Pollution of coastal streams from agricultural activities: Alexander stream case study

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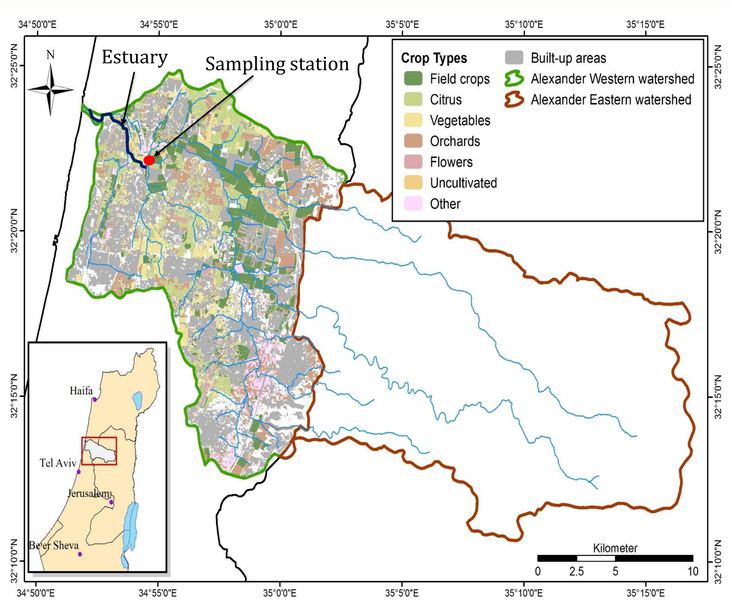

Figure 1. The Alexander Stream watershed and land use in the western part.

Background, Motivation and Hypothesis

Conventional agriculture activity enhances soil degradation processes via exceeding runoff and soil erosion rates. These processes are mainly triggered and governed by rain storm events, creating sheet flows, carrying detached sediments and organic pollutants, which in turn enters the riverine system and aquatic environments. The transported pollutants may travel vast distances and their impact on the aquatic environment is uncertain. We hypothesize that (1) Significant portion of pesticides is being transported adsorbed to suspended sediments as well as in the dissolved phase. and (2) Pesticides composition and amounts may differ between the two mediums based on their chemical properties. Therefore, the main aim of this study was to characterize and quantify pesticides load from cultivated fields to the Alexander estuary and examine their composition both in the suspended solids and dissolved phases during storm water flow events.

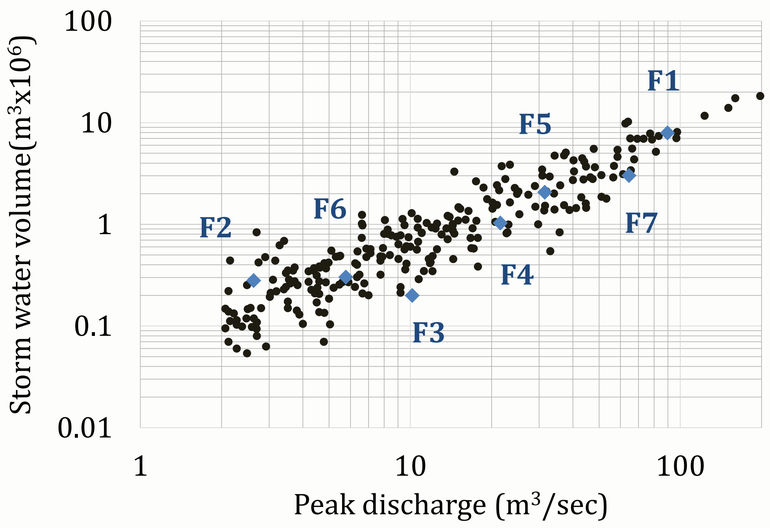

Figure 2. The Alexander Stream hydrological regime (1967-2015). Storm water volumes to peak discharges. Measured storm water flow events are marked as F1-F7 and blue dots.

Study Site and Methods

An automated sampler was stationed at the Head of the Alexander estuary draining 520 square kilometers of which about 60% uses for agricultural activity (Fig. 1). Along the rainy seasons of 2013/14 and 2014/15 we were able to sample seven storm water flow events (F1 to F7; Fig. 2). Collected sample were separated to solution and suspended solids. All samples (solutions and solid materials) were analyzed for the presence of 250 pesticides.

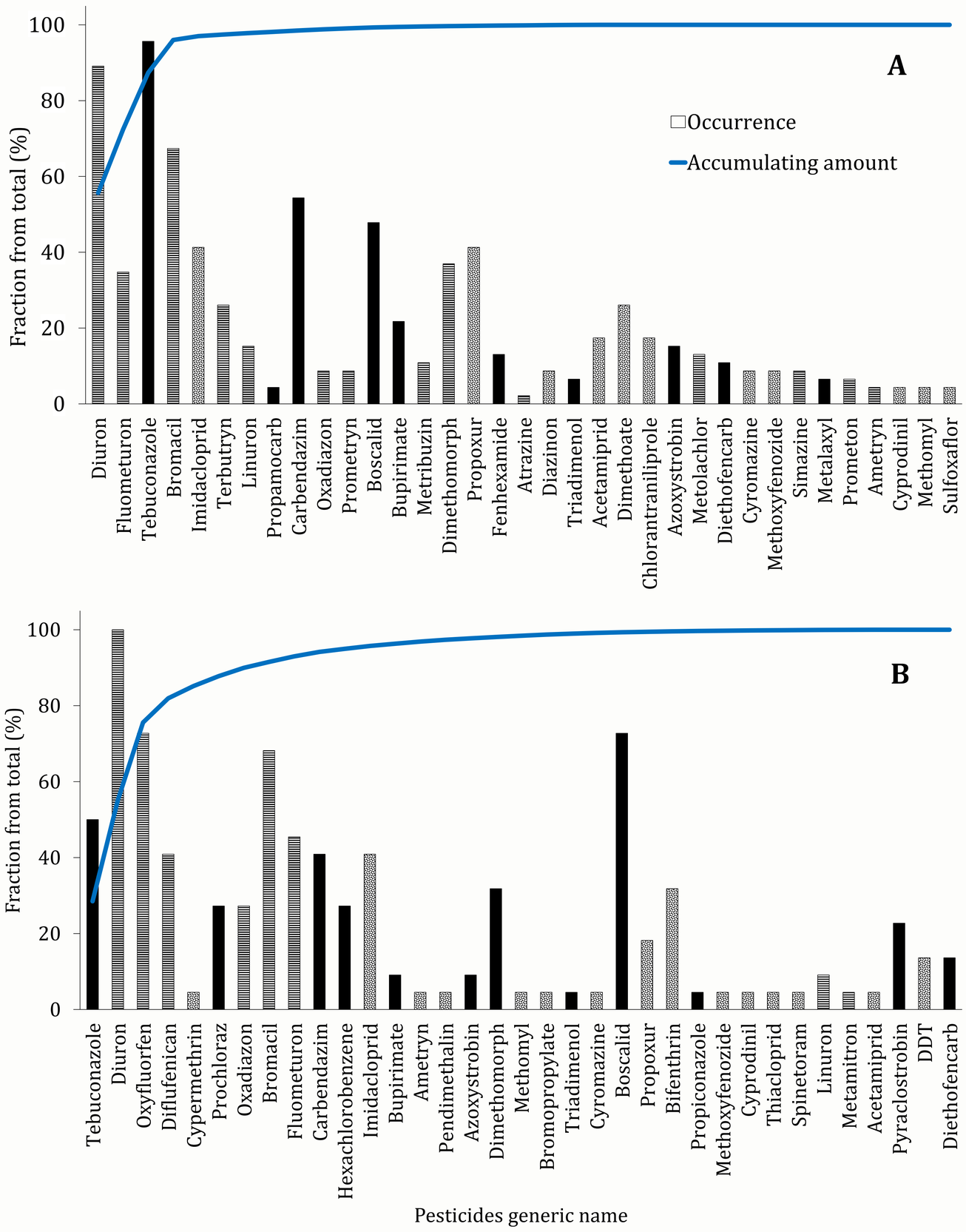

Figure 3. Pesticides observances (% from total) and accumulating amounts (% from total) in the dissolved (A) and adsorbed (B) phases of 7 storm water flow events (F1-F7) sampled in the Alexander Estuary head during the rainy seasons of 2013/14 and 2014/15.
Solid bars represents Fungicides, striped Herbicides and doted Insecticides.

Results

- All 7 storm water flow events were well fitted into the Alexander stream hydrological regime and represents accurately the watershed behavior (Fig. 2).
- Pesticides were detected in all samples with a total composition of 63 compounds (Fig. 3).
- 50 kg of pesticides were introduced to the Alexander estuary via storm water flow events; 90% were at the dissolved phase and 10% were carried by the suspended solids.
- Diuron, Fluometuron, Tebuconazole and Bromacil made up 95% of the total pesticide load in the dissolved phase (Fig. 3A) while the 95% of composition in the suspended solids was made up from 11 pesticides.
- Different dynamics for the different pesticides classes were observed within the rainy season: a positive correlation between herbicides amounts to flow event peak discharge was observed (Fig. 4); while lower level of insecticides and fungicides were observed along the rainy season.

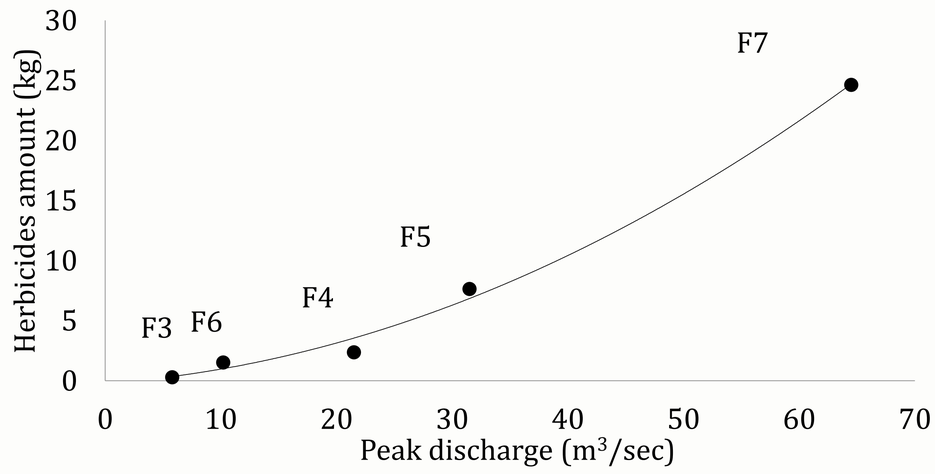

Figure 4. Herbicides amounts vs. peak discharges during the rainy season 2014/2015 (F3-F7).

Summary and Conclusions

- Pesticides amounts, classes and composition differ between the dissolved and adsorbed phases.
- Although accounts for 10% of the total load; pesticides at the suspended solids are of great importance in terms of composition and reactivity.
- Only herbicides amounts were correlated with storm water flow events peak discharges. This indicated sheet erosion processes and is probably due to their intensive application over vast surfaces of bare soil.
- To better understand behavior of pollutants during storm water flow events there is a need to examine their occurrence in both phases (dissolved and suspended solids).
- The introduction phase (i.e., dissolved vs. suspended solids) will probably affect their fate and impact on the estuarine and marine environments.