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PJBS

ISSN 1028-8880

**Pakistan
Journal of Biological Sciences**

ANSI*net*

Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Ecological Risk Analysis for Biotope Potantiality of Gala Lake in Turkey

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Abstract: In this study ecological risk analysis is applied for biotope potential of Gala Lake. The suitability and sensitivity of biotope potential against the present and planning uses are determined and then data is transferred to map. Suitability and sensitivity are evaluated together and ecological risk is determined then transferred to map. The most sensitive areas as regards biotope potential are determined as “Nature Conservation Area and Sites”. Ecological risk; is “high” in Hisarlı Mountain and the swamp areas, “medium/low” in agricultural fields.

Key words: Ecological risk, ecological planning, Gala lake, wetlands

INTRODUCTION

As a result of various activities of human some damages has occurred in nature. The excessive use of natural resources increased depended on the industrial revolution and as a result irreversible environmental pollution formed. The opinion of accepting the environmental problems as “international” instead of “national” gets important and it is understood that urgent measures must be taken to prevent or decrease the degradation in nature.

The starting point of solving the environmental problems and the nature conservation is to know and describe the problems. Almost every country carries on various studies on describing the environmental problems (Anonymous, 1998).

It is important to analyses and evaluates the relations between land sources and land uses to provide conservation and sustainable development of natural resources. The most common method is “ecological risk analyses”. Ecological risk assessment is process for systematically evaluating how likely it is that adverse ecological effects may occur as a result of exposure to one or more stressors. The goal of ecological risk assessment is to help understand the relationship between stressors and ecological effects to inform risk management decisions (Anonymous, 2003).

Ecological risk analysis was firstly applied by Bachfisher *et al.* (1977) in Germany. According to Aulig *et al.* (1977) the quantity of interactions among the present uses and planned uses should be determined in grades. Thus the negatively being affected risk of important ecologically biotopes and the other elements by various activities is exposed.

The ecological risk analysis is applied in a few fields in Turkey. The studies of Köseoğlu (1981), Altan (1982),

Altan (1991) and Yücel (1997) on this subject are available.

In this study, ecological risk analysis is applied to Gala Lake which is one of the important wetlands in Turkey by considering the mentioned studies.

In this study the determination of ecologically sensitive areas is aimed by determining the uses which destroy the biotope potential of Gala Lake and the ecological effects originated from these uses. For this purpose, the suitability, the sensitivity and the negative effect as regards biotope potentiality are determined and according to the result the ecological risk mapping is prepared.

MATERIALS AND METHODS

Gala Lake is chosen as material in this study (Fig. 1). The Meriç River, which constitutes the border between Turkey and Greece, forms a large delta and several small lakes are located. Gala Lake located in Thrace Region of Turkey and 10 km to the north of Enez. Gala the major lake on the delta, consist of two sections, Büyük (or Big) Gala and Küçük (or Small) Gala. Lakes Pamuklu and Meriç and the two Gala Lakes are all interconnected. Pamuklu Lake to the northeast of Gala Lake is covered with reeds. Gala Lake has a big water mirror in the research area. Reeds are mostly seen in the edge of the lake, but Küçük (or Small) Gala Lake is mostly covered with reeds (Fig. 2). Gala Lake is in the borders of Meriç Delta, which was announced as class A type wetland according to international criteria and announced as “Nature Conservation and Site Area”. The north part of the area is used as rice paddies, the foothill of the Hisarlı Mountain is covered with bushes and forests.

The basis of ecological risk analysis is consist of the interactions among the different complex land uses and the analysis of the interactions between the natural

potentiality and land uses. This interaction is formed by the relation among the uses which destroys the land, the effects formed by these uses and the components which are destroyed by these effects (Altan, 1991; Yücel, 2001).

Ecological risk analysis method is formed by four different phases which follows each other. Determination of ecological risk, sensibility against the negative effect and intensity of negative effect forms the two important phases. According to Bachfischer, the sensibility against the negative effect is depended on the usage of the sources in the area, the quantity of the suitability of these uses and the reaction of the land to these effects. This concept qualitatively describes the suitability of the natural potential of the land for the various land use. Quantitatively, the amount of the suitable land uses to the land gets important (Altan, 1991).

The other concept is intensity of negative effects. The intensity of the effect is depended on the land use which is the source of negative effect and the state of the negative effects formed by this land use. The intensity of the negative effect is determined by two factors. The first one is the sort and the quantity of the negative effect and the second one is the condition and the distribution of the natural factors in the area (Altan, 1991).

Another concept for determining the ecological risk is “the suitability” for land use. The suitability and sensitivity are related with each other. If the natural potential is suitable to the land use then the sensitivity is low, if not then sensitivity is high (Yücel, 2001).

When the intensity and sensitivity which are effective in obtaining the risk are evaluated together the risk of the negative effect can be indicated in grades. The risk gets lower when the sensitivity and intensity get lower. It is impossible to make a numerical evaluation since the criteria which play role in determining the ecological risk is ecological factors, instead of this it is possible to make comments by using grades (Yücel, 2001).

In the first step of this study the grades for sensitivity and suitability are made by using evaluating factors for biotope potential. Various evaluating factors are considered in determining the suitability and sensitivity.

In the second step a graduation is made to determine the sensitivity which is necessary to display the degrees and the amount of the effects. The grades are determined as “high sensitive” “medium sensitive” “low sensitive”.

Afterwards, potential negative effect is displayed by determining the negative effects and their intensity and sensitivity against these negative effects. To display the degree of effects a graduation of “high intensity” “medium intensity” and “low intensity” is made. The potential negative effects and suitability for uses are

evaluated together and the ecological risks were displayed.

In the last stage of the study data are transferred from 1/25.000 scaled maps to 1/50.000 scaled maps. By considering the suitability and sensitivity for biotope potential, suitability is given by cross-hatching and the sensitivity of the biotope potential is given by coloring. The criteria of suitability and sensitivity are given in the same map but the risky areas against ecologically negative effects are given in a transparent map which is put on the main map. The risky areas are determined depended on the degree of correspondence of suitability and sensitivity.

Ecological risk analysis for biotope potential of Gala lake:

Biotope is defined as a homogeneous living medium where is evident separated from the other environments (Çepel, 1995). Biotope potential is the wealthy of the species and varieties of flora and fauna in an area.

The state of being effected from the pressures in the environment and suitability and sensitivity of the biotopes of Gala Lake which provides living mediums for important bird species is determined individually.

Suitability: The biotope potential of the research area is consist of existing flora and fauna in the area. Kantarci (1988), Anonymous (2000a) and Anonymous (2001) were referred to determine the flora of the area. Besides data which was collected in the area studies were evaluated. The area has three structurally different ecosystems which are; water ecosystems, half-terrestrial ecosystems and terrestrial ecosystems. In Table 1 the flora of Gala Lake and Pamuklu Lake is given.

The criteria from Red Data Book prepared by IUCN in 1994 were used to determine the species in danger and the endemic species (Anonymous, 2000b). There is not any endemic species in the research area. According to the criteria of IUCN *Trapa natas L. (Trapaceae)* in the Pamuklu Lake environment is in the group of “vulnerable” species. This property makes the area more important.

The area is not only important because of the plant communities but also because of the potential of providing living mediums, accommodation and protection zones for birds. Various studies are available about the research of bird species of Thrace region. In the studies on Gala Lake different numbers of bird species are given. According to Anonymous (1991) the number of bird species is 112, it is given as 111 in Anonymous (2000a), 146 in Ertan (1994), 134 in Kaya (2000).

Three bird species of 134 is in the group of A.1.2, 23 in A.2, 30 in A.3, 21 in A.4, 6 in B.2, 10 in B.3. A total number of 93 is in the “Red List”. A.1.2 includes the

Table 1: Flora of Gala and Pamuklu lakes (Kantarci, 1988, Anonymous, 2000a and Anonymous, 2001)

Fresh water ecosystems		Half-terrestrial ecosystems	
Family	Latin name	Family	Latin name
Alismataceae	<i>Alisma plantago-aquatica</i>	Cyperaceae	<i>Cyperus sp.</i>
Ceratophyllaceae	<i>Ceratophyllum demersum L.</i>	Cyperaceae	<i>Carex sp.</i>
Cyperaceae	<i>Scirpus=schoenoplectus lacustris L.</i>	Cyperaceae	<i>Rhynchospora sp.</i>
Haloragaceae	<i>Myriophyllum verticillatum</i>	Equisetaceae	<i>Equisetum sp.</i>
Hydrocharitaceae	<i>Vallisneria spiralis L.</i>	Gramineae	<i>Agropyron repens (L.)beauv.</i>
Lemnaceae	<i>Spirodela polyhiza (L.) schliden</i>	Gramineae	<i>Butomus umbellatus l.</i>
Lemnaceae	<i>Lemna minor L.</i>	Gramineae	<i>Panicum purpureccusi</i>
Lemnaceae	<i>Lemna trisulca L.</i>	Potamogetonaceae	Potamogeton natans
Menyanthaceae	<i>Nymphoides peltata (s.m.gmalin) o.kuntze</i>	Salicaceae	<i>Populus alba</i>
Najadaceae	<i>Najas minor L.</i>	Salicaceae	<i>Salix nigra l.</i>
Nymphaeaceae	<i>Nymphaea alba L.</i>	Tamaricaceae	<i>Tamarix germanica</i>
Poaceae	<i>Phragmites australis (cav) trin ex steudel</i>	Typhaceae	<i>Thypha latifolia</i>
Potamogetonaceae	<i>Potamogeton fluitans</i>	Terrestrial ecosystems	
Potamogetonaceae	<i>Potamogeton crispus L.</i>	Betulaceae	<i>Carpinus orientalis miller</i>
Potamogetonaceae	<i>Potamogeton pectinatus L.</i>	Cornaceae	<i>Cornus mas l</i>
Potamogetonaceae	<i>Potamogeton panormitanus biv.</i>	Cupressaceae	<i>Juniperus oxycedrus l</i>
Potamogetonaceae	<i>Potamogeton perfoliatus L.</i>	Fagaceae	<i>Quercus frainetto ten.</i>
Ranunculaceae	<i>Ranunculus trichophyllus chaix.</i>	Fagaceae	<i>Quercus cerris l.</i>
Salviniaceae	<i>Salvinia natans(L.) all.</i>	Pinacea	<i>Pinus brutia Ten</i>
Trapaaceae	<i>Trapa natans L.</i>	Rhamnaceae	<i>Paliurus spina- christi Mill.</i>
Typhaceae	<i>Thypha angustifolia L.</i>		

species of Turkey which are critically endangered, A.2 includes the ones endangered, A.3 includes the ones threatened, A.4 includes the ones near threatened, B.2 includes the ones migrating over Turkey or winter visitors of Turkey which are endangered, B.3 includes the ones migrating over Turkey or winter visitors (Kaya, 2000).

Cygnus olor, *Grus grus*, *Alcedo atthis* are the winter or summer visitors but not the native species of Gala Lake defined as critically endangered species of Turkey in "Red List".

The native species of Gala Lake which are endangered in Turkey are; *Podiceps nigricollis*, *Phalacrocorax carbo*, *Pelecanus onocrotalus*, *Egretta garzetta*, *Aquila heliaca*, the ones winter or summer visitors but not native species are *Podiceps cristatus*, *Podiceps grisegena*, *Phalacrocorax aristotelis*, *Pelecanus onocrotalus*, *Pelecanus crispus*, *Botaurus stellaris*, *Ardea cinera*, *Ciconia nigra*, *Tadorna feruginea*, *Tadorna tadorna*, *Charadrius dubius*, *Hoplopterus spinosus*, *Chlidonias hybrida*, *Chlidonias leucopterus*, *Streptopelia turtur*, *Coracias garrulus*, *Upupa epops*.

The endangered migrating bird species over Turkey or winter visitors are *Podiceps auritus*, *Mergus merganser*, *Calidris ferruginea*, *Gallinago gallinago*, *Tringa erythropus*, *Tringa ochropus*.

The threatened migrating species over Turkey or winter visitors are; *Calidris minuta*, *Limosa limosa*, *Numenius arquata*, *Tringa nebularia*, *Tringa glareola*, *Larus minutus*, *Larus ridibundus*, *Larus genei*, *Larus canus*.

According to Ongan (1994) the fish fauna of Gala Lake is represented with 16 species which are; *Perca*

fluviatilis L., *Rutilus rutilus L.*, *Cyprinus carpio L.*, *Scandinius erythrophthalmus L.*, *Carassius auratus L.*, *Esox lucius L.*, *Abramis brama L.*, *Tinca tinca L.*, *Aspius aspius L.*, *Stizostedion lucioperca L.*, *Bilicoa bjoerkna L.*, *Lepomis gibbosus L.*, *Leuciscus cephalus L.*, *Anguilla anguilla L.*, *Siluris glanis L.*, *Astacus leptodactylus*. *Esox lucius*, *Stizostedion lucioperca L.* ve *Anguilla anguilla L.* have economic value. *Perca fluviatilis L.*, *Rutilus rutilus L.*, *Cyprinus carpio L.*, *Scandinius erythrophthalmus L.*, *Carassius auratus L.*, *Abramis brama L.* are fishing species. Besides the fish species, the lakes in the area also include turtle, frog and water snake species.

Otto-Zimmermann determined the suitability for biotope types flora and fauna as "high" "medium" and "low" in the suitability classification of biotope potential as regards biotope types (Table 2) (Yücel, 1997). Biotope mapping which has an important role in determining the biotope potential for biotope mapping has been prepared by us (Fig. 3).

The Küçük Gala Lake and Pamuklu Lake have characteristic biotope structure in the protection zone. The north part of the "Nature Conservation and Site Areas" has rice paddies in places. The suitability classification of the area is given in Table 3. According to this table the wetlands and the areas protected by legal arrangements are determined as "very suitable", the waters and forests rich by the nutrition as "Less suitable", the areas poor by the species as "not suitable".

Sensibility: The sensibility of the biotope potential is the reaction of the biotopes against the present or possible external interferences and against the hindrances which

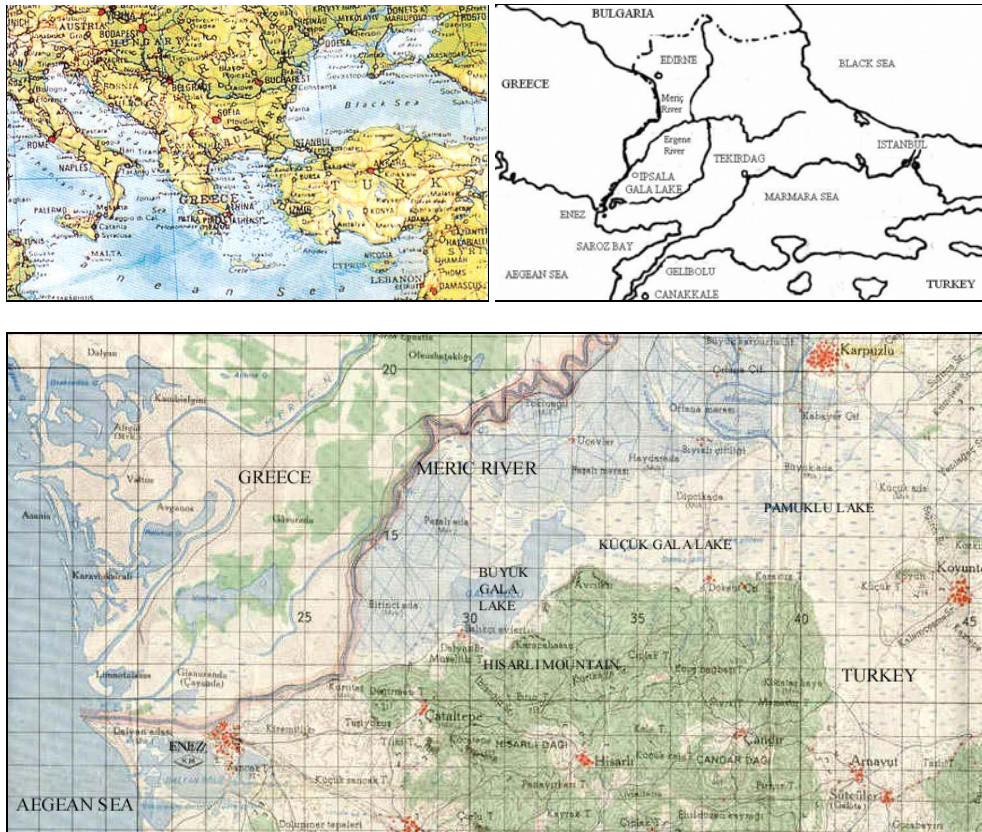


Fig. 1: Research area



Fig. 2: A view of Küçük Gala Lake

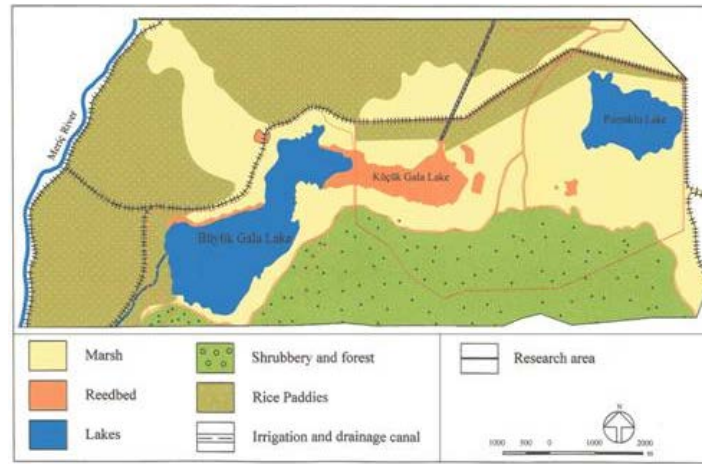


Fig. 3: Types of Biotope

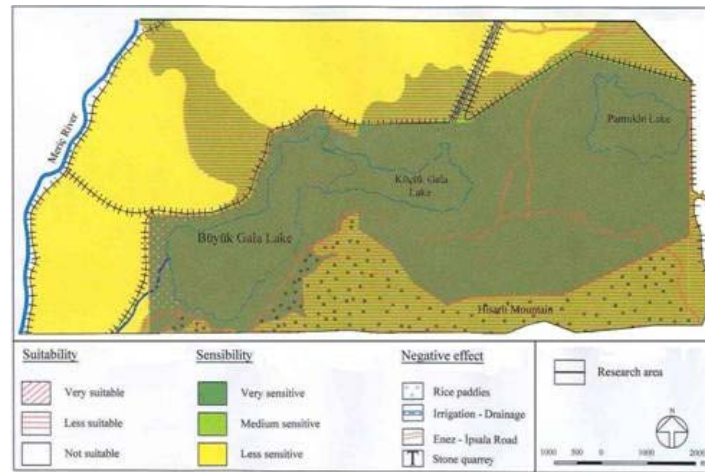


Fig. 4: Biotope Potential

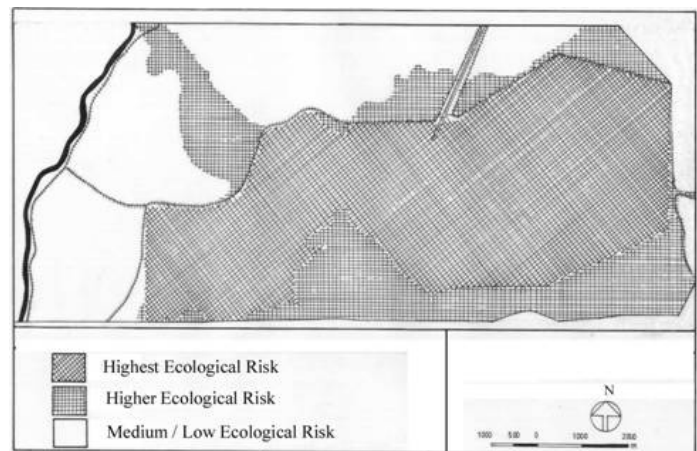


Fig. 5: Ecological risk map for Biotope Potential of Gala Lake

Table 2: Suitability classification of biotope potential as regards biotope types (Yücel 1997)

Suitability	Biotope types
Very high	Flora: Rather poor living mediums as regards nutrition, poor water as regards nutrition, wetlands in good conditions, turfs, species in "Red List". Fauna: The areas where the species in "Red List" fed, sheltered, reproduce.
High	Flora: Wetlands (reeds, high perennials), natural forest, extensively used wet meadows, species not included in "Red List". Fauna: Living mediums where the species fed, sheltered and reproduce.
Medium	Flora: Eutroficated water with poor flora (streams, small lakes), extensively used meadows, hedges, forest poor as regards species. Fauna: species generally found in the region.
Low	Flora: Excessively used meadows with a little number of hedges, monoculture forests, Temporarily uncultivated areas with ruderal plants. Fauna: Species generally found in the region.

Table 3: The suitability classification of Gala lake biotope potential

Type of biotope	Suitability evaluation	Suitability
Nature conservation area and sites of Gala lake	Areas conserved by laws wetlands	High
Irrigation and drainage systemsHisarl mountain	Waters rich by nutrition forests	Low
Rice paddies	Areas poor by nutrition	Not suitable

Table 4: The sensibility classification of the biotope potential of Gala lake

Type of biotope	Sensibility criteria	Sensibility degree
Wetlands	Agricultural activities, road construction, stone quarry	High
Wetlands, shrubbery, destroyed forests	Drainage, tree cutting	Medium
Rice paddies	Agricultural activities	Low

Table 5: The intensity of the negative effects

Types of the effects	Intensity
Agriculture usage of chemicals	High
Transportation planned roadway	High
Stone quarry threat of living life	Medium

Table 6: Determination of potential negative effects

Intensity of negative effect	Sensibility (All of land-uses)		
	High	Medium	Little
Present and planned land-uses			
High	●	●	●
Medium	●	●	●

● Highest potential negative effect, ● Higher negative effect

Table 7: Determination of ecological risks

Potential negative effect	Suitability (Nature conservation)		
	High	Medium	Low
●	■	■	■
●	■	■	■

■ Highest ecological risk, ■ Higher ecological risk, ■ Medium/low ecological risk

blocks its functions in landscape. The sensibility criteria of the area are given in Table 4.

Sensibility of any biotope has a close relation with the suitability of this biotope. The sensibility of the biotope becomes higher depending on; the sensitivity of the ecological balance of the biotope, the number of the endemic species and the species in danger of disappearance, the hard conditions for biotope to renew itself. From this point of view, Gala Lake and Pamuklu Lake is classified as "high sensible", wetlands and Hisarlı Mountain as "medium sensible", agricultural fields as "low sensible" (Fig. 4). The road planned to be built from Enez to Ipsala increases the sensibilities of the biotopes in the "Nature Conservation and Site Areas".

Negative effect: In the research area the pressure due to the present uses on the biotope potential is the usage of chemicals (pesticides and fertilizers). The plant and animal species especially birds and fishes are under excessive pressure. Besides the drainage systems causes important function loss in wetlands. Another land uses that affects the biotope potential are the road from Enez to Ipsala which is partially structured and the stone and the stone quarry. The ecological risks are determined as follows by considering the suitability and the sensibility of the biotope potential and effects.

First of all the intensity of the negative effects according to the present and planned land uses are determined (Table 5).

In the second step, "potential negative effects" are determined by considering the intensity of the negative effects and the sensibility of the biotope against all the land uses on the area (Table 6).

Lastly, the ecological risks are determined by considering the potential negative effects and the criteria of suitability to nature of biotope potential (Table 7). This Data is collected and transferred to the map given on Fig. 4.

Ecological risk for biotope potential in the study area is determined for Nature Conservation Area and Sites as "highest", for marshes and Hisarlı Mountain as "higher", for rice fields as "medium/low" (Fig. 5). Since the Nature Conservation Area and Sites has sensible characteristic biotopes it is determined as high risky areas. 93 of 134 bird species of the area are in the "Red List", this expose the importance of the area as regards conservation.

REFERENCES

- Altan, T., 1982. A Research on Application of Ecological Landscape Plans in Regional Scale and Determination of Land Use Proposal in Cukurova by Using Software. Cukurova University Agriculture Faculty. Publication No:161, Adana.
- Altan, T., 1991. Ecological Risk Analyses and Tourism Planning. Tourism and Environment Conference, October 3-5, 1990. Environmental Problems Foundation of Turkey Publication, Ankara, Turkey, pp: 75-98.
- Anonymous, 1991. Council of Ministers Decision Showing the Announcement of Natural Conservation of Gala Lake, Official Gazette, 18/8/1991, Number: 20964, Ankara, Turkey.
- Anonymous, 1998. Environmental Problems of Turkey. Environmental Problems Foundation of Turkey Publication No: 131, Ankara, Turkey.
- Anonymous, 2000a. Rural Environment and Forestry Problems Research Association Publication No: 9, Ankara, Turkey.
- Anonymous, 2000b. The Red Data Book Of Turkish Plants. The Association For Conservation of Nature and Van Centennial Univ. The Association For The Conservation of Turkey's Nature Publication, Ankara, Turkey.
- Anonymous, 2001. Environmental Report of Edirne. Governorship of Edirne.
- Anonymous, 2003. Ecological Risk Assessment Training, U.S. Environmental Protection Agency, (EPA), Washington, D.C.
- Aulig, G., R. Bachfischer, J. David, G. Kiemstedt und Müller, 1977. Wissenschaftlichen Gutachten zu Ökologischen Planungsgrundlagen im Verdichtungsraum Nürnberg-Fürth-Erlangen-Schwach, München.
- Bachfischer, R., J. David, H. Kiemstedt and G. Aulig, 1977. Die Ökologische Risikoanalyse als Regionalplanerisches Entscheidungsinstrument in der Industrieregion Mittelfranken. Landschaft+Stadt, Eugen Ulmer Gmb. H. and Co., Stuttgart, 9: 145-161
- Çepel, N., 1995. The Dictionary of Nature Conservation and Ecology. Publication of TEMA Foundation, Publication No: 6, Istanbul, Turkey.
- Ertan, A., 1994. Conservation and Usage Problems of an Important Bird Area: Gala Lake and It's Basin. Enez Environment Symposium, Edirne Environment Foundation Publications No: 1, Edirne.
- Kantarci, D., 1988. The ecological properties of Hisarli Mountain and Gala Lake and opportunities for evaluation of the region as natural conservation area Proceedings of the Symposium of Gala Lake and its Problems, May 27, 1988, Enez, Edirne.
- Kaya, M., 2000. Researches on Onito Fauna of Gala Lake and Its Environment. Graduate School of Natural and Applied Science (Ph.D. Thesis) Thrace Univ., Edirne.
- Köseoğlu, M., 1981. Landscape Ecology Studies and Research on Mapping of Ecologically Important Biotopes As in Aegean Region. Aegean University Agricultural Faculty Publication No: 442, Bornova Izmir, Turkey, pp: 148.
- Ongan, T., 1994. Present Situation of Fisheries and Aquaculture of Gala Lake and Comparison The Situation in The Past. Enez Environment Symposium, Edirne Environment Foundation Publications No: 1, Edirne.
- Yücel, M., 1997. Ecological Risk Analyses of the Region Between Seyhan River and Yumurtalık Gulf in Cukurova Basin. Cukurova University Agriculture Faculty Resarch Project No: BAP-PM-96/03, Adana
- Yücel, M., 2001. Environmental Impact Assessment. Baki Kitapevi Publication No: 24, Adana, pp: 298.