SURVEY EFFECTS OF AGRICULTURAL RUNOFF ON WATER QUALITY WITH BIOTIC INDICES (Case Study: Keselian River- North of Iran)

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ABSTRACT

Biological and ecological study of water resources is the most fundamental issue in scientific researches and studies of ecosystems. Agricultural water that includes organic substances affects the quality of river water, and studying the biological community of the river is one of the ways to study the degree of this effect. The structure of macro invertebrate was studied from April to August of 2009 in two stations before and after rice-farmed fields. Results showed that sensitive groups decreased and biological indices include EPT, Hisenhoff and Shanoon faced fluctuation as well.

KEYWORDS

Agricultural runoff, Water quality, Biological indices

1 INTRODUCTION

Macroinvertebrates are integrally linked to aquatic habitats and their abundance and community structure are related to both chemical and physical in-stream conditions, making them useful biological indicators [12,15,27]. Macroinvertebrates are directly influenced by physical conditions such as substrate type, channel morphology, amount and type of detritus and aquatic vegetation and canopy cover [22,23,25] and are indirectly affected by changing nutrient concentrations and shifts in primary productivity [32,26]. Unlike water quality measurements, which only provide an instantaneous assessment of stream conditions, macroinvertebrate assemblages can be used to identify past disturbances and toxic effects that are not readily detected by chemical means.

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The distribution of macroinvertebrate taxa and densities in agricultural headwater streams is influenced by many factors, such as organic pollution [35], habitat degradation [13,24], and pesticides[29].

The input of materials from agricultural fields produces marked short-term changes of the abiotic conditions in headwater streams. In addition to an increased hydraulic stress[10,7] there are increased concentrations of suspended particulates[14,16], nutrients [33,3] and pesticides[4,11,34].

Non-point-source agricultural pollution is regarded as the greatest threat to the quality of surface waters in rural areas [19]. The most important routes leading to non-point-source pesticide contamination of aquatic systems are runoff and spraydrift [8]. Of all non-pointsource pollutants, insecticides are among the most crucial chemical stressors because of their extremely high toxicity to many non-target aquatic organisms [5]. However, it has been shown that there are almost no studies dealing with insecticide effects on invertebrate communities under field conditions [28]. Deleterious effects have been reported during transient peaks of parathion-ethyl in a small eadwater stream in northern Germany [4]. Recent studies by Leonard et al. [17] indicated effects of the cotton insecticide endosulfan on river invertebrates in Eastern Australia.

In this study, we investigated the effects of runoff from agricultural fields by comparing the benthic macroinvertebrate communities of paired sites upstream and downstream of farms along one stream.

2 MATERIALS AND METHODS

2.1 Study Area

This study has been done in Keselian River one of the most important branch of the Telar River full of Forum (the following major areas of the southern Caspian areas) which is current in mazandaran province. The river emanate from the heights of Mount Si Saman Alborz mountain range with 1596 meters height and waters village such as Sangdeh, Pashakla, Matekola , Kchyd, Shirgah Amirkola.

All sampling sites were unshaved and situated at low altitudes (o60m asl). They were low gradient (o1%) streams with substrate of mixed sand and cobbles, and a discharge between 0.1 and 0.25ms_1. Water depths varied between 8 and 20 cm and the width of the wetted channel ranged from 200 to 300 cm.

In this stream, an upstream site surrounded by abandoned fields was compared to a downstream section where there was active agriculture (Fig. 1). Apart from this difference, sites were selected to be similar in physical aspect, riparian features and substrate. To minimise the confounding effects of longitudinal variation, the upstream and the downstream sample point were not more than 1000m apart. No point sources of pollution were evident within the study reaches. We sampled both sampling sites in 6 month when has active agriculture: on March 25th 2000 to August 25th 2010 monthly.

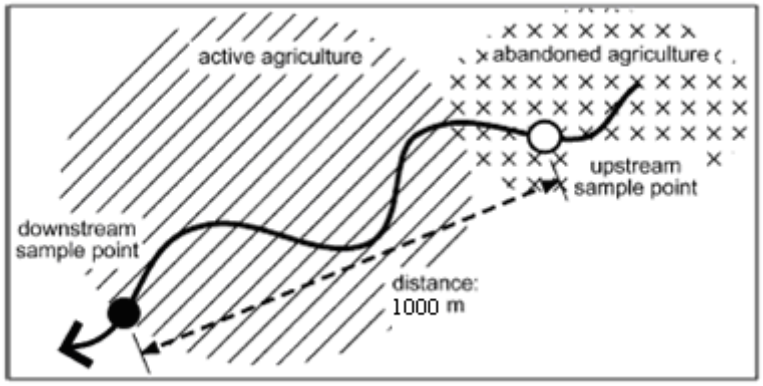

Figure 1. Schematic diagram of the sampling strategy in Keselian River

2.2 Sampling and data analysis

Three replicate benthic samples were taken at each site on each date. Samples were taken with surber sampler and preserved in 70% ethanol. Samples were sorted to species or orphospecies and counted.Then samples identified by identification keys [6,20,21,36], it was calculated the Shanon, EPT, total Taxa and Hilsenhof index and these data were analysed with EXELL, SPSS and SYSTAT software

3 RESULTS AND DISCUSSION

The aquatic macro invertebrate community at the study sites was quite diverse, supporting the impression gained from water-quality measurements. Diptera, Ephemeroptera, Tricoptera and Coleoptera larvae were dominant, while Plecoptera were absent.
There were differences in the number of macroinvertebrate taxa collected in upstream versus downstream sites in March (Fig. 2 A). Number of taxa in the downstream site in this Stream less than upstream.

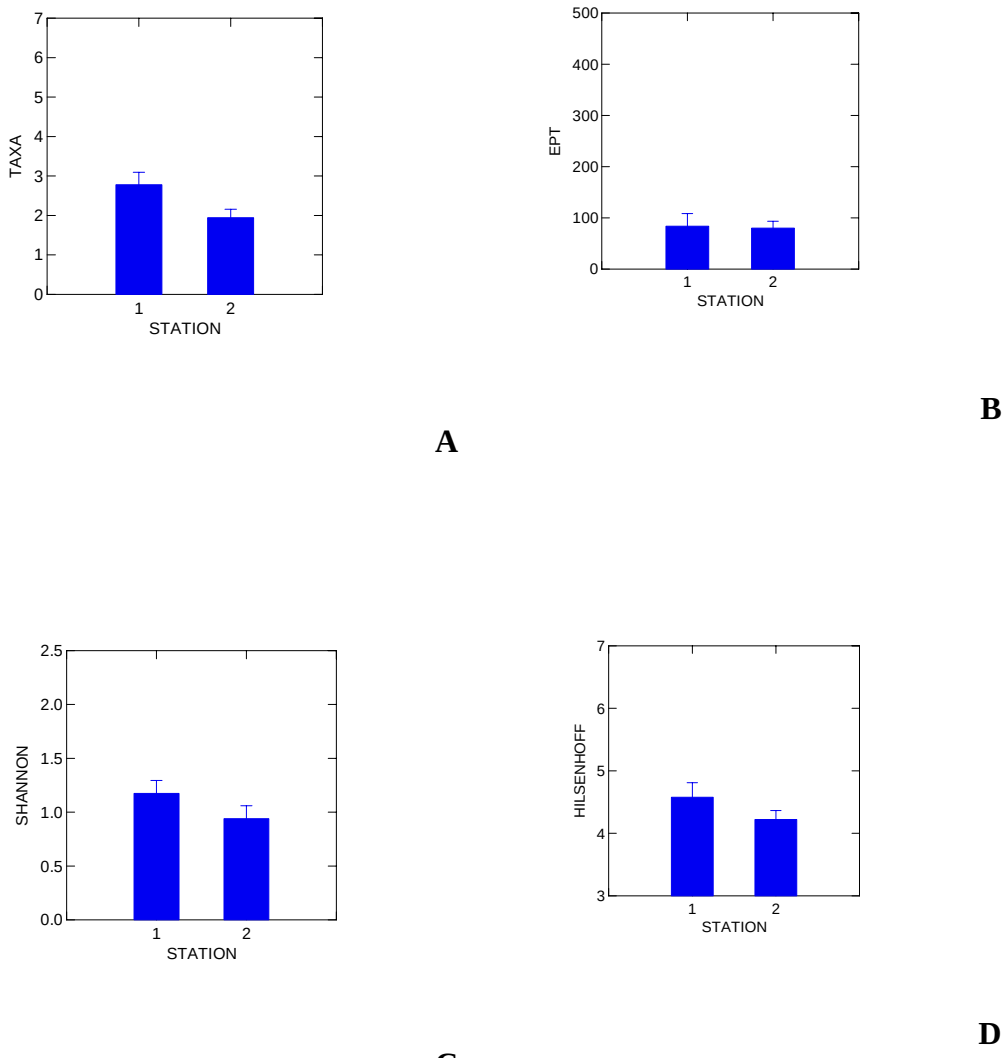

Figure 2. (A) Mean number (± SE) of taxa, (B) Mean number (± SE) of EPT, (C) Mean number (± SE) of Shanon and (D) Mean number (± SE) of Hilsenhof in the upstream and the downstream sampling points of Streams in March to August 2010.

Table 1. List of all taxa at sampling sites.

Order	Family	Genus
Ephemeroptera	Ecdyonuridae	Rhithrogena
	Ecdyonuridae	Ecdyonurus
	Baetidae	Baetis sp.
	Caenidae	Caenis
Diptera	Tipulidae	Tipula sp.
	Simuliidae	Simulium sp.
	Chironomidae	Chironomus
	Blepharoceridae	
	Rhagionidae	Atherix
Trichoptera	Hydropsychidae	
Coleoptera	Helmidae	
Oligochaeta	Lumbricidae	Eiseniella

Our investigation shows that agricultural runoff had a significant effect on the benthic community of Keselian River. This effect was evident from a comparison of upstream and downstream sites in the stream. Runoff from agricultural fields in temperate latitudes is known to cause short-term changes in abiotic conditions in streams; in particular,increases in hydraulic stress [10] and suspended sediment loads [16]. Although these factors may cause reductions in benthic fauna,especially as a result of substrate displacement (e.g. [31,1]), it is unlikely that the magnitude of this effect would have varied systematically between the upstream and the downstream sites. Agricultural field runoff includes nutrients [3] andpesticides [31,35]. Both may degrade the water quality dramatically. To our knowledge,no instance in which nutrients cause short-term toxic effects has been reported in the literature. However,short-term contamination by pesticides has well-documented toxic effects on aquatic communities [2,9,18]. Schulz and Liess [28] provide an overview of field studies undertaken in temperate latitudes that establish a relationship between insecticide contamination and consequent effects on aquatic fauna.

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