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Determination of Priority Contamination Factors in Lake of Manyas (Bird Paradise)

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Abstract

Wetlands of which importance has been begun to understand better day by day, are rapidly contaminated as results of population growth, irregular urbanization, industrialization and agricultural activities. The Lake of (Bird) Manyas of Balıkesir, which is one of the most important wetlands protected with Ramsar Convention and hosts Bird Paradise National Park in is under the high pollution risks because of increasing industrial activities in its surrounding. Furthermore, in consequence of the lack of knowledge on the current pollution levels of the lake and the impact of industries on the lake, the management plans prepared to lake protection cannot be all got in the act and not be executed in a seriously. For this reason, by determining the general state of the lake, taking of measures to minimize pollution and ensuring of sustainability of the ecosystem is ofgreat importance. In this study, to determine pollution level of the Manyas Lake and sectoral effects on, in addition to conventional parameters, other pollution parameters determined by considering of the lake stress elements were examined. In the monitoring stage, from the previously determined sampling points of the lake and streams, water and sediment samples were taken by manual sampling method and analysed to determine the type, amount and change of contaminants. Results obtained from the monitoring studies carried out in last four years compared with Water Pollution Control Regulations (WPCR) of Turkey. It was concluded that the main pollution parameters of the lake were determined as Dissolved Oxigen (DO), Chemical Oxigen Demand (COD), Nitrate, Phosphate, Copper, Lead and Zinc. According to the specified pollutants, wastes from agricultural activities, mining activities, poultry farms and slaughterhouses mostly reach to the lake. It is concluded that these sectors are the major stress factors for the lake.

Key words

Bird Paradise, Contaminants, Manyas Lake, Monitoring, Wetlands

1. INTRODUCTION

The wetlands can be described as; "Natural or artificial, continuous or seasonal, drinkable, bitter or salty, calm or flowing water masses, marshes, peat bogs and sea water that not passing to six meter after tide of sea". The wetlands in the Mediterranean and its around are inlet, river delta, shore lagoon, lake, marshes and oasis, natural or artificial salty waters and dams [1]. The wetlands are ecosystems that have the highest biological variety after tropical forests. The wetlands that provide appropriate nourishment, reproduction, and accommodation media for the living creatures with rich variety, is not only rich museums of owner countries but also rich museums of the entire World [2].

The main reasons of the wetlands losses or damage in environmental quality level are that environmentalproperty and services of wetlands do not take part in economical system. Therefore, to realize the sustainable usage of the natural sources like wetlands, it is necessary to evaluate the positive or negative directions of every operation to be applied to this type sources in respect to community comfort [3]. The wetlands are underthreat due to humane usage. The some of factors causing species loss and ecosystem destruction are; spoil of water quality due to pollution causing from agricultural, municipal and industrial wastes, construction of dams on wetlands, changing of direction and extreme water supply,

extreme fish hunting, pulling water plants and burning the reed beds [4]. Turkey is assumed as the most important country in Europe and Middle East in respect to wetlands due to geographical and climate conditions. Turkey has about 300 wetlands that have totally two million hectare area. Of them, it is established that 135 piece has international importance [5].

The lake of Manyas comprise 20.400 hectare field that formed around the lake and its surroundings. The most important and rich region of the lake is the delta forming by Sığıcı Delta and Manyas Stream. The 64 hectare delta that is formed by Sığırcı Stream is declared as the National Park at 1959, 25.000 hectare field containing the lake and near surroundings is declared as Wild Life Protection Field at 1977 and the National Park and its surroundings are declared as first degree natural protection field at 1981. According to 2873 counted National Park law, the Bird Paradise is the unique natural sources that has simultaneously "Natural Protection Field" and "Wild Life Protection Field" properties. Together with becoming side of Turkey to Ramsar Aggreement, firstly 10.200 hectare field and then the whole of the lake were included to Ramsar Agreement at 1998 [6]. The reed bed field where the Sığırcı Stream comes together with the lake was taken to protection at 1959 as "Bird Paradise National Park". As Manyas is known as the first Bird Paradise field in Turkey has pioneered to known of wetlands, nature and birds. The lake of Manyas is rich in respect to water products and it has 23 different fish types. In addition, at the lake and its , there are 266 different bird types have beed determined and some are birds that their generation has come to an end [7].

The lake of Manyas is located in the border of Balıkesir City and Manyas District, at south of Marmara Sea and in a graben going over between Biga Peninsula and Ulu mountain. The average surface area of the lake of Manyas is 200 km^2 and at summer seasons this value decreases. The length and width of the lake are 20 km and 14 km, respectively and the lake has inclined shape. The lake has 14 km height from sea level and exhibits shallow property. The lake is nourished by Kocaçayand Sığırcı Streams. In addition, Dutludere, Köydereand other small several streams nourish the lake of Manyas. The extra water of the lake is transferred to Susurluk Stream by Karadere Stream [8].

In this study, the parameters causing stress on the Lake of Manyas that is important for Turkey were determined. In the samples taken from streams and the lakechemical analysis were done. The contaminating levels and seasonal changes of the parameters were examined. The pollutant sources and solution suggestions for decreasing of pollutants were taken hand.

Figure 1. (a) Lake of Manyas on Turkey Map (b) Lake Of Manyas (BirdParadise)

2. MATERIALS AND METHODS

2.1 Sampling Points

Geographical location of the Lake of Manyas has 40° 11' 36" the North and 27° 58' 0" the Easth coordinates. Sea height changes between 14.5-17.5 meter based on water level. To determine the water quality in the Lake of Manyas, the water samples from the predetermined points was taken and their analysis were done. To determine the seasonal change of pollutants, samples were taken at rainless and rainy periods.While selecting the sampling points, the points that well represent the whole water sources were selected.

The volume of the Lake of Manyas is 800 million m^3. The water sources feeding the lake is KocaçayStream(74%), other streams and rainfall. The big portion of water reaches from Karadere to Susurluk stream and spills to Marmara Sea [8].

Therefore, samples were taken from Sığırcı, Kocaçayand Mürvetler Streams that feed the lake and from Karadere Stream that is unique water exiting points from the lake. The sampling points are shown in Figure 2.

Figure 2.Sampling Points

While the water is being sampled, these criterions are taken into consideration; sampling points were determined at enough number so that they represent the water quality in sampling regions and characterize the water quality change. The waters entering the lake and exiting from the lake were taken into consideration, in addition, at least one sampling from interior of the lake was done. While samplings were being done interior of the lake, the points at which water flows and complete mixing occurs, were selected. At streams, the sampling points were selected at the near lake enter after last discharge point.

2.2 Analysis

The taken samples were protected by appropriate chemicals and stored at T<+4°C and the chemical using for protecting water is used according to parameter that would be analyzed. pH and dissolved oxygen measurements were done timely. All chemical analysis were done in Balıkesir University laboratories. On the other hand, the analysis results belonging to pat years were taken evaluation. All analysis were conducted based on Standard Methods [9].

3. RESULTS AND DISCUSSION

3.1. Analysis Results and Quality Classification

Description of water quality is made by Continent Interior Surface Waters Classification ofSurface Water Quality Control Regulation. Four main water quality classes (I- IV) that take part here, have been described with 45 parameters. The waters belonging to class I is the waters which can be used for drinking and and daily usage without any treatment and only should be disinfected. The waters belonging to class II is the waters which can be used as drinking and daily usage after treatment. The waters belonging to class (III) is the waters which can be used in the industries (except food, textile industries) for industrial water supply and cannot be used as drinking and use water. The waters belonging to class (IV) is low quality waters from class (III) and need a treatment [10].

The classification of the studied water sources according to Continent Interior Surface Waters Classification is given in the below Tables. In these tables, the I, II, III, and IV quality waters are indicated as *,**, *** and ****, respectively.

Table 1. Analysis Results forLake of Manyas

LAKE OF MANYAS						
PARAMETER	UNIT	2012	2013	2014	2015	2016
TEMPERATURE	(°C)	15,3*	10,5*	8,7*	8,6*	17*
pH		9,45****	9,26****	8,52**	8,08**	8,75**
DO	mg/L	7,23*	7,28*	-	-	12,66*
BOD	mg/L	5*	0*	-	-	5*
COD	mg/L	19*	58**	56**	34**	48,03**
NITRATE	mg/L	1,7*	4,52*	25,37****	1,3*	-

PHOSPHATE	mg/L	-	0,1293*	0,16**	0,03*	0,017*
COPPER	µg/L	1,55*	0,282*	0,003*	0*	<5,9*
LEAD	µg/L	0,24*	0,014*	0,006*	0*	<6,5*
MANGANESE	µg/L	-	0,041*	0,08*	-	-
IRON	µg/L	1,86*	0,167*	1,147*	0,03*	<4,1*
ZINC	µg/L	1,59*	0,17*	-	0,48*	<3,9*

Table 2. Analysis Results for Kocaçay

KOCAÇAY						
		2012				
TEMPERATURE	(°C)	16*	12,2*	8,7*	12,1*	18*
pH		8,3**	7,77**	7,58**	7,82**	8,73**
DO	mg/L	5,79**	6,46**	-	-	12,44*
BOD	mg/L	2,5*	0,2*	-	-	5*
COD	mg/L	4,77*	16*	10*	17,82*	49,755**
NITRATE	mg/L	2,3*	10,54**	10,32**	6,6*	-
PHOSPHATE	mg/L	-	0,298**	0,1*	0,13*	0,07*
COPPER	µg/L	1,36*	0,020*	0,001*	158,8***	<5,9*
LEAD	µg/L	0,96*	0*	0,005*	23,76**	<6,5*
MANGANESE	µg/L	-	0,144*	0,167*	-	-
IRON	µg/L	1,71*	0,230*	0,288*	153,4*	<4,1*
ZINC	µg/L	<0,43*	0*	-	23,7*	<3,9*

Table 3.Analysis Results for MürvetlerStream

MURVETLER STREAM						
PARAMETER	UNIT	2012	2013	2014	2015	2016
TEMPERATURE	(°C)	16,6*	11,7*	8,4*	9,8*	12,7*
pH		8,45**	8,29**	7,5**	8,06**	7,51**
DO	mg/L	8,75*	6,8**	-	-	8,62*
BOD	mg/L	3,1*	0,4*	-	-	3*
COD	mg/L	5,57*	4*	8*	31,16**	45,39**
NITRATE	mg/L	3,2*	2,9*	12,64**	2,9*	-
PHOSPHATE	mg/L	-	0,496***	0,2**	0,24**	0,135*
COPPER	µg/L	1,09*	0,017*	0,003*	495,2****	<5,9*
LEAD	µg/L	0,35*	0,004*	0,001*	2,3*	<6,5*
MANGANESE	µg/L	-	0,051*	0,022*	-	-
IRON	µg/L	1,71*	0,256*	0,201*	86,9*	<4,1*
ZINC	µg/L	<0,43*	0*	-	1*	<3,9*

Table 4.Analysis Results for Karadere

KARADERE						
PARAMETER	UNIT	2012	2013	2014	2015	2016
TEMPERATURE	(°C)	20,5*	11*	8,2*	9,37*	16*
pH		8,19**	8,5**	7,15*	7,7**	9,2****
DO	mg/L	9,38*	7,46*	-	-	6,5**
BOD	mg/L	7,6**	0,3*	-	-	5*
COD	mg/L	11,95*	18*	22*	10,72*	28,82*
NITRATE	mg/L	11,3**	2,12*	9,78**	1,2*	-
PHOSPHATE	mg/L	-	0,193*	0,15*	0,05*	0,041*
COPPER	µg/L	1,62*	-	0,001*	432,6****	<5,9*
LEAD	µg/L	0,78*	-	0,003*	7,1*	<6,5*
MANGANESE	µg/L	-	-	0,217*	-	-
IRON	µg/L	1,71*	-	0,455*	232,4*	<4,1*
ZINC	µg/L	<0,43*	-	-	8,1*	<3,9*

Table 5.Analysis Results for Sığırcı Stream

SIGIRCI STREAM						
PARAMETER	UNIT	2012	2013	2014	2015	2016
TEMPERATURE	(°C)	24*	11,3*	8,3*	8,9*	17,8*
pH		7,66**	7,93**	7,42*	8,6**	8,72**
DO	mg/L	5,63**	4,45**	-	-	12,52*
BOD	mg/L	25,8***	0*	-	-	6*
COD	mg/L	39,2**	12*	46**	23,16*	50,915**
NITRATE	mg/L	5,3*	6,44*	56,73****	7,7*	-
PHOSPHATE	mg/L	-	0,885****	1,03****	0,76****	0,022*
COPPER	µg/L	2,15*	0,094*	0,002*	194,8***	<5,9*
LEAD	µg/L	1,4*	0,006*	0,002*	0,3*	<6,5*
MANGANESE	µg/L	-	0,314*	0,316*	-	-
IRON	µg/L	1,71*	0,288*	0,267*	341,6**	<4,1*
ZINC	µg/L	<0,43*	0,593*	-	11,6*	<3,9*

When compared the Sığırcı Stream with other streams, it is seen that the organic load of the Sığırcı Stream is higher than other streams. Especially, COD, BOD, Nitrate and Phosphate levels are the high pollution parameters in the Sığırcı Stream.The agricultural industries and hen slaughters located at the north regions of Bandırma District are the main reason of organic pollution in the Sığırcı Stream. In addition, the municipal wastewaters of the vicinity villages are the other reason of the organic pollution in the Sığırcı Stream.

The lake waters is belonging to (II) and (III) classification according to BOD parameter and belonging to (I) and (II) classification according to COD parameter. If it is thought that the Sığırcı Stream is responsible for 3% of water feeding the lake, it is seen that Sığırcı Stream is important pollution source of the lake.

It is clear from the analysis results of Mürvetler Stream that its water quality is not of problematic contaminants for the Lake of Manyas. The reason of this is that there is not any industrial activity and discharge of municipal wastewater to

Mürvetler Stream. This has provided that the Mürvetler Stream remains over as clean when compared the other streams. KocaçayStream, the other water supplier of the lake, is the clean water source for the lake like Mürvetler Stream except high heavy metal concentration measured rarely.

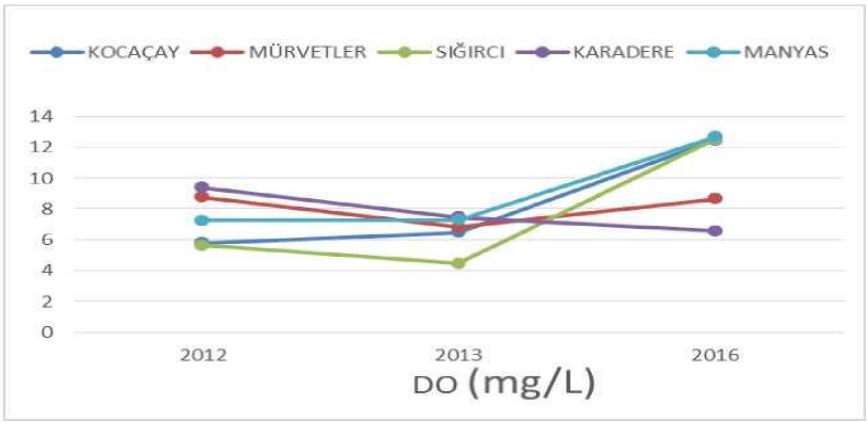

Figure 3. DO concentrationchangesbased on year

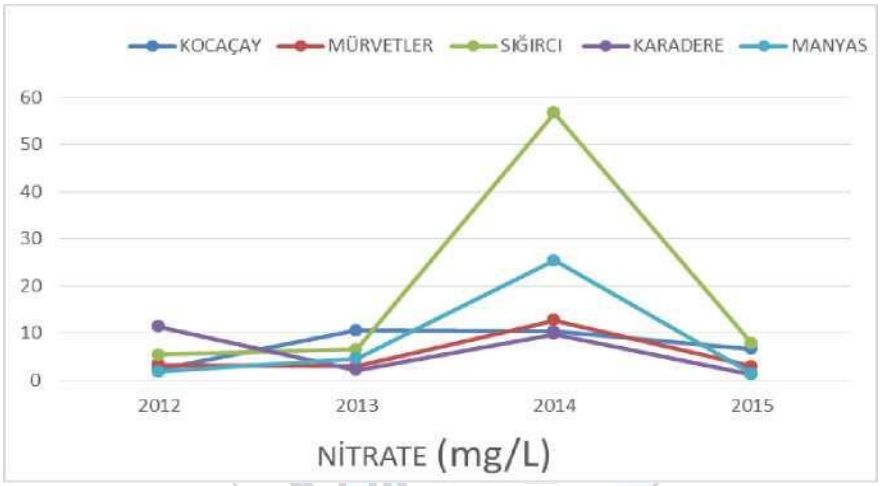

Figure 4. Nitrate concentration changes based on years

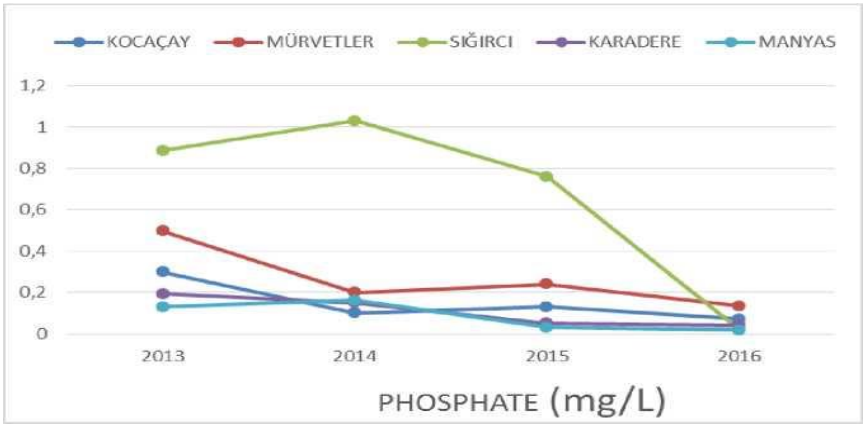

Figure 5. Phosphate concentration changes based on years

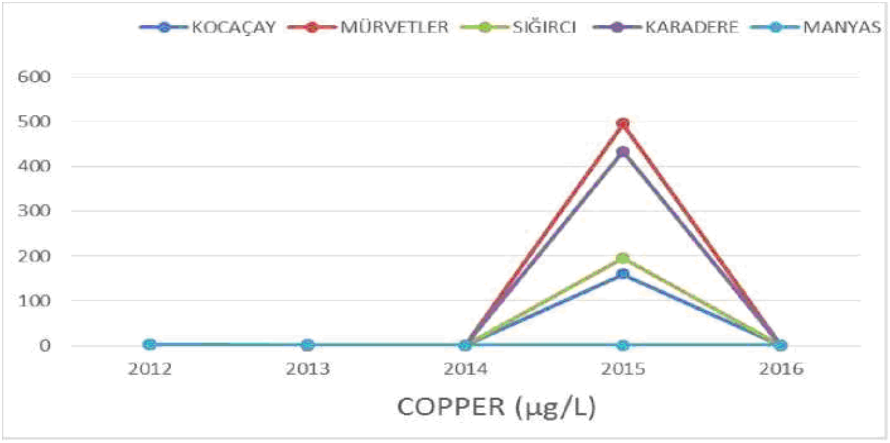

Figure 6. Copper concentration changes based on years

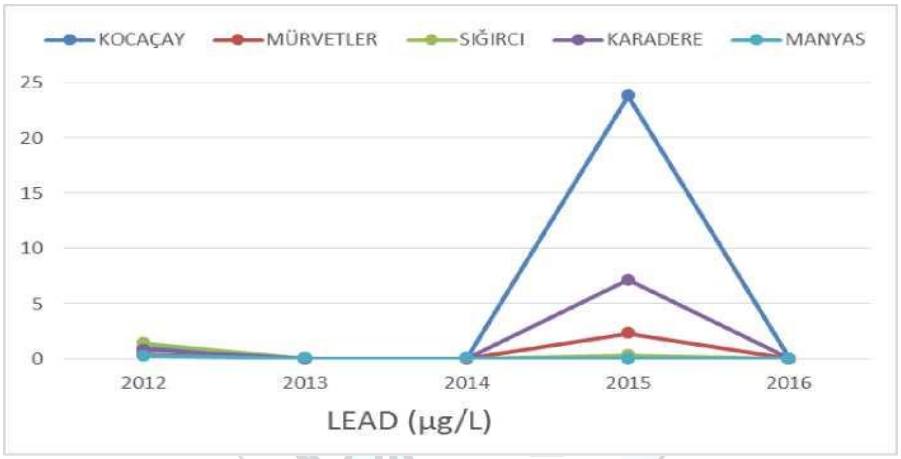

Figure 7. Lead concentration changes based on years

4. CONCLUSIONS

For the aim of prevention of pollution of the Lake of Manyas that is important natural source of Turkey, some precausions should be taken. These precausions can be summarized as follows:

- The industries in the lake regions must build the treatment systems and their operations should be controlled in respect to whether they are properly operated or not. When the treatment systems are not operated, strict sanction should be applied.
- The municipal wastewaters from houses around the lake should be treated.
- The water quality should be monitored by continuous monitoring devices at appropriated points and thus the controls will become continual.
- The flotation wastes which exist in the flood beds of Kocaçayand the stream connected to it should be collected from that region. Thus, the heavy metal transmigration to the lake should be prevented. At the same time, these wastes are economically valuable wastes as they are rich in zinc and lead.The alternatives that reduce the artificial fertilizer applications and enable to use of the mechanical agricultural struggle methods should be investigated and applied.

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