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Assessment of biodiversities and spatial structure of Zarivar Wetland in Kurdistan Province, Iran

MAHDI REYAHI-KHORAM♥, KAMAL HOSHMAND♥♥
Department of Environment, Hamadan Branch, Islamic Azad University, Hamadan, Iran, P.O.BOX: 734, Professor Mosivand st. Tel: +988114494170, Fax: +988114494170, Email: ♥phdmrk@gmail.com; ♥♥kamal_hoshmand@yahoo.com

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ABSTRACT

Reyahi-Khoram M, Hoshmand K. 2012. Assessment of biodiversities and spatial structure of Zarivar Wetland in Kurdistan Province, Iran. Biodiversitas 13: 130-134. Wetlands are valuable ecosystems that occupy about 6% of the world's land surface. Iran has over 250 wetlands measuring about 2.5 million hectares. Zarivar wetland (ZW) is the only natural aquatic ecosystem in Kurdistan province in Iran. The present research was carried out during 2009 through 2010 with the aim of recognizing the capabilities and limitations of ZW through documentary, extensive field visits and also direct field observations during the years of study. Geographic Information System (GIS) has been used to evaluate the land as a main tool. The results of this research showed that ZW has a great talent regarding diversity of bird species and the ecological status of wetland has caused the said wetland welcome numerous species of birds. The results of this research showed that industrial pollutions are not considered as threats to the wetland but evacuation of agricultural runoff and development of Marivan city toward the wetland and the resulting pollution load could be introduced as an important part of the wetland threats. It is recommended to make necessary studies in the field of various physical and biological parameters of the wetland, and also the facing threats and opportunities.

Key words: aquatic, biodiversity, environment, wetland, Zarivar

INTRODUCTION

The environment is a giant and sophisticated set of different processes that have emerged due to gradual evolution of living beings and their interference with nonliving parts on earth. Wetlands are ecosystems that provide numerous goods and services that have an economic value, not only to the local population living in its periphery but also to communities living outside the wetland area (Reyahi Khoram et al. 2011, 2012). Wetlands are valuable ecosystems that occupy about 6% of the world's land surface. They comprise both land ecosystems that are strongly influenced by water, and aquatic ecosystems with special characteristics due to shallowness and proximity to land. The Convention on Wetlands is an intergovernmental treaty, adopted on 2nd February 1971, in Ramsar, a northern coastal city in Iran; its aim is to promote the conservation and wise use of wetlands, acknowledging that these are extremely important ecosystems for the conservation of biological diversity and welfare of human communities. At present the Ramsar list includes 1933 wetlands of international importance, summing up 189 million of hectares protected in the 160 member states (Ramsar Convention of Wetlands 2011).

Iran has over 250 wetlands measuring about 2.5 million hectares. 22 out of these wetlands measuring 1.8 million hectares have been registered as international wetland in Ramsar Convention (Ramsar Convention of Wetlands 2011). Although the ecological value of wetlands is 10 times as forests and 200 times as farmlands, but unfortunately, 6 international wetland sites of 22 registered wetland sites of Ramsar conversion with the area of 583000 hectares (over 30% of the area of the wetlands of the country registered with Ramsar Convention) are exposed to the threat and acute ecological changes, so that their name is in Montreux Record (Ramsar Convention of Wetlands 2009). Although various different classifications of wetlands exist, a useful approach is one provided by the Ramsar Convention on Wetlands. It divides wetlands in to three main categories of wetland habitats: marine (coastal) wetlands; man-made wetlands and inland wetlands. Inland wetlands refer to such areas as lakes, rivers, streams and creeks, waterfalls, marshes, peat lands and flooded meadows (Schuyt 2004).

Zarivar wetland (ZW) is inland wetland according to mentioned classification. ZW is the only natural aquatic ecosystem in Kurdistan province in Iran. This wetland has formed due to sever erosion of geological formations of the region. This important ecological zone is located in the northwest of Marivan city and situated in the north of Zagros fold belt. According to the classification of wetland habitats approved by Ramsar convention, ZW is in the sweet water section of permanent reservoirs of permanent sweet water wetlands (more than 8 hectares). From a tectonic point of view, Marivan region is an active region and its fold belongs to the middle of the third geological period. ZW is located between 46°, 06', 11" to 46°, 9', 16" eastern longitudes and between 35°, 30', 53" to 35°, 35',

12" northern latitude with altitude of 1285 meters from sea level, and 2 Kilometers far from Marivan city in Kurdistan province (Figure 1)

The aim of this research is to determine characteristics of ZW and providing management strategies which tourists could visit the attractions without damaging the area.

MATERIALS AND METHODS

The present research was carried out during 2009 through 2010 to recognizing the capabilities and limitations of ZW in Kurdistan province in Iran through documentary, extensive field visits and also direct field observations during the years of study. Through the period, using the map, Global Positioning System (GPS) and in some cases through afoot surveying or using car, the geographical location of aquatic species of the region were identified. In this research, valid academic resources were used for identification of Birds, Mammals, Reptiles and Amphibians (Latifi 2000; Mansoori 2008; Ziaie 2008). To identify and define ecological resources of the region, digital maps were used and on this basis the topology situations as well as ground cover of studied area have been accomplished. In addition, Geographic Information System (GIS) has been used to evaluate the land as a main tool. The software used was Arc View (version 3.2a) with the Universal Transverse Mercator (UTM) projection and scale was 1/50,000 (Demers 2009).

RESULTS AND DISCUSSION

Physical and hydrological status

ZW covering 3292 hectares was officially declared as a wildlife refuge in 2009 by Department of Environment (DoE) of Iran. The semi humid to humid climatic conditions of the area surrounding the ZW caused formation of a unique forest covering in the mountains of this region, and despite the numerous devastating consequences, it has still beautiful landscapes. The pastures of ZW were one of the first grade and appropriate pastures of Iran. But today, due to irregular use, its ecological balance has changed. ZW was more extensive with a spherical zone shape was made in the past due to function of some faults with northwestern-southeastern alignment and falling of its middle part. Other natural functions of ZW are related to sweet water wetland that creating an appropriate medium for growth of plants, fish and also living of migrating and native birds and animals.

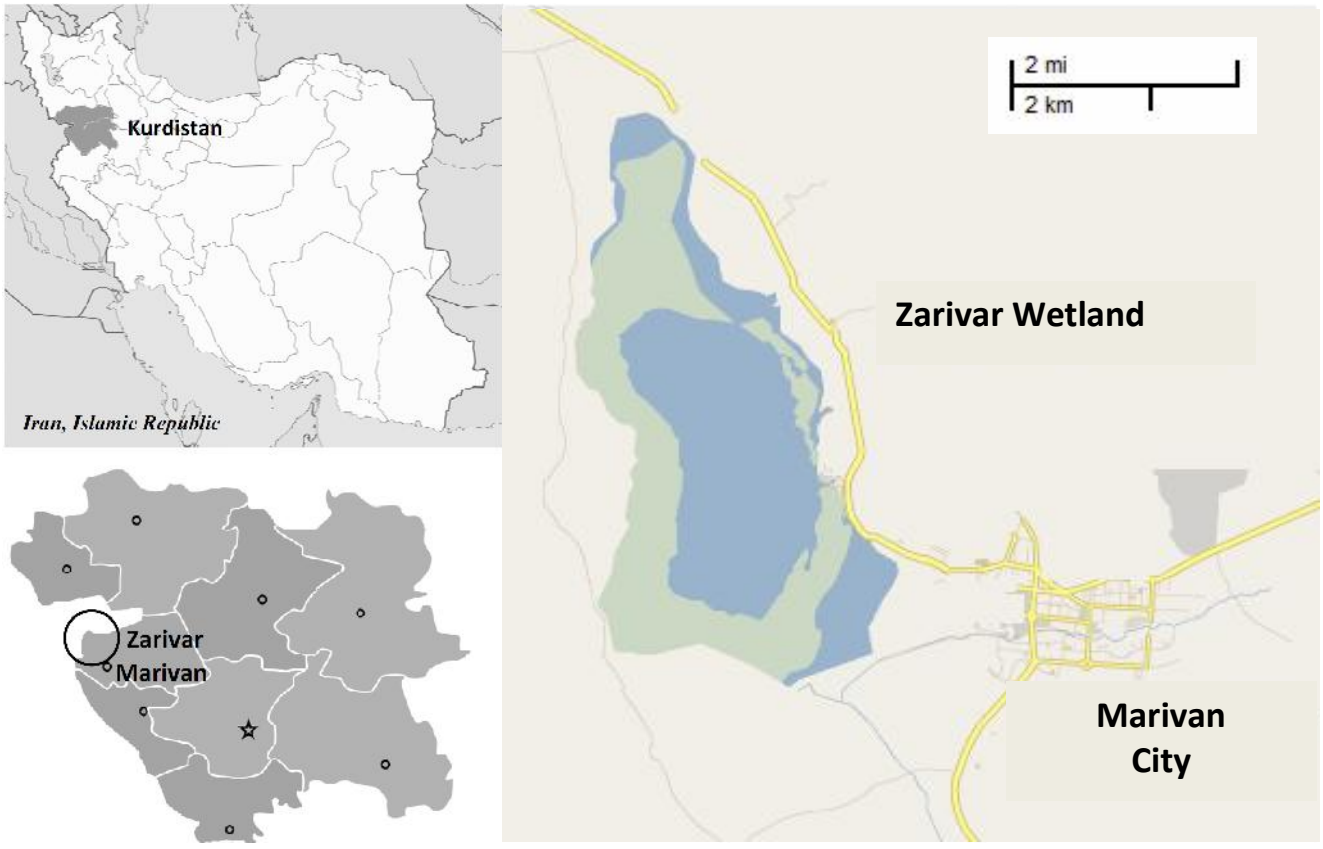

Figure 1. Location of the study area, Zarivar Wetland, Marivan City, Kurdistan Province in Iran

The surroundings of wetland are Forest Mountains related with Zagros Mountains. The water of sweet water wetland is supplied from a number of springs on the bottom of wetland and also climatic precipitations and numerous springs surrounding the wetland. Due to the changes in the volume of wetland water in the seasons of the year, its water level changes. Its minimum depth is 6 meters and maximum 12 meters. The Zarivar basin with a population of 70,445 (over 85% city dwellers) has two sub basins; Marivan sub basin with the area of 5000 hectares and Zarivar sub basin with the area of 10,827 hectares. The volume between the minimal and maximal figures of wetland water height reaches 19 million cubic meters, and the average annual water evacuation of springs at the bottom of wetland reaches 13 million cubic meters. The average annual water entering the wetland is about 54 million cubic meters, of which 41 million cubic meters is supplied through surface runoff and the remainder through the springs at the bottom of wetland. The average annual precipitation of the region is 786 millimeters. The area of wetland varies due to the changes of water volume during various seasons. The wetland medium perimeter is about 22 Km, relative humidity of 58% and the average annual evaporation of approximately 1900 mm. The highest point in the studied area is 1895 meters above sea level, on northwest of wetland.

The soils around the wetland and shallow lands are deep with brownish grey color. Most of these soils are of silt clay or loam silt clay. The soil textile is light in the water surface parts and is heavy in depth. The underground water table in these types of soil has been estimated 1 to 2 meters. ZW acts in the center of the basin as water flow regulator. The status of springs at the bottom of wetland is not precisely known. Some deem it likely that the water of springs is supplied through carset resources. On this basis, the said springs are related with the confined aquifer from geohydrological point of view. An aquifer may be defined as a formation that contains sufficient saturated permeable material to yield significant quantities of water to springs or wells. Confined aquifers, also known as pressure aquifers, occur where groundwater is confined under pressure grater than atmospheric by overlying relatively impermeable strata. Therefore, if the wetland water level is manipulated by measures such as dam construction, the pressure of water due to increasing water level of wetland will prevent from water flow of wetland bottom springs.

Field studies showed that the industrial plants are not located around the wetland. Hence ZW is not exposed to industrial wastewater pollution and the source of wetland pollution is related to surface runoff and compared to the flow rate of springs, it is more important as regards quality and quantity.

Based on the existing reports, the amount of five-day Biochemical Oxygen Demand (BOD_5) and Chemical Oxygen Demand (COD) of wetland water is very small so that BOD5 of wetland water has been reported between 1 to 2 milligrams per liter and the amount of Dissolved Oxygen (DO) was acceptable (Rahnamai 1996). Ghaderi and Ghafouri (2006) showed in their research that from the pollutants transferred to ZW and regarding the intensity of pollution production, the non point source pollution related to agricultural activities was first rank among other pollutant as community wastewater, solid waste grassland pollution and forest. These pollutions are transferred directly to wetland and threaten the biological systems of ZW.

In this situation, the results obtained from the experiments made on the wetland water show that the amount of DO of wetland water is in favorable limit and the amount of the measured BOD and COD is acceptable. It is obvious that the low amount of pollution indices including BOD and COD indicate that the amount of self-purification capacity of wetland is favorable and the reedy surrounding the wetland has an effective role in diminishing the pollution.

The results of this research showed that industrial pollutions are not considered as threats to the wetland but evacuation of agricultural runoff and development of Marivan city toward the wetland and the resulting pollution load could be introduced as an important part of the wetland threats. Also evacuation of urban and rural wastewaters inside the wetland will create sever problems for the ecological status of the wetland.

Biological status

ZW is considered among the important habitats of the province, and its surrounding regions are appropriate habitat for various animals. Reedy that is connected to the wetland coasts and the reedy that have been formed the islands inside the wetland, are among the main habitats for the birds and amphibious of wetland. Each year numerous species of migrating birds including waterfowl and wader birds spend part of their winter times and birth giving season in this wetland. The biological statuses of wetland include the following sections.

Animal phone

The said wetland is important as concerns biological conditions. First its surrounding reedy's is ecologically appropriate for egg laying of the birds and amphibious. Also the wetland water ecosystem provides appropriate conditions for the life of various amphibious and aquatics (Rahnamai 1996). The most important known biological elements existing within ZW adopted by its environment is as follows:

Phytoplanktons:

Blue-green algae	(*Microcystis* sp.)
Brown algae	(*Macrocystis* sp.)
Diatom	(*Cymbella* sp.)
Diatom	(*Navicula* sp.)
Diatom	(*Synedra* sp.)
Green algae	(*Chalmydomonas* sp.)
Green algae	(*Chlorella* sp.)
Green algae	(*Scenedesmus* sp.)

Zooplanktons:

Cyclops	(*Cyclops* sp.)
Daphnia	(*Daphnia* sp.)
Diaphanosoma	(*Diaphanosoma* sp.)
Phyllodiaptomus	(*Phyllodiaptomus* sp.)
Rotifer	(*Rotifera* sp.)

Fishes:

Caspian shemaya, Blea	(*Chalcalburnus* sp.)
Common carp	(*Cyprinus carpio*)
Crucian carp	(*Carassius auratus*)
Eel	(*Mastacembelus mastacembelus*)
Grass carp & White amur	(*Ctenopharyngodon idella*)
Mosquito fish	(*Gambusia affinis*)
Parma levantská	(*Capoeta damascina*)
Silver carp	(*Hypophthalmichthys molitrix*)
Stone morocco	(*Pseudorasbora parva*)

Birds:

Common moorhen	(*Gallinula chloropus*)
Eurasian Coot	(*Fulica atra*)
Grate crested grebe	(*Podiceps cristatus*)
Great cormorant	(*Phalacrocorax carbo*)
Grey heron	(*Ardea cinerea*)
Lesser white-fronted goose	(*Anser erythropus*)
Little grebe	(*Tachybaptus ruficollis*)
Mallard	(*Anas platyrhynchos*)
Purple heron	(*Ardea purpurea*)
Squacco heron	(*Ardeola ralloides*)
Water rail	(*Rallus aquaticus*)

Mammals:

Otter, european oteter	(*Lutra lutra*)
Water vole	(*Arvicola terrestris*)
Wetland cat	(*Felis catus*)
Wild boar	(*Sus scrota*)

Reptiles:

Caspian pond turtle	(*Mauremys caspica*)
Common grass snake	(*Natrix natrix*)
Tesselated snake	(*Natrix tessellate*)

Amphibians:

Green toad	(*Bufo viridis*)
Green tree frog	(*Hyla cinerea*)
Wetland frog	(*Rana ridibanda*)

It is to be noted among the said fish species, Stone morocco (*Pseudorasbora parva*), Crucian carp (*Carassius auratus*) and Mosquito fish (*Gambusia affinis* (species are introduced to the said ecosystem and the remainders are native.

Plant flora

The flora of ZW includes the flora of the regions surrounding the wetland and the parts inside it. The ecological status around the lake, namely penetration of dry regions inside the water or more movement of water toward dry regions makes an inseparable tie between hydrophilic and xerophytes units. The natural changes of the water level of wetland during various seasons are accompanied by stress on the plant coverage, but its role in biodiversity of the coverage around the wetland is positive and causes formation of different units around it.

Aquatic plants of ZW are divided into four categories of emergent plants, submerged plants, floating-leaved plants and floating plants. Emergent plants grow in the humid lands of the margins of ZW and may penetrate into wetland from the humid lands. The emergent plants in ZW are Common reed (*Phragmites australis*), cats tail (*Typha* sp.), ruch (*Juncus* sp.), flowering rush (*Butomus umbellatus*), cypress grass (*Cyperus rotundus*), alkali bulrush (*Scirpus maritimus*) and sedge (*Carex* sp.).

Submerged plants spend their entire life cycle under the water unless the flowering stage. This group of aquatic plants is rooted in the water bed. Submerged plants could be observed from near shore to the deepest part of ZW. The most area covering these plants could be observed in the distance between water bed of wetland just in vicinity of farmlands in south of ZW and the eastern and southeastern coasts. Submerged plants in ZW are: common bladderwort (*Utricularia neglecta*), common hornwort (*Ceratophyllum demersum*), pondweed (*Potamogeton* Sp.), and longroot smartweed (*Polygonum amphibium*).

The third category of aquatic plants of ZW includes floating-leaved plants whose leaves are floating on the water surface and their roots are inside the bed. The most location of accumulation of this type of wetland plants is in the distance between the wide band of straw farms in the southern coasts of ZW and eastern coasts of wetland in contact with slope lands on which recreation installations have been constructed. The most species of floating-leaved plants on ZW is white lotus water lily (*Nymphaea alba*).

The fourth category of aquatic plants of this wetland is floating plants which are also known as free floating plants with leaves and stems floating on water surface. The root of this category of aquatic plants in the water column is free, with no contact with the bed. Although the root is free and there is no dependence on the bed, these plants in ZW are only observed in shallow waters (depth of 0.5 to 1 meter). The most extensive species of floating plants in ZW is Common duckweed (*Lemna minor*) species.

Based on the results, ZW has a grate capability regarding diversity of birds, Fishes, Mammals, Reptiles, Amphibians and flora species and the ecological status of wetland has caused the said wetland hosts numerous ecotourists every year including school and university study groups as local and international tourists.

CONCLUSION AND RECOMMENDATIONS

The obtained results show that this wetland is very talented in the field of ecotourism, bird watching and recreation. It is obvious that investment of public and private sectors will help to realization of potential talents of the wetland and the native people will enjoy its graces. On this basis, they will show more interest in protection and maintenance of the wetland. Local people have good experiences and have inherited such experiences from their ancestors. In this situation, providing an initial trainings related to environmental conservation and ecotourism, they may take part in the related economic activities like local accommodation centers department, restaurants, visitors' guide production of handicraft, and other tourist services. Certainly training to villagers about the values of ZW, guarantees sustainable ecotourism in the area and so implementing ecotourism programs must provide an economic base for preservation and restoration of ZW. It is obvious that programming must be made in such a way as to guarantee the preservation and durability of the areas, increasing income of local people and also increasing the fans of nature and environment.

Study and investigation of the area can be recommended to determine and identify the borders of

wetland. Also, Comprehensive study and topographic surveying of the status of actual evaporation and potential evaporation of the wetland water is recommended. Since environmental management of ZW is very important, it is suggested that the authorities consider and Efforts for declaration of ZW as an International Wetland according to Ramsar Convention.

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