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Influence of Environmental Parameters on the Aquatic Entomofauna Assemblages of Singanullur Lake, Coimbatore, India

Susheela P* and Radha R.
Department of Zoology, P.S.G.R Krishnammal College for Women, Coimbatore, Tamil Nadu, INDIA

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Abstract

The aquatic insects are an important component of biodiversity and are very important indicators of water quality parameters. The distribution and composition of insect communities are considered to be determined by the environmental factors and interactive relationship within the ecosystem. The present investigation was to determine the effects of environmental factors on the aquatic insect assembly in Singanullur Lake, Coimbatore .Three different sampling stations were selected and were examined for the water quality and aquatic insect assemblages. A total of aquatic insects were collected from the lake with the highest number of aquatic insects from the order Hemiptera. The water analysis results revealed that Station I- had the best water quality when compared to the other sites. Thus environmental variables were found to influence the aquatic insect distribution in the lake.

Keywords: Aquatic insects, environmental parameters, Singanullur, biodiversity.

Introduction

Wetland ecosystems cover approximately 6% of the Earth's land but play a much larger role in the planet's sustainability[1]. The wetland ecosystem provides a suitable habitat for different species of plants and animals and they are also essential for the survival of other types of ecosystem also[2]. There are about more than 45000 species of insects in the world that inhabit various freshwater ecosystems. The insects help in the recycling of nutrients and form a crucial part of natural aquatic ecosystem[3].

Aquatic insects are an assemblage of arthropods that survive only in water ecosystem[4]. The aquatic insects are a good indicator of water quality parameters due to their varying tolerant levels in the environment[5]. The various wetlands found in different parts of the world are often subjected to increasing pollution loads that ultimately affect the quality of water and health status due to changes of physico-chemical properties of water[6]. The variations in the physico-chemical parameters of water greatly influence the diversity and distribution of aquatic insects in the water[7].

The benthic macro-invertebrates that are found in the aquatic ecosystem have received significant attention in the study of wetland ecosystems[8]. The relationship of macro invertebrate community and environmental parameters has been the theme of numerous investigations. The benthic macro invertebrates are considered as the one of the most excellent bio-indicators of water quality[9]. Wetland vegetation can have a huge impact on invertebrate communities, as many invertebrates are found on macrophytes, where they seek shelter from predators, and obtain food[10].

Aquatic insects and other macro invertebrates are often sampled to assess the overall quality of the ecosystem where the animal dwells[11]. Macro invertebrates can be regarded as bio-indicators of water quality parameters because these communities react to hydrological stress, which reflect changeable environmental surroundings. The response of the various pollutants may be evaluated through interpretation of diversity and organism tolerance[12]. Aquatic macro-invertebrates are an indication of a healthy aquatic ecosystem and hence sampling of aquatic macro-invertebrates is inevitable for determining the pollution status of a wetland[13].

In spite of the studies carried out on the aquatic insects in various streams of Western Ghats, there has not been any attempt to document their diversity in Singanullur lake, Coimbatore[14,15]. This investigation was to determine the outcome of water quality due to the seasonal distribution of aquatic insects of Singanullur Lake, Coimbatore with regard to the diversity of macro-invertebrates and quality of water in the lake.

Material and Methods

Study site: This investigation was carried out to access the insect diversity in the Singanallur lake of Coimbatore district. The study site is situated in Coimbatore at 10° 59'46" N 77° 01'11" E at an approximate altitude of 470m near Singanallur. The city is traversed in the middle by river Noyyal. The entire water body of the lake covers 288 acres with utmost depth of 13.95 feet and storage capacity of 52.27 M.cft.

Station I The station is the control station which was likely to be unpolluted due to least human interferences.

Station II The station has medium transparency and was somewhat polluted. The scarce vegetation includes Eichnornia plants and grasses.

Station III The station has low transparency and was highly polluted .Sewage water was dumped into the area and the area was filled with dense vegetation of Eichnornia plant and grasses.

Collection of water samples and physico-chemical analysis of water: The water samples were collected from each sampled stations in 200ml plastic containers washed with nitric acid to remove the contaminants in water. The sampling period ranged from December to March for both wet and dry season. The water sampling was usually done between 7:00 am and 12:00 noon. The water samples collected were then taken to the laboratory and analyzed immediately. The surface water temperature was recorded with a Mercury-in-glass thermometer; pH was measured *insitu* with pH meter. The dissolved oxygen present in the water samples were measured *in situ* with dissolved oxygen meter.

Sampling of Aquatic insects: Aquatic insects were sampled using telescopic nets, D frame aquatic net, and hand picking. The nets were moved through the water column or rapidly pushed into macrophyte beds and into the substrate to collect the samples. Each sample was collected to provide some standardization of sampling effort. The identification of the insect samples was done using standard keys. The aquatic insect identification was done following the manual of Subramanian and Sivaramkrishnan[16,17]. The sampling of the insects was conducted over a 4 month period from December 2013- March 2014.

Results and Discussion

A total number of insects belonging to the orders Ephemeroptera, Hemiptera, and Coleoptera were collected from December 2013 to March 2014 in three sampling stations of the Singanallur Lake. The analysis was based on three sampling sites and a total of aquatic insects were collected from the lake with the highest number of aquatic insects from the order Hemiptera. There were variations on the total number of individuals collected from different stations in the lake.

The highest number of aquatic insects was found at the first sampling station because there were several types of micro-habitats with aquatic plants, gravel and sand. On the other hand, the lowest number was found from Station III which might be the result of human interference which is not suitable for aquatic insect survival. The highest aquatic insect diversity was found to be in Station I (2112) followed by Station II (1469) and Station III (931) (table-1).

Table-1
Aquatic insect assemblages in three sampling sites of Singanullur lake, Coimbatore from December 2013-March 2014

Order	Family	Genus	Site I				Site II				Site III			
			Dec	Jan	Feb	Mar	Dec	Jan	Feb	Mar	Dec	Jan	Feb	Mar
Ephemeroptera	Baetidae	*Baetis sp*	25	16	10	-	15	7	3	-	5	2	-	55
Hemiptera- Bugs	Corixidae- Water boatman	*Micronecta sp*	75	68	55	95	50	62	42	70	20	43	35	30
	Belostomatidae water bugs	*Diplonychus sp*	90	82	62	85	63	65	52	65	42	42	40	55
	Notonectidae (Back swimmers)	*Enithares sp*	85	75	45	95	55	61	31	75	35	35	20	15
	Nepidae	*Laccotrephes sp*	68	50	20	35	45	30	12	29	30	12	2	10
	Nepidae	*Ranatra sp.*	55	45	25	25	30	29	10	16	15	11	-	55
	Gerridae (Water striders)	*Tenagogonus sp*	90	70	45	85	65	60	16	72	30	30	14	45
Coleoptera- Beetles	Dytiscidae	*Laccophilus sp*	85	72	62	75	75	50	45	61	40	35	25	-
	Curculionidae	*Phytoscaphus sp.*	48	25	12	-	10	9	3	--	3	-	-	9
	Noteridae	*Noterus sp*	52	45	35	25	25	25	21	15	5	16	15	55
Total			2112				1469				931			

Table-2
Environmental variables of three sampling stations of Singanullur lake, Coimbatore

Parameters	Station I				Station II				Station III			
	Dec	Jan	Feb	Mar	Dec	Jan	Feb	Mar	Dec	Jan	Feb	Mar
Temperature	20.8	20.5	22	24.8	21.3	21	22.3	25.7	21	20.8	22.8	22
Turbidity	45.9	44.8	46.7	54.9	46.1	45.5	47.2	61.1	44.3	45.2	46.1	61.3
pH	7.81	7.82	7.93	7.85	7.74	8.06	8.11	8.2	7.2	7.1	7.1	7.1
TDS(mg/l)	1158	1279	1232	1332	1154	1286	1216	1306	1223	1234	1221	1220
TSS(mg/l)	1.57	1.50	1.49	1.4	1.44	1.64	1.60	1.36	1.62	1.60	1.54	1.85
BOD(mg/l)	12.33	8.43	10.56	11.44	8.42	8.83	9.43	9.55	3.4	4.3	4.5	5.1

The physico-chemical parameters analyzed for the three sampling stations are given in figure-1 to 6. The water temperatures were found to be varying from 20.8°C (Station-1) to 21.3°C (Station-II) and 21°C (Station-III). The pH analysis of all three stations revealed alkaline nature of water with values ranging from 7.8 to 8.2 and was within the acceptance range of BIS. Most aquatic insects belonging to Hemiptera and Coleoptera are only slightly affected by acidic pH of water whereas others like Ephemenoptera, Trichoptera and Odonata were found in alkaline water ecosystem. The lowest turbidity was recorded for Station-I and highest turbidity value was for Station-III.

Dissolved Oxygen is an essential bio-indicator of the water ecosystem that supports aquatic ecosystem[18]. Biochemical Oxygen demand represents the degree to which the breakdown of organic matter in a water sample consumes oxygen[19]. In water characterised by a low BOD, less oxygen is consumed by decomposition and respiratory processes. Low BOD concentration i.e. < 3 mg/lit in fresh water aquatic system indicates higher pollution causing a drastic negative consequence on aquatic ecosystem[20]. The lowest DO was measured at Station III which might be caused by contamination form community wastewater. The highest BOD (12.33 mg/L) was measured at Station I. The low values of DO concentration recorded during this study, is a warning of decline of the water quality in the station due to various human interferences.

It can be observed that the diversity of aquatic insects is greatly determined by the environmental variables. Station-III in our study has shown the presence of least diversity and community assemblages of aquatic insects because of high sedimentation leading to the decline of primary producers of the lake. Aquatic insects were adversely affected and there was a significant reduction on insect diversity at the polluted stations. Thus destruction of aquatic habitat can lead to reduction in bio-diversity of aquatic macro invertebrates.

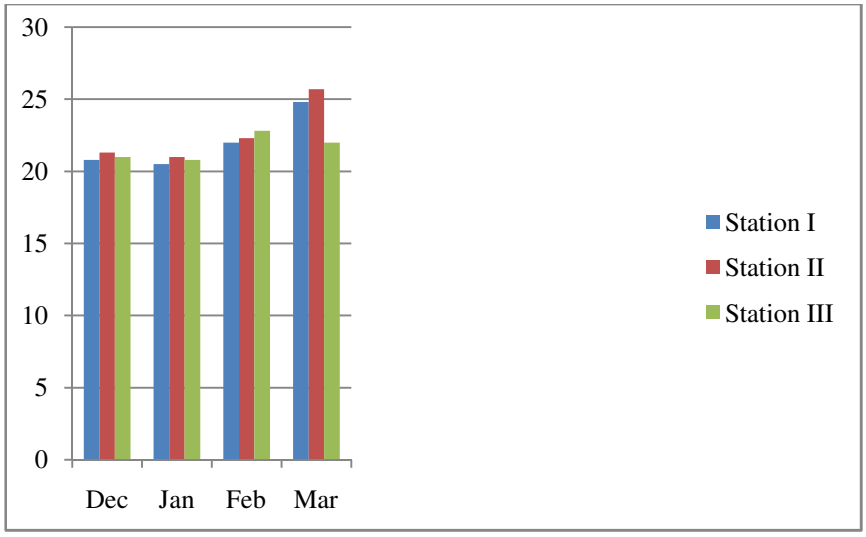

Figure-1
Temperature levels in the sampling stations of Singanallur Lake from December 2013 to March 2014

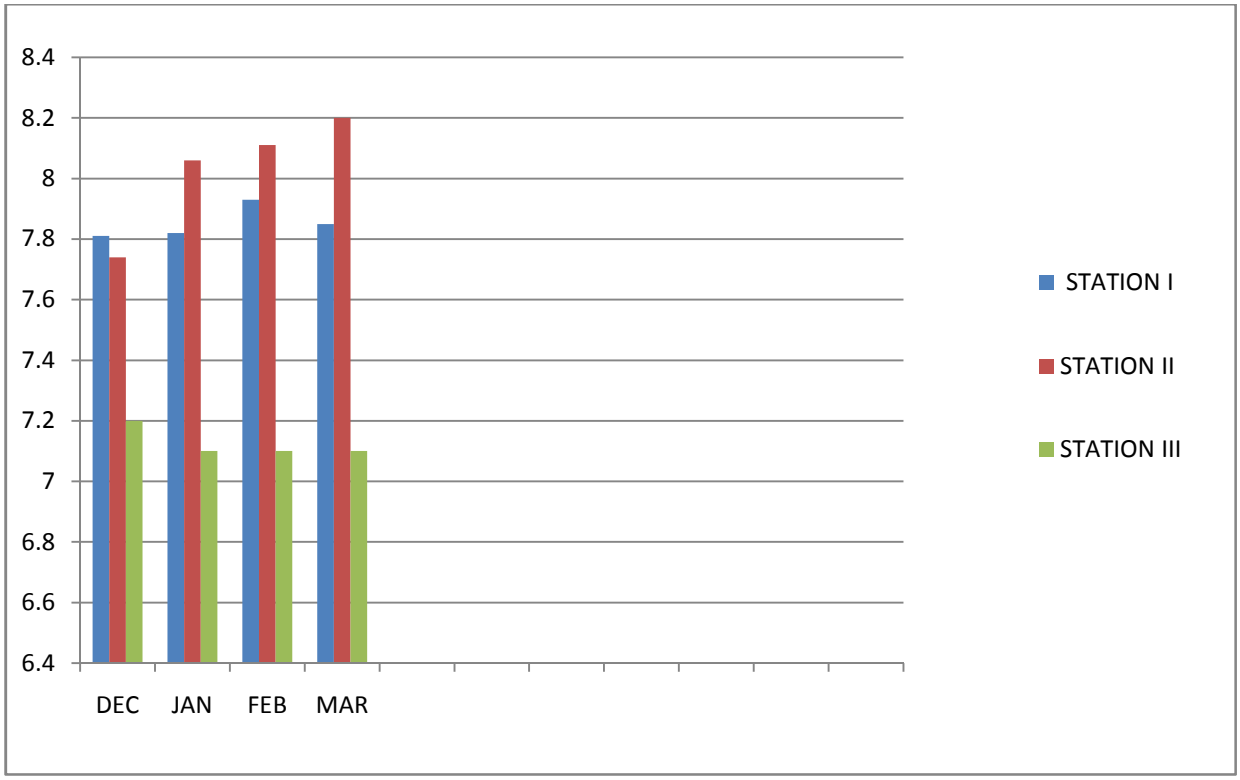

Figure-2
pH levels in the sampling stations of Singanallur Lake from December 2013 to March 2014

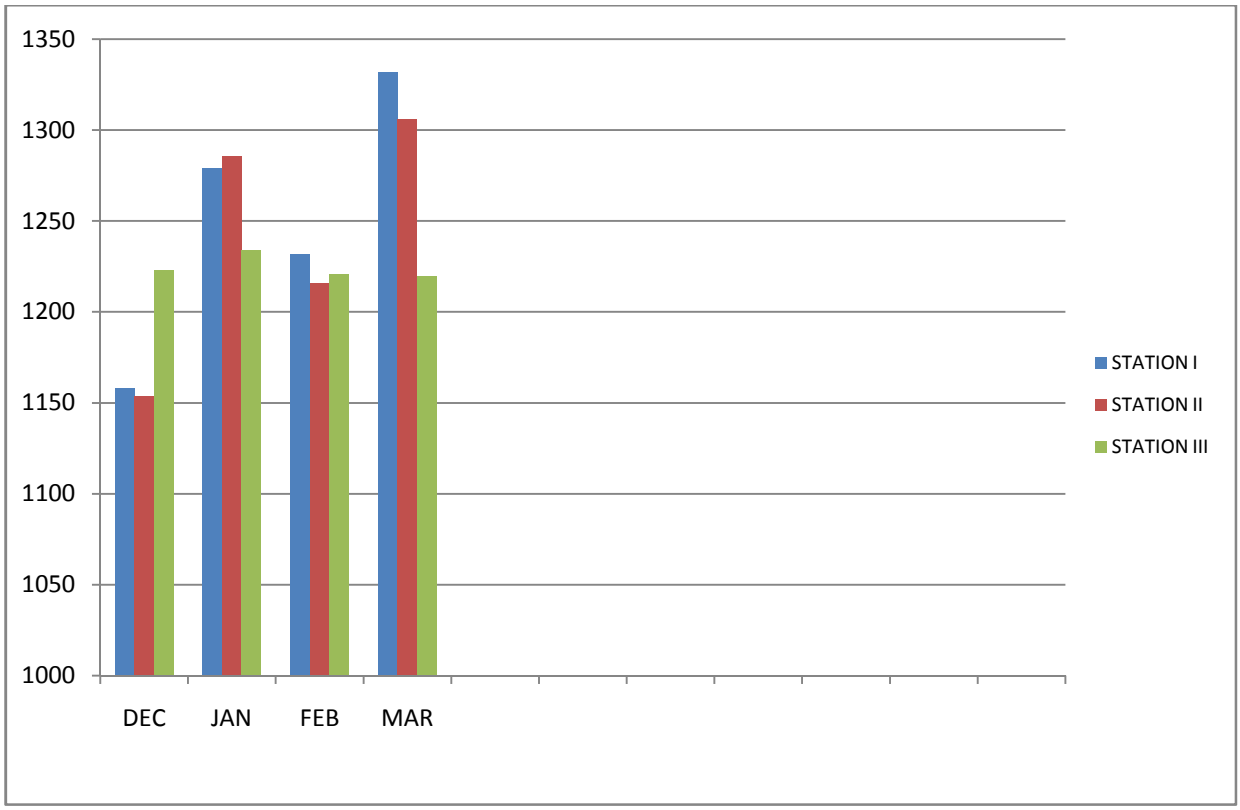

Figure-3
TDS levels in the sampling stations of Singanallur Lake from December 2013 to March 2014

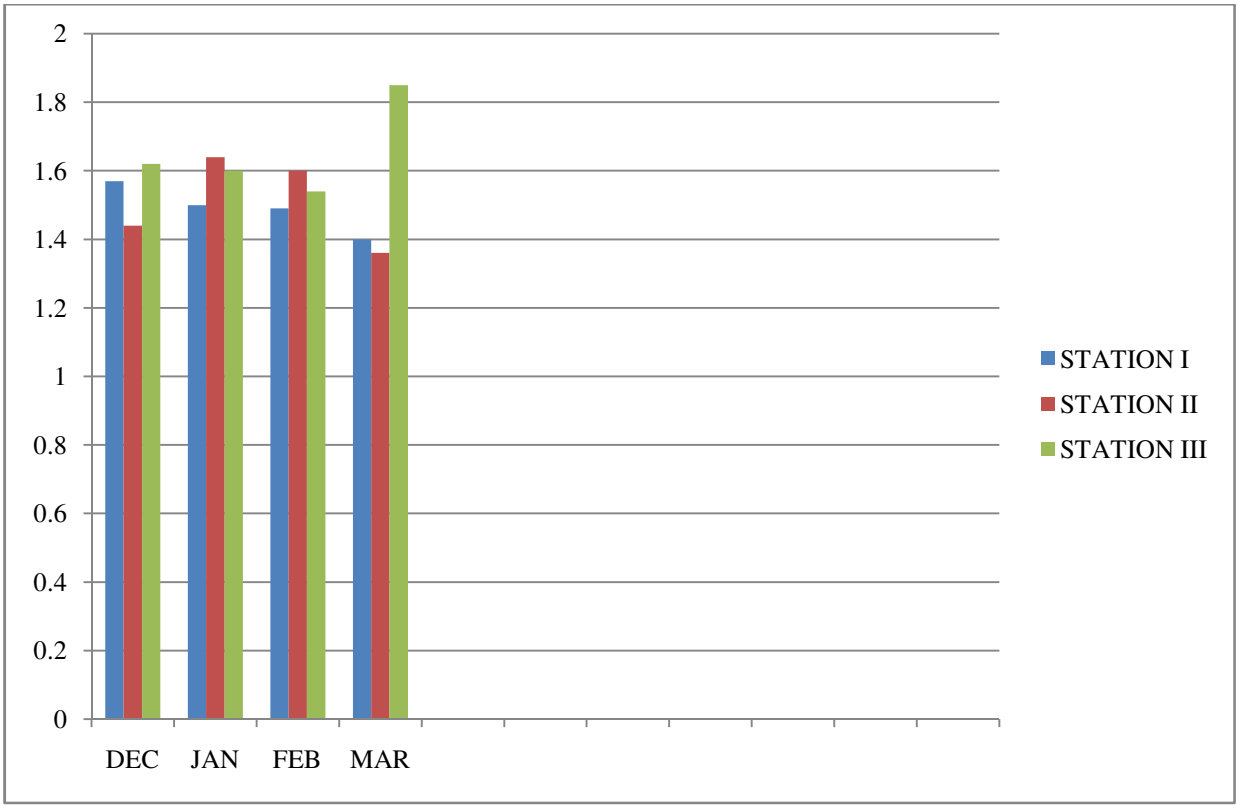

Figure-4
TSS levels in the sampling stations of Singanallur Lake from December 2013 to March 2014

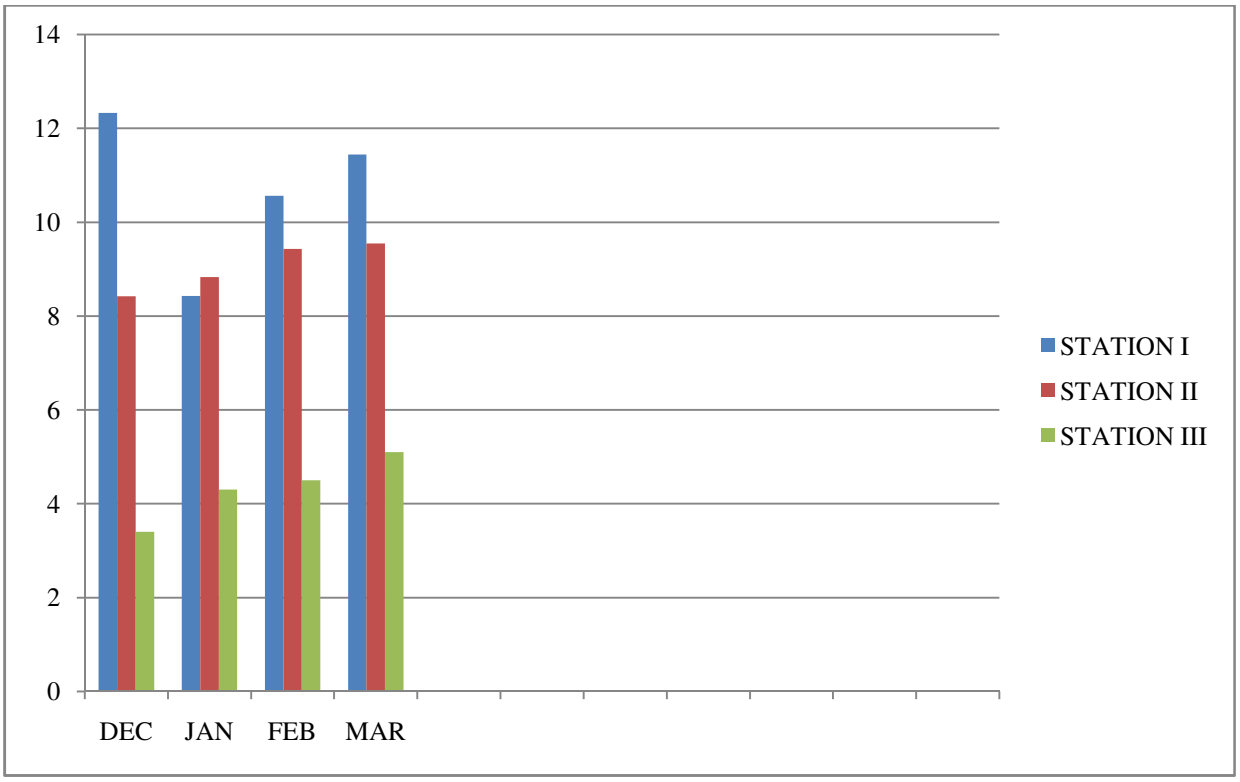

Figure-5
BOD levels in the sampling stations of Singanallur Lake from December 2013 to March 2014

Conclusion

The present investigation has concluded that there is an important association between the composition of aquatic insects and environmental conditions. A close study of these aquatic insects has derived to the fact that Singanullur Lake has some level of pollution. The water quality of the lake plays a crucial role in the maintenance of bio-diversity of aquatic insects in the lake. It is highly essential to keep a check on the increasing anthropogenic disturbances which adversely affect the fresh water ecosystems and cause a severe threat to the aquatic lakes. It is necessary that satisfactory conservation measures have to be performed before they are discharged into lakes to improve the quality of lake water.

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