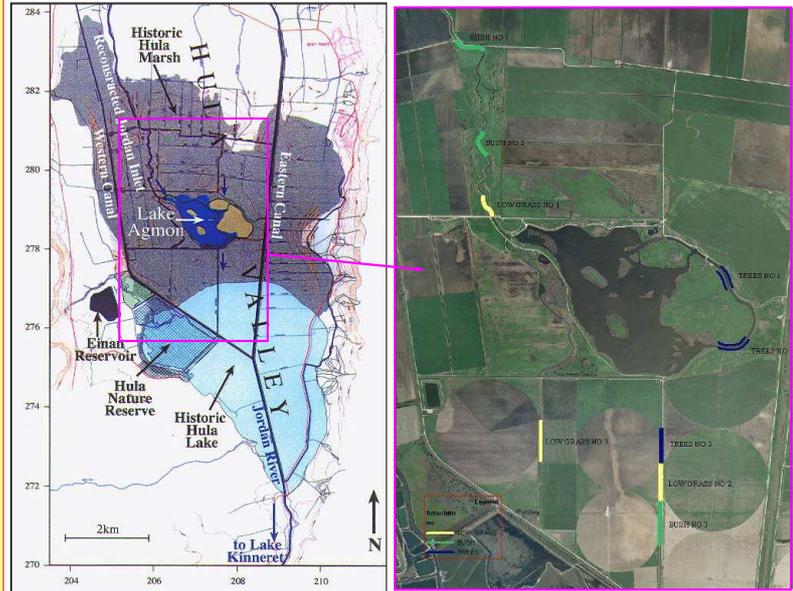


Figure 2. Low harvested grasses along reconstructed Jordan River.



Figure 3. High perennial mixed-reeds along a drainage canal south of lake Agmon.



Figure 4. Perennial grasses with woody species along the banks of the reconstructed Jordan stream.



Results

We compared six locations along a major drainage canal (see Fig. 1) characterized by perennial grasses with woody species. Within this habitat we differentiated between two buffer strips; low grasses versus high grasses woody strips. At each location we sampled shallow groundwater ~ 0.75 m below surface and analyzed for nutrients concentrations. In the woody area with high grasses P concentrations at locations #1 and #3 were significantly higher in the cultivated fields compared with the buffer strips but this trend was reversed at the site #2. Nitrate concentrations were higher at two locals of the buffer strips while the third exhibited the opposite trend. Similarly, no trends were observed for sulfate and bromide concentrations (Table 1).

Table 1. Concentrations in shallow groundwater at woody high grass sites and nearby fields

| Location | P | Cl | NO ₃ | SO ₄ | Br |
|--------------------|--------------------|--------------------|-----------------|-----------------|------|
| | µg L ⁻¹ | mg L ⁻¹ | | | |
| Woody High Grass 1 | 12 | 144 | 157 | 536 | 0.93 |
| Field 1 | 23 | 79 | 105 | 565 | 0.74 |
| Woody High Grass 2 | 17 | 116 | 149 | 481 | 0.78 |
| Field 2 | 3 | 64 | 71 | 1,046 | 0.80 |
| Woody High Grass 3 | 7 | 76 | 16 | 522 | 0.70 |
| Field 3 | 74 | 65 | 68 | 510 | 0.68 |

Similarly, no trend at all was observed in the woody area with low grasses (Table 2). Hence, we concluded that the influence of the buffer zone on groundwater quality is limited and the main function of the buffer zone in this area is to provide enriching habitat for nesting birds and small mammals which are important for thriving ecotourism industry in this study area (> 500,000 visitors annually).

Table 2. Concentrations in shallow groundwater at woody low grass sites and nearby fields

| Location | P | Cl | NO ₃ | SO ₄ | Br |
|-------------------|--------------------|--------------------|-----------------|-----------------|------|
| | µg L ⁻¹ | mg L ⁻¹ | | | |
| Woody Low Grass 1 | 12 | 55 | 114 | 1,374 | 0.69 |
| Field 1 | 6 | 100 | 90 | 1,298 | 1.04 |
| Woody Low Grass 2 | 7 | 176 | 127 | 1,395 | 2.15 |
| Field 2 | 8 | 68 | 115 | 1,635 | 1.25 |
| Woody Low Grass 3 | 8 | 108 | 177 | 1,193 | 1.06 |
| Field 3 | 7 | 65 | 53 | 1,278 | 0.79 |

