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Conservation of Iranian Wetlands project

Fars DOE

Lake Parishan
Concise Baseline Report

" Saving Wetlands,for People,for Nature"

Department of Evironment
UNDP/GEF

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CIWP

Saving Wetlands for People, and Nature

DOE - UNDP/GEF

Lake Parishan

A Concise Baseline Report

Compiled by: A. Lotfi
Edited by : Dr. M. Moser

2010

FWA	Fars Province Water Authority
PCO	Project Central Office of CIWP
CIWP	Conservation of Iranian Wetlands Project
LP	Lake Parishan
DOE	Department of Environment
MoJA	Ministry of Jihad Agriculture
MOE	Ministry of Energy
IMO	Iran Meteorology Organization
FECO	Fars Province Environmental Conservation Office
KECO	Kazeroun Environmental Conservation Office

Preface

Historical literature indicates that the older civilizations have been formed besides the rivers and wetlands and various values of the wetlands have always improved the quality of natural environments. Now a day, most of the people, particularly those living around the wetlands are to some extent aware of the values and functions of the wetlands, and the role they play in sustaining the indigenous communities.

Despite being located in the semi- arid part of the country, the Fars Province is considered as one of the five first provinces of Iran regarding the extent of its wetlands. However, due to accelerating development programs and over-exploitation of the basic natural resources, along with occurrence of few natural events such as climate change and prolonged droughts during recent decade has led to degradation of parts of these valuable habitats. Wetlands in many countries are facing similar crisis; and considering their global functions, particularly from biodiversity point of view, their improvement requires an effective participation of the involved parties worldwide. Hence, Conservation of Iranian Wetlands Project (CIWP) with the partnership of Department of Environment of Iran as a national executive organization, UNDP and GEF has been defined with the goal of sustainable elimination or mitigation of deteriorating factors which are impacting the wetlands and providing improved management for these valuable ecosystems. The important approach of the project is elaborated as follows:

> **"If the decision makers and local societies become aware of values and functions of the wetlands and get participated in designing and implementation of managerial plans, they will better support sustainable management of the wetlands."**

Parishan wetland in Fars Province is among the valuable and important ecosystems of Iran, which not only provides rich biodiversity but also provides significant socio-economical services to the local population. The wetland is part of the "Arjan-Parishan" protected area and is registered as an internationally important wetland in Ramsar Convention. It is considered by UNESCO as one of the biosphere reserves.

As one of the two key wetlands of the CIWP and for the purpose of developing a management plan, the existing information were collected and compiled into this concise baseline report. This report in fact reflects the baseline environmental condition of the Lake prior to the implementation of the management plan.

Important to note is that presently the Parishan wetland management plan has been developed with the collaboration of all stakeholders including governmental and none governmental organizations and local societies, and has been ratified by parliament as an inter-sectoral document. In addition the executive structure of the management plan at local and provincial levels has been formed. It is obvious that successful implementation of Parishan wetland management plan and the extent of its effects in the region require utilization of knowledge, and technical inputs from all experts in the relevant governmental organizations as well as experiences and knowledge of indigenous communities. It is hoped that with the effective cooperation of all stakeholders, we could observe the establishment of ecosystem approach for the conservation of this valuable ecosystem, along with sustainable use of its resources for the benefits of local societies.

We are grateful to Mr. A. Lotfi for compiling data and writing the English version of the report, Dr. M. Moser for his technical supervision and editorial inputs, to Mrs. Y. Akbarzadeh for translation, and Mrs Jolaee and Mr. A. Arvahi for their coordination and management for the publishing works.

CIWP National Project Manager

Director General of Fars Province Environment Conservation Office

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1. INTRODUCTION

1.1 Purpose of the report

This report compiles existing information on Lake Parishan to describe the Lake and its attributes, including the, ecological and socio-economical characteristics of the lake and its surrounding villages. The report provides a concise baseline of the status of the Lake at the time of the UNDP/GEF/DOE Conservation of Iranian Wetlands Project.

1.2 Existing information

The Lake Parishan area has been subject to several different studies including geology and geophysics, climatology, water and land resources, fauna and flora, human population and rural economy etc. Also several dissertations deal with the ecological attributes of the lake which all together provide good information on the lake.

The earliest report on Lake Parishan is the material included in "A directory of wetlands in the Middle East, 1995", compiled and edited by D. A. Scott. This report outlines the general ecology of the Iranian wetlands including Lake Parishan and summarizes the information on water birds of this wetland.

Shilat Research and Training Institute of Bushehr Province conducted the first comprehensive studies of the wetland to evaluate and promote fishery capacities of the Lake. The study conducted in 1995-96 covered different areas of physical and ecological attributes of the lake including geology, climate, soil, hydrology and groundwater, flora, fauna, limnology, and fish harvesting activities..

The second comprehensive studies were accomplished by DOE with the purpose of developing a plan for management of the Arjan and Parishan protected areas and to evaluate and promote its ecotourism capacities. These studies conducted in 2000-01 by Jam-e-Iran consulting engineers covered almost all the physical, ecological, and socio-economical aspects but on the larger watershed of combined Arjan and Parishan protected areas. Considering Lake Parishan's ecological attributes, the study is largely built on the former studies of Shilat. However, the set of reports provide comprehensive and valuable information.

During the 1990s DOE Fars conducted periodic studies on the limnology of Lake Parishan. These provide good information on limnology and the quality of the Lake's water.

The Ministry of Energy and Fars Water Authority have conducted several studies in relation to water resources. The earliest studies on ground water resources were conducted in the 1970s. These were then followed with subsequent complementary geophysics and ground water tracking studies using isotopic and tracing materials. During the last decade, FWA has prepared annual reports on groundwater resources and abstraction.

Ministry of Jihad Agriculture monitors cultivated areas of individual crops and collects information at town level. However village level data could be obtained from village Islamic Councils and/or Jihad Agriculture office at Kazeroun. The same may provide village level information on the volume and type of agro-chemicals supplied or used, number of domestic animals and poultry, etc.

The Census Center of Iran collects 10 yearly census of population by village. Health office of Kazeroun and its rural health centers collect information on the annual births and deaths and thus may help in updating village population data.

Data on climatology of Kazeroun and Bushehr were collected from website of IMC, and records of Parishan evaporation station were gathered from Fars Water Authority.

The Ministry of Petroleum has conducted regional geology surveys and has produced detailed geological maps.

In addition to the above references, several dissertations, research works, papers and articles deal with attributes of Lake Parishan. Table 1 gives an inventory of such documents:

Table1 Key references on Lake Parishan

	Subject	Author/ Organization	Year
1	A survey on Lake Parishan water quality	Azarnia S., Banaee K./DOE Fars	
2	Interactions between benthos and benthivores	Izadi Gh. Dissertation Natural Res. Dept. Tarbiat Modarres Univ	
3	Determining development capacities in LP	Hosseini H. et al	
4	A quick look at Arjan- Parishan wetlands	Mirzaee F./DOE Fars	
5	Aquatics in Lake Parishan	Jafari M. Dissertation, University of Tehran	1979
6	Report on Lake Parishan	Abbasi H./ DOE	1983
7	Restoration of Parishan Wetland	Azarnia S./DOE Fars	1988
8	Biometric survey of fish reserves of LP	Adibi A./ DOE Fars	1988
9	*Carasebarbus luteus* in Lake Parishan	Vali zadeh A. Dissertation, Natural Res. Dept. Tehran University	1988
10	A directory of wetlands of the Middle East	Scott D.A.	1995
11	Lake Parishan, the second Iranian Ramsar site	Maafi A. /article in aquatics	1996
12	Reptiles in Lake Parishan	Farhadpour H./DOE- Fars	1997
13	Lake Parishan, student research on wetland / wild-fowl management	Rahbar N.	2001
14	Evaluation of tourism capacities of LP	Arzyaban-e-Mohit /DOE Fars	2002
15	Phytoplankton and primary production of LP.	Dehghan A./ Dissertation	2002
16	Ecosystem of Lake Parishan	Dehghan A.	2005
17	Ground water studies of Lake Parishan Area	Fars Water Authority	2006
18	Management plan of Arjan-Parishan Reserve	Jam-e-Iran/ DOE	2002
19	Investigation on impacts from exploitation of ground water on Lake Parishan	Zamin ara Fars Consulting Eng./DOE Fars	2010
20	Lake Parishan	Bushehr Shilat Research Institute.	1996

1.3 Methodology for preparing the present report

The first steps taken for preparing the present report were to collect existing documents dealing with LP. These include reports of Shilat studies (1995-96), Jam e Iran (2001), Fars Provincial Water Authority's annual reports on Parishan Area groundwater resources, and the studies recently conducted by PCO and Fars DOE under CIWP.

The above reports were then reviewed and in some cases compared and the key attributes of the Lake were abstracted and compiled into a summary concise report to describe the physical, ecological and sociological attributes of the Lake.

The draft report was reviewed and edited by the international senior expert for its quality and content. And at the final stage was commented by provincial DOE and ot other relevant organizations.

2. LOCATION AND GEO-PHYSICAL CHARACTERISTICS

2.1 Location

Lake Parishan is located 15 km west of Kazeroun town, in Fars Province. It is in a rather isolated depression in between the Shapour and Dalaki River catchments (Map 1). Geographically its center is defined as 51,20 E and 29, 30 N. It is about 820 meters above mean sea level.

2.2 Landscape

The interesting scenery of Lake Parishan include a combination of water body, aquatic vegetation around the wetland, cultivated lands in the south western flat areas, cultivated lands in the northern sloping foothills, woodland in the northern mountains and several isolated rock outcrops. As part of the wetland catchment area, spectacular cliffs north and east of the lake provide impressive views.

Vast areas in the north-west, north-east and east parts of the wetland are covered with dense Phragmites reeds while almost all the northern boundary of the wetland is covered with a narrow growth of Phragmites.

Outcrops are all Sarvak and Asmari rocks. While the southern faces of the outcrops are generally steep, the northern faces are normally less steep and provide somehow easy access to the tops where one can gain good views over the entire wetland.

2.3 Topography

The wetland is formed in a shallow depression stretched out at the toe of the northern foothills and extends several kilometers in the east-west direction. The entire bed of the wetland is flat with very slight slopes from all sides towards the central deeper part of the wetland close to the foothill (Map 2).

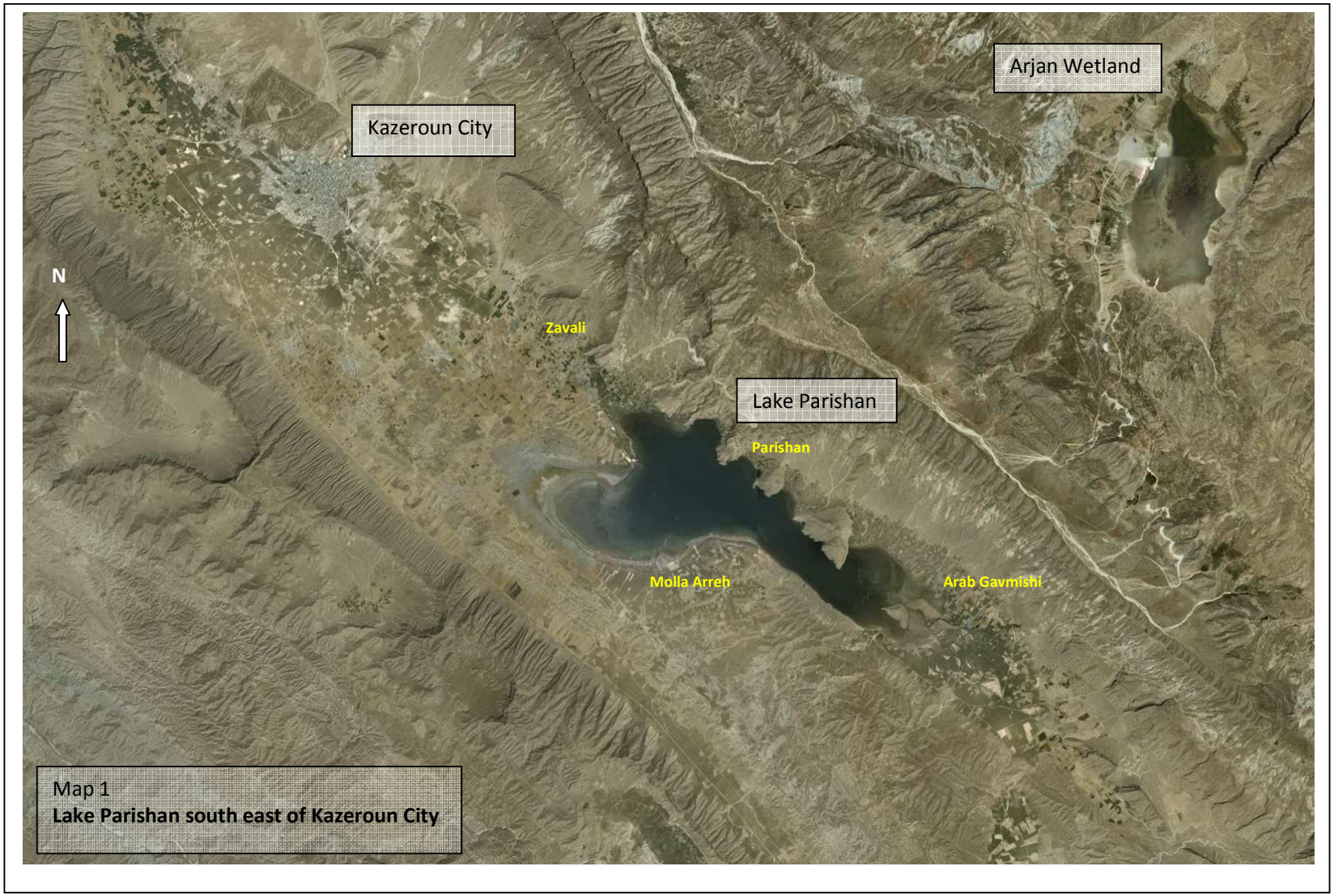
The catchment area of the wetland includes in addition to the wetland, the high mountains in the north with altitudes of around 1800 meters above mean sea level, (locally called Sarbalesh) and low hills all along the southern boundaries. The flat bed of the wetland (at 820 meters above mean sea level) extends south west and fades out into the flat valley of Kazeroun.

2.4 Geology

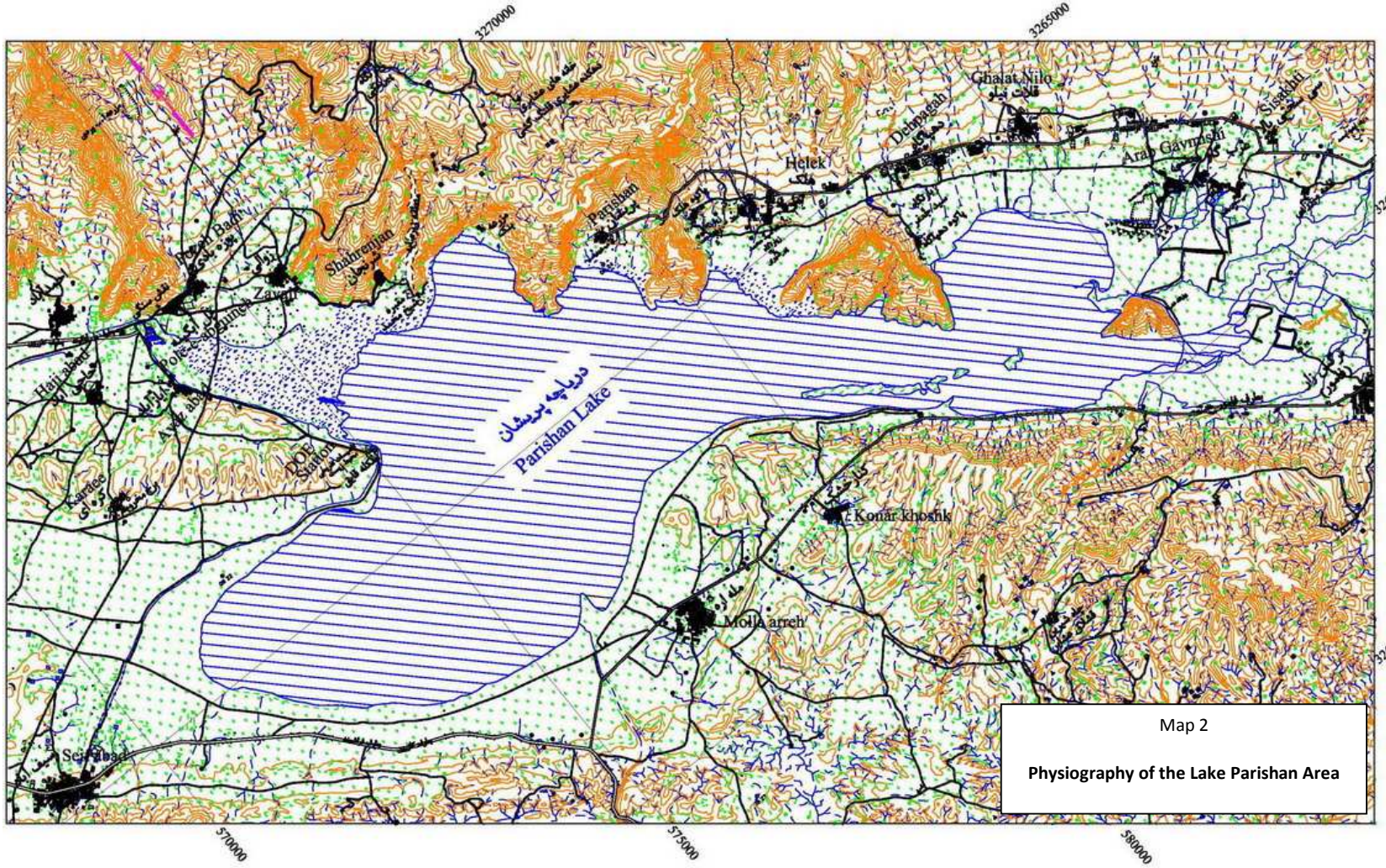
The mountainous territory of the catchment of Lake Parishan is located in the so called “Simple Folded Zone” of the Zagros Chain which is laid in a generally NW-SE direction.

The geological setting in the catchment area is sequentially comprised of Ilam, Sarvak – Pabdeh, Gurpi, Jahroum, Asmari, Gachsaran and Aghajari, Bakhtiari formations and the recent alluviums (Map 3).

The Sarvak, Jahroum and Asamri formation are mainly comprised of limestone with considerable cracks and cavities which provide moderate to good water storing capacity and conductivity. Indeed all the springs around LP are directly formed in this limestone or are recharged by water resources from them. Several Sarvak and Asmari limestone outcrops in the eastern part of the catchment under-laid by rather impervious Miocene formation are good reasons for the exposure of several springs in this part. Gourpi formation though mainly comprised of limestone has little fissures and thus is considered impervious.



Map 1
Lake Parishan south east of Kazeroun City



Map 2

Physiography of the Lake Parishan Area

Miocene Gachsaran and Aghajari formations in this area are comprised of generally fine materials (sandstone, marlstone, mud-stone) with very low water conductivity. These form the impervious bed rock underneath the valley and the lake.

Bakhtiari formation (exposed in the ridges south of the Lake) is comprised of conglomerates which is only partially water conductive.

Recent alluviums / colluviums show different hydrogeological characteristics. Those in the northern foothills are deep (reportedly max. 120 meters [10]) and are comprised of coarse alluvial or colluvial material with good water storing potential and higher conductivity. Wells in these foot hills have good discharges of good quality water. However, the alluvial deposits in the southern slopes are comprised of finer materials with lower water storing capacity and transmissivity. Wells in this part are not as productive as those in the north and east, and water quality is also much lower.

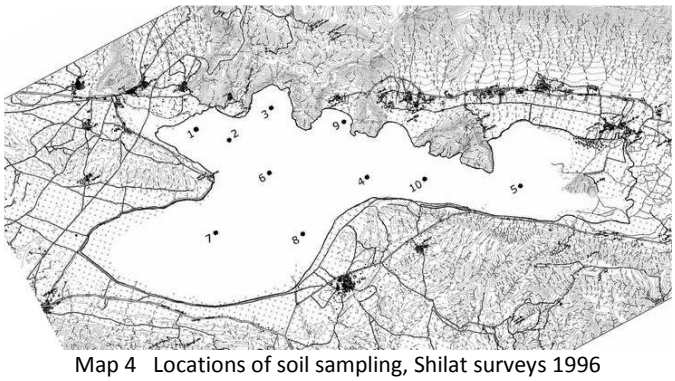
Geological sections across the east and west of the Lake reveal a significant difference in geology of these two parts. While in the western part cross-section BB' indicates a folded zone of fairly regular configuration, the eastern part is highly crushed with several trusts and faults.

Several indications supported by field investigations and few research works prove inter-connections between Arjan and Parishan lakes mainly through Asmari and to a lesser extent through Sarvak formations. There are several sink holes in Arjan Lake through which its water is transferred towards the springs around LP and even the springs in Shapour Valley west of Kazeroun city.

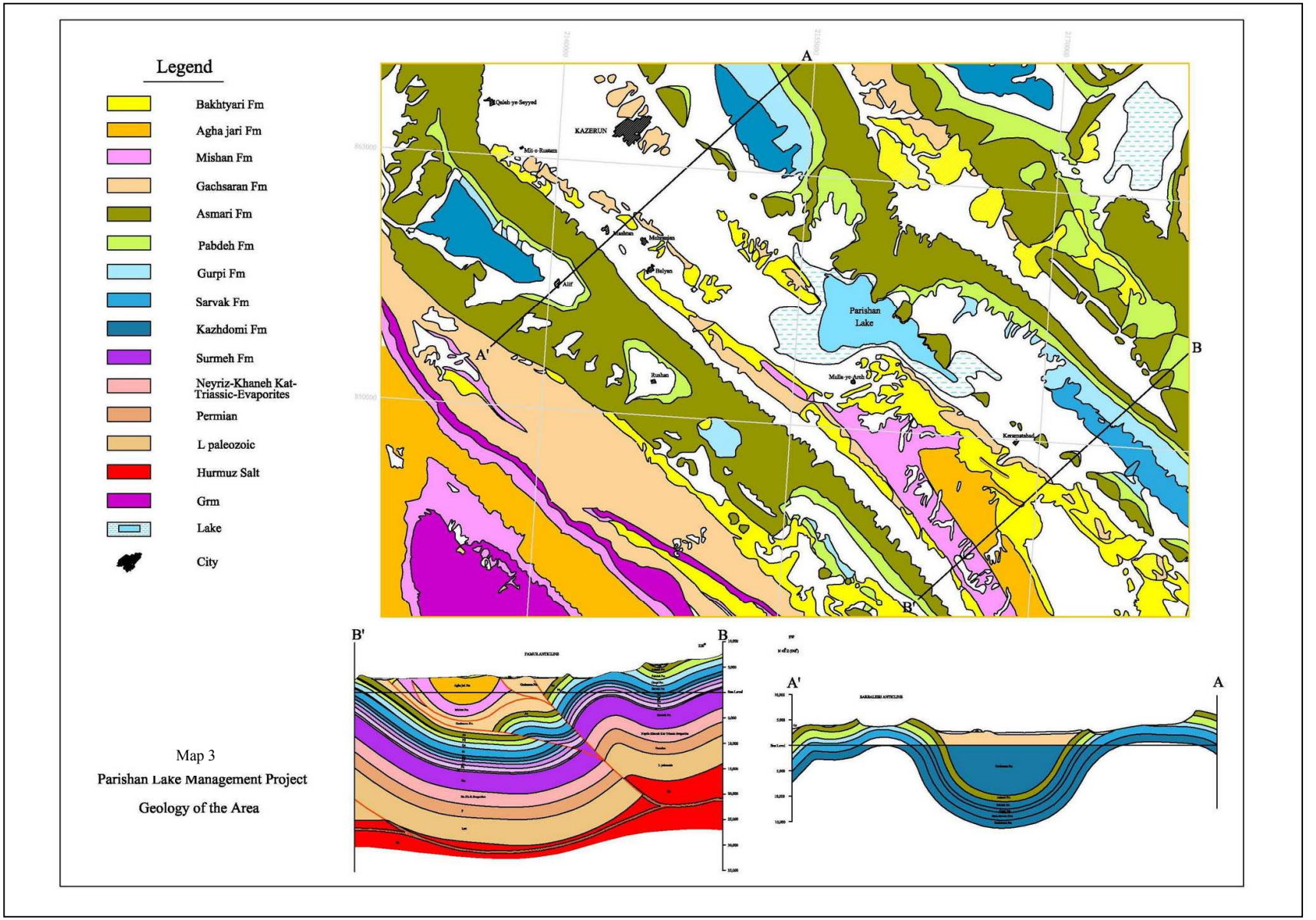
2.5 Soils

Soil surveys of 1964 by the Soil Institute and 1968 by Sabraco Consulting Engineers aimed at soil and land classification for irrigation development and mainly covered the areas around the Lake with very little coverage over the lake itself. During this period the Lake was experiencing a prolonged drought very similar to the present condition of 2000-2010 and part of it was dry such that direct soil sampling was possible in part of it.

In 1996, Shilat Research Center of Bushehr carried out a more comprehensive soil survey of the Lake bed. Four sessions of seasonal sampling was conducted in 10 stations inside the Lake (Map 4). Grab and underwater soil samplers were used for this purpose. The following descriptions on LP's soils are based on this latter survey. Tables in Appendix 1 display the physical and chemical analyses of soils.



Map 4 Locations of soil sampling, Shilat surveys 1996


Legend
Bakhtyari Fm
Agha jari Fm
Mishan Fm
Gachsaran Fm
Asmari Fm
Pabdeh Fm
Gurpi Fm
Sarvak Fm
Kazhdomi Fm
Surmeh Fm
Neyriz-Khaneh Kat-Triassic-Evaporites
Permian
L paleozoic
Hurmuz Salt
Grm
Lake
City
KAZERUN
Qaleh ye Seyyed
Mir o Rustam
Mashian
Mahmoodan
Balyan
Atir
Parishan Lake
Rushan
Mulla-ye Atsh
Kavamabad
A
A'
B
B'
Map 3
Parishan Lake Management Project
Geology of the Area

LP's bed is comprised of thick layers of fine sediments deposited on Miocene formations which together form a very low permeable to rather impermeable stratum. Almost all the deposits in the Lake bed are uniformly composed of fine to very fine particles (clay, silt) and only in narrow strips alongside the northern and southern slopes soil particles may contain fine sand in their composition. The texture of different parts of the Lake's bed could be defined in three categories. Deposits in the western part of the lake are generally uniformly moderately heavy textured (Silty Clay Loam, Points 1 and 2), while in the middle parts (points 3, 4 and 6) are heavy or moderately heavy in the surface but lighter in the lower layers, and finally are generally uniformly light in the eastern parts. Geological formation around the lake should, as origin, have affected the attributes of lake's bed deposits. Thus one should expect calcareous materials in the northern, and marl and gypseous materials in the southern part of the lake.

However, all the soils are rich in lime content while gypsum is reported in lower layers of few sampling points (1, 2, 7, 8, and 10). Dense reed beds at the eastern and western ends of the lake, where most of the inflow come, should have played a distinct role in filtering coarser materials and allowing fines to move further inside the lake. Therefore substrata in the reed-beds should contain more portion of coarser sandy material in their texture.

Soils of Lake's bed are generally grayish, with darker colors in the top (more organic material) and lighter in the lower layers. No mottling has been reported in the soil profile. When dried, the soil crusts and shrinks and forms comparatively wide cracks such that walking over them is very difficult.

Soils generally contain good portion of organic material and in most cases contain shell particles of fine to medium size. However organic materials (root, leaves, etc) reduce in the deeper layers.

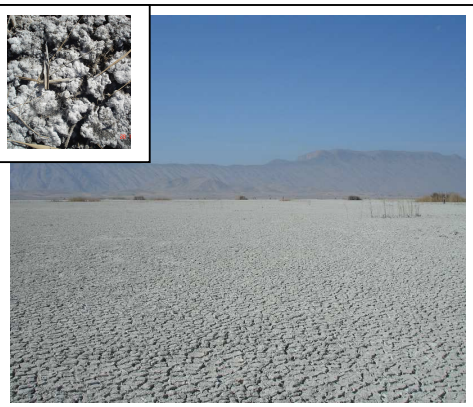


Fig 1 View of Lake bed and salt efflorescence

Salinity of soils (saturated extract) is affected by lake's water salinity and generally varies in between 3 to 7 dS/m. Almost in all the cases chloride anion significantly dominate sulfate and bi-carbonate. Calcium+ magnesium and sodium are the main cations and in most cases the former combination slightly dominates the latter. pH of soil (saturated paste) varies between 7.9 - 9.0.

Soil erosion by wind exists in the south western part of the lake which is often dry and exposed.

3. CLIMATOLOGY

Lake Parishan is located in the semi-arid part of southern Zagros with hot and comparatively long summers, and temperate and comparatively short winters. It is influenced by four major air masses among which "Mediterranean fronts" are the most significant and are the source for the major part of the annual precipitations.

3.1 Precipitation

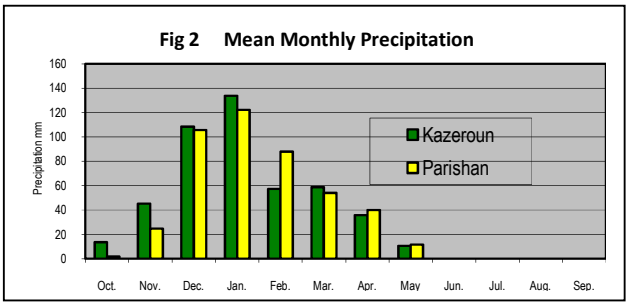
Precipitation in the area is usually in the form of rainfall and mainly occurs during winter and spring months. Summer is generally dry with very occasional low precipitation. Snow occurs very rarely and only on the top of the higher altitudes of the northern mountains, and lasts no more than a few days.

Parishan climatology station has precipitation records since 1988. Average annual precipitation of the station is 450 mm and ranges between minimum 200 mm. to max. 700 mm. In the Kazeroun station about 15 km east of Parishan, the average annual precipitation, recorded since 1957, is 470 and ranges between 130-900 mm.

Analysis of the annual precipitation indicate that with 75% probability (3 out of 4 years), the annual precipitation at Parishan is equal to or less than 600 mm. If according to the evidences the annual precipitation lower than 250 mm could be considered as dry year affecting the inflows into the lake, then 8 out of 22 years of data period (about 1/3 of the period), the area has faced drought. Worth to mention is that 3 out of the 8 dry years have successively occurred in the last 3 years ending in 2009/10.

The annual average number of days with precipitation is 30 and ranges between 11 and 55 days/year.

Generally, most of the annual precipitation occurs in winter time followed by fall and spring months in a descending order. December and January are the months with maximum average monthly precipitation, and July is the month with absolutely no rainfall.



The monthly average of number of days with precipitation is 7-8 days in January. The maximum number of days with precipitation ever recorded in any month is 20 days in January. Probability analysis of maximum daily precipitation in Kazeroun indicates that with 80% probability (4 out of 5 years) the maximum daily precipitation is equal or less than 80 millimeters.

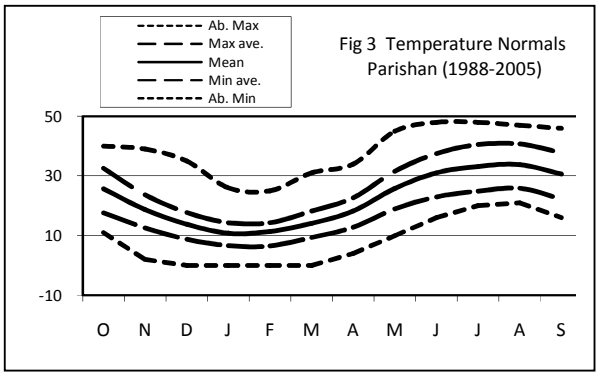
3.2 Temperature

The Lake area has temperate winters with long and relatively hot summers. It seems that temperature in this area is more governed by latitudes rather than altitudes (Jame-e- Iran). The temperature attributes of Parishan and Kazeroun stations are summarized in the following table:

Table 2 Summary annual temperatures (° C)

Stations	Duration	Absolute maximum	Average maximum	Mean	Average minimum	Absolute minimum
Kazeroun (IMO)	1957-1985	48.5	31	22	13.1	-8
Parishan (FPWA)	1988-2005	48	28.5	22.2	15.9	0
Parishan (FPWA)	2007-08	48	31.1	22.3	13.6	-3

Although temperature data from Kazeroun and Parishan stations are not from the same period, the narrower ranges of variations between monthly average maxima and minima in Parishan station in comparison with similar data from Kazeroun, particularly in the cold seasons clearly indicate moderating effects of the Lake which is brought about by the higher humidity around the Lake environment.



The temperature regime of Parishan station for the year 2007-8 when the lake surface was significantly reduced is also indicated in the table to confirm the above conclusion.

January and February with monthly averages in the range of 10 -12 °C are the coldest, and July- August with a monthly average in the range of 33-34 °C are the warmest months of the year. Absolute maximum temperatures during the summer rise up close to 49 °C. Winters are generally temperate and freezing happens but not frequently.

Freezing may start from mid December and may happen up to late February. Minimum temperature ever recorded for Kazeroun station is -8.0 for December. However this should be considered as an exceptional record. Recent data from both Kazeroun and Parishan has not shown minimum temperatures less than 0.

Freezing hours are normally from around midnight and continue no later than 0800-0900hrs in the mornings. The total number of days with freezing temperature does not exceed 15 days per year.

A quick survey of changes in climate was exercised using Bushehr longer data on temperature. Figures 4a to 4e (below) depict the 20 years moving averages of the mean seasonal and annual temperatures. As could be seen, during the last 30 years the mean annual temperature has increased about 1 degree centigrade. The rate of increase is almost nil for winter but is highest for summer (1.5 degrees).This could be in line with the general increase of ambient air temperature due to the global climate change.

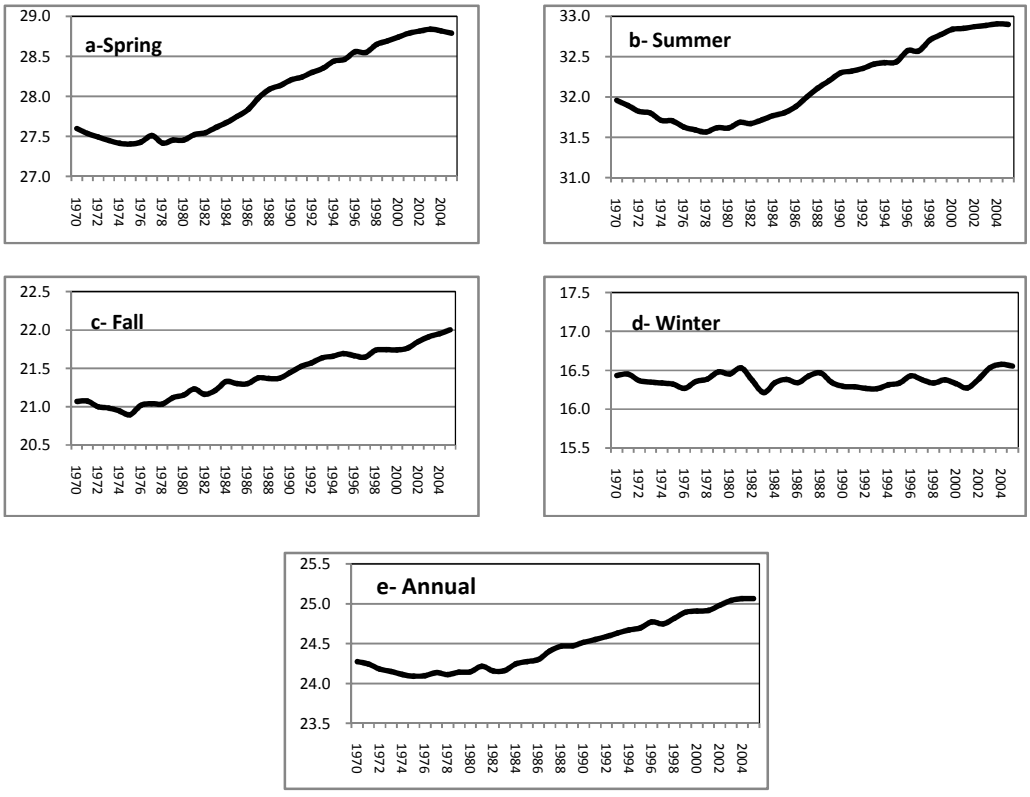
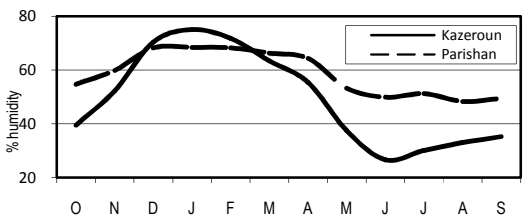


Fig 4 Long term trends in ambient air temperature for Bushehr station

3.3 Humidity

Relative humidity is usually measured three times a day at 06.30, 12.30 and 18.30. The observation at 06.30 accounts for daily maximum and that of 12.30 represents the daily minimum relative humidity. The average humidity in Parishan station is generally higher and more uniform during the seasons than in Kazeroun which again is an indication of moderating effects of the Lake. This moderation effect is more significant during the summer months i.e. May through Sept.

Fig 5 Relative humidity of LP region



3.4 Sunshine hours

For preparing this report only one year record (1385, 2006) of sunshine hours was available from Kazeroun station (Table below). The new IMO station in Kazeroun will hopefully continue measuring this parameter which is an important factor which affects the growth of plants including wetland plants.

Table 3 **Records of average daily sunshine hours, Kazeroun IMO**

Years	Meh	Aba	Aza	Dey	Bah	Esf	Far	Ord	Kho	Tir	Mor	Sha	Ann-ual
	Oct	Nov	Dec.	Jan	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	
1384-85 (2005-6)					4.2	9.2	7.6	9.9	11.5	11.4	10.7	10.2	
1385-86 (2006-7)	9.8	6.8	6.1	6	6.9		5.9						

3.5 Wind

The limited data available on wind are from evaporation measuring stations of FPWA and the recent records of Kazeroun IMO station. The data from former source reflect average wind speed measured above evaporation Pan which is about 0.5 meter above ground. Those from IMO station show max wind speeds and are measured at about 10 meters above ground. Table 4 displays existing information. There are not enough records of general prevailing wind speed and direction. However information from local people as well as general information of climate of this part of the country explains that prevailing winds generally blow from west and south west (Mediterranean fronts). However, occasionally strong winds blow from south and south east (Sudan fronts).

Table 4 **Wind speed data**

Hours	Data duration	Unit	Meh.	Aba.	Aza.	Dey	Bah.	Esf.	Far.	Ord.	Kho.	Tir.	Mor.	Sha.
			Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Kazeroun IMO	2005-06	Speed					6	7	18	15	15	12	14	19
		Direction					140	320	270	270	280	260	280	260
	2006-07	Speed	11.0	7	11	6	9	14	11					
		Direction	280.0	280	140	340	280	160	130					
Parishan,	1988-2006	m/sec	2.1	2.1	1.7	2.1	2.1	2.4	2.5	2.9	3.1	3.2	3.2	2.7

3.6 Evaporation

Class A pan evaporation data is recorded in Kazeroun and Parishan since 2001 and 1988 respectively by FWA. IMO has started recording pan evaporation in Kazeroun station since 2005. Table below indicates records for pan evaporation. One may notice that the annual rates of pan evaporation range between 2400-3100 mm. The maximum monthly evaporation occurs in summer months, i.e. June through August, and in the order of 380 to 400 mm per month. Minimum evaporation normally occurs in January and around 20-60 mm.

Table 5 **Mean monthly evaporation** (figures in mm.)

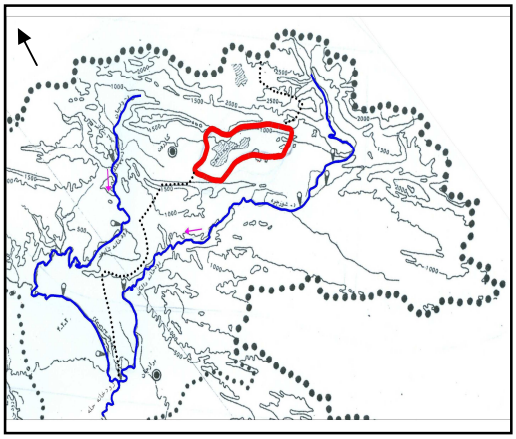
Stations	Oct	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Annual
Parishan,1	218	121	57	42	52	76	133	247	349	402	403	339	2439
Kazeroun,1	233	148	64	57	66	98	164	285	389	400	385	326	2614
Kazeroun,2	279	150	60	21	36	171	208	357	487	512	471	406	3157

Source: (1) FPWA (1367-85), (2) IMO (1384-86)

Measurements of pan evaporation in Parishan during 2007-08 (very dry period in which water body was almost disappearing), has increased up to 3818 mm., while that of Kazeroun does not reveal such deviation. This is a clear indication that increase in the evaporation is due to decrease in ambient humidity because of diminishing Lake's water surface.

4. Hydrology

The surface area of the watershed is about 275 sq. kilometers and is bounded from the North and South by the divides on the Dashtak and Sarbalesh anticlines respectively. To the east, the watershed is bounded by the topographical divides in an undulating area and to the east by a topographical divide in a rather flat territory. The wetland itself is formed in the bottom of the depression in between the two northern and southern anticlines (Map 2).



Map 5 **Lake Parishan in between Shapour and Dalaki river catchments**

The catchment of the Lake Parishan is located in between the divides of the Shapour and Dalaki river basins and seems to be an isolated and closed catchment with no visual connection with either of the two said river basins (Map 5). However, despite its visual topographical configuration, the actual basin of the Lake extends –through Karst formations- north towards Arjan Lake. Indeed, explorations and researches proved that Lake Arjan, 15 kms north of Lake Parishan, has a significant water contribution to the flows of springs around Lake Parishan through Karst formations.

4.1 Surface waters

Considering the range of annual precipitation in the small catchment of the Lake, the surface water resources are restricted to occasional overflows produced after heavier precipitations that reach the Lake through small water courses. Using very restricted information, the average runoff coefficient is estimated at 12% ranging between 8-18% depending on the volume of precipitation. Given the average annual precipitation in the area to be 450 mm/yr, the contribution of surface runoffs to recharge the Lake is estimated at about 34.5 mcm/yr (Table 1).

Table 6

Estimates of water inflow into the Lake from precipitation in an average year

Sources of runoff	Area Km2	Rainfall mm/yr	Runoff coef.	Volume of water, mcm/yr
Runoff in the catchment	225	450	0.12	12.0
Direct precipitation over the Lake	50	450	1.00	22.5
Total inflow to the Lake				34.5

As estimated, the average volume of water which directly flows into the lake is about 35 mcm/yr equivalent to about 0.7 meter of water column in the Lake. In different years

with different precipitation, the range of inflows into the lake varies between 25-50 mcm/yr.

4.2 Ground water

Groundwater is another main source of water supply to Lake Parishan. Ten springs, the majority of which are karstic, discharge into the Lake after parts of their flow is diverted for irrigation. Several submerged springs, in the north western part of the Lake, directly discharge into the Lake's water body. It is quite likely that other parts of the northern boundary of the Lake also discharge seepages from the foothills into the lake. These latter sources are neither visible nor measurable. Also quite a number of wells (more than 900) exploit water from the alluvial aquifer around the Lake to supply water for irrigation. Such composition of ground water resources and interactions they have with the water body in the Lake somehow complicate the hydrological interpretation of the Lake.

"Gap" spring in NW of LP flows just on the lake's bed below water level.

Ground water of the area has been studied on several occasions. Also, FPWA produces periodical reports of Parishan ground water resources which contain valuable information.

Karstic and Alluvial aquifers

Two main aquifers contribute to the water supply regime of the Lake, i.e. alluvial aquifers and karst formations. Karstic aquifers are formed in the limestone formations (Sarvak, Asmari) which extend all along the north and east of the Lake. Alluvial aquifers are formed in the foothills and valley bottom around the Lake (see Map 6).

Arjan wetland is located at about 1500 meters above mean sea level, about 700 meters higher than Parishan Lake.

Studies have proved that Lake Arjan, some 10 kms north of LP and 700 meters higher in elevation, had distinct effects in recharging Karstic springs in the Parishan-Kazeroun area.

Alluvial aquifers exist mainly in the foothill alluvium/colluviums north of the lake and finer alluvial around the east, south and west of the Lake. Particularly, the aquifer in the south and southwest of the lake is of low hydrodynamic characteristics.

Ground water in the alluvial aquifer is observed through 21 observation wells (Map 1, appendix 2). These wells are observed each month for monitoring the changes in water level and sampling for water quality analyses.

Springs

Ten springs expose around the Lake. Most of them are located in the eastern part of the lake while few also expose in its northern and north-eastern parts. Table 7 displays the list of springs and some of their characteristics.

FPWA conducts monthly measurement of spring flows. All these measurements are at the upstream section of the springs, prior to water abstraction for irrigation. There is no direct measurement of the flow which enters the Lake.

As indicated in Table 8, the total volume of spring flows for the year 2004-05 exceeds 28 mcm/yr, much less than the existing records of 59 mcm/yr in 1999 and 2000 (Fig 6, Table 8).

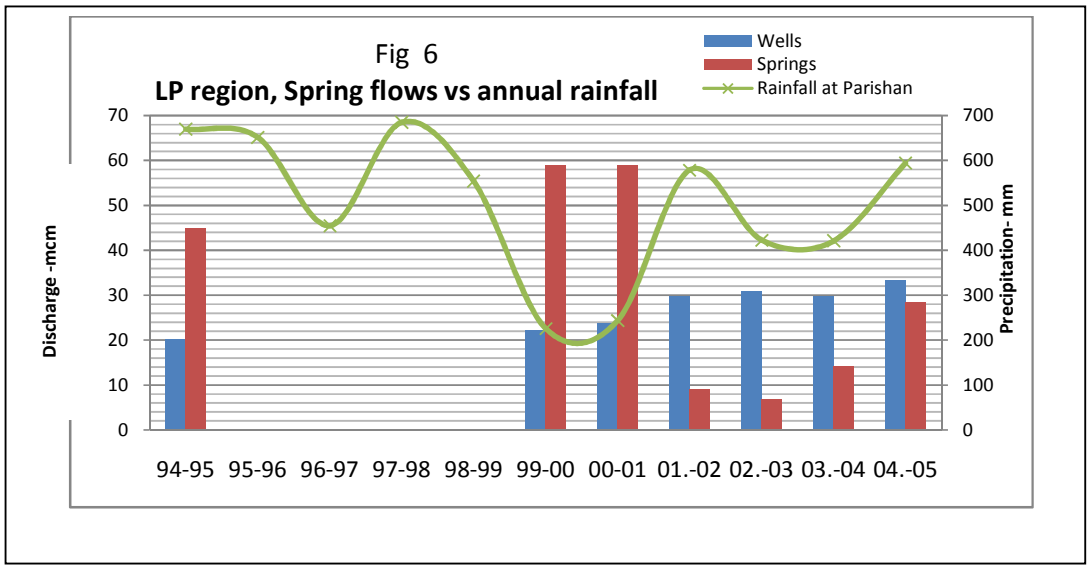
Table 7 Springs around Lake Parishan (2005-06)

	Name	Annual flows		Eastern longitude	Northern Latitude	Type of Spring
		Q lps	V 10^3 m^3			
1	Ab morak	15-35	684	586803	3262290	Alluvial/exposed in a natural drain
2	Jamshiri	80-150	3,700	587861	3258689	Karstic
3	Koshk khani	1- 4	66	582998	3259865	Conglomerate/ expose in valley
4	Deh bozorgi	0 – 20	216	591138	3258955	Karstic
5	Helak	0 – 313	4,800	589306	3257695	Karstic
6	Pol abguineh	0 – 287	3,600	573656	3270419	Karstic
7	Ghaleh narenji	50 – 664	11,800	589031	3260870	Karstic
8	Ab siro	35 – 135	2,500	587863	3261883	Allvial/ exposed in valley
9	Darreh Tini	0 - ?	224	584338	3259276	Valley alluvial
10	Garab	20 -?	858	586520	3259735	Karstic
		Total	28,500			

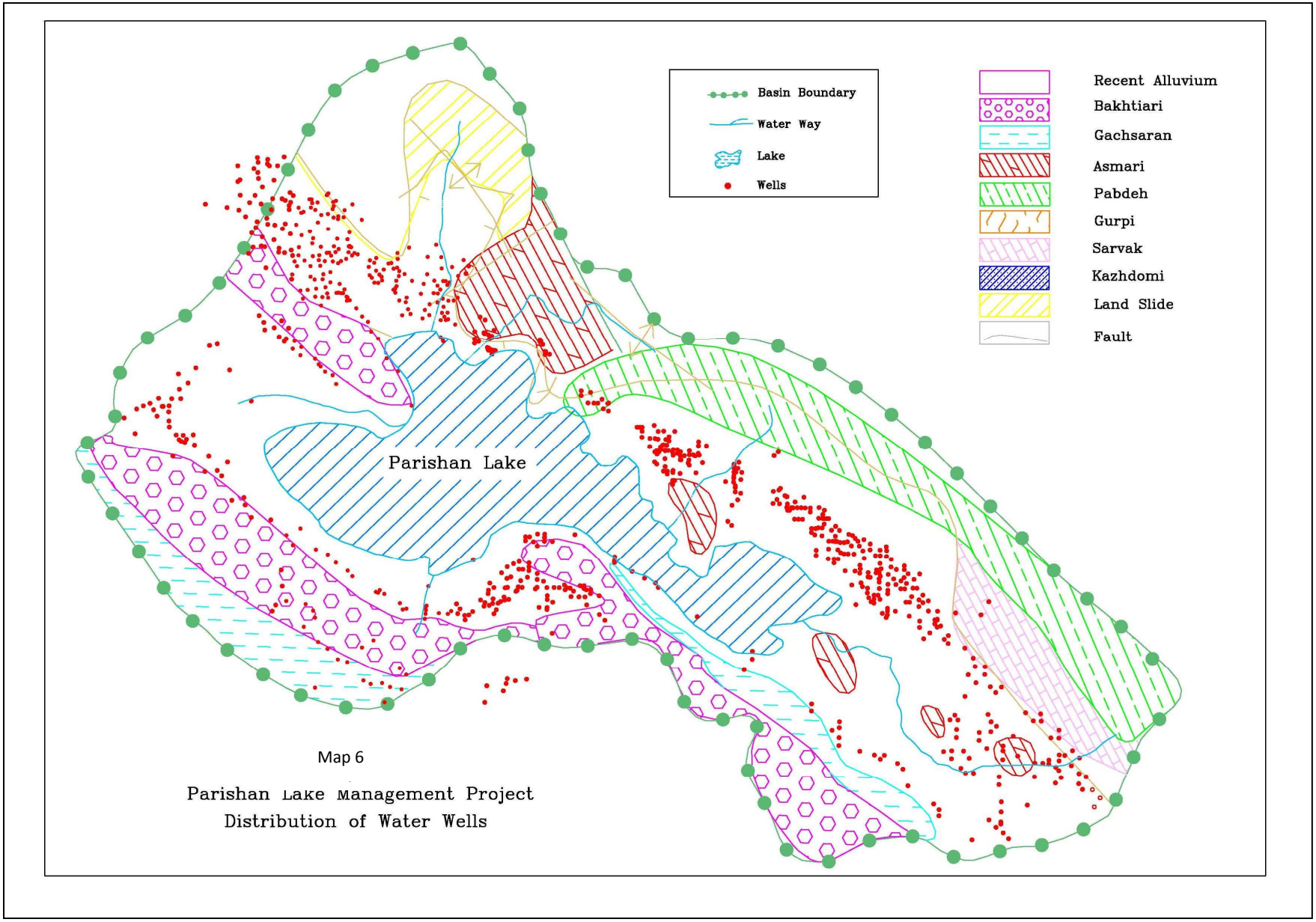
Source: [10]

Wells

Presently more than 900 wells are operating around the lake (Map 6). The density of the wells is more concentrated in the north, west and southwest around the Lake. They abstract ground water from the aquifer which is directly in contact with the Lake's water body. The wells in the north and east directly intercept ground water flows before they reach the Lake.



Wells around the Lake are clearly competitors to the Lakes water resources. Increasing number of wells and increasing volume of water uptake particularly in the northern and eastern parts of the lake has significantly reduced the inflows into the lakes. This is clearly reflected in the data which is presented in Table 8 and Fig 6 where the changes in the ground water flows of different resources are displayed against variations in annual precipitation. It also seems that the drought period of 2001/03 accompanied with low springs' flows have been a reason for rapid increase in the number of wells and the volume of ground water depletion. This has resulted in an additional uptake of about 6 mcm /yr which has continued during the subsequent years.



Map 6

Parishan Lake Management Project
Distribution of Water Wells

Table 8 Ground Water Resources of Lake Parishan

(Discharges in mcm/yr)

Sources / years		1994/5	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05
Wells	No.	624	643	660	853	867	832	834
	Disch.	20.2	22.2	23.7	29.8	30.9	29.7	33.2
Springs	No.	10	10	10	10	10	10	10
	Disch.	45	59	59	9.1	6.7	14.2	28.5
Qanats	No.	1	1	1	1	1	1	1
	Disch.	0.1	0.12	0.12	0	0	0.1	0.1
Total		65	81	83	39	38	44	62

Source: [16]

Ground water levels and depths

Ground water levels are regularly measured in more than 21observation wells around the Lake. The result of such observations are displayed in Appendix 2, Maps 2 & 3 (depth to ground water), and Map 4 (ground water contours).

As indicated in Maps 2 and 3 ground water in the aquifers of north of Lake is significantly deeper than in the southern aquifer and varies between more than 25 to less than 10 meters. In the southern alluvial aquifer, the depths are shallower and vary between 20 to less than 5 meters.

Groundwater contours clearly indicates the ground water flow from all surrounding areas towards the lake (Map 4, appendix 2). There is an exception for the south western part of the Lake where ground water seems to flow away from the Lake. Because of the thick heavy deposits in the lake's bed, it is very unlikely that the lake is recharging the ground water in this part.

4.3 Groundwater quality

The data on EC of groundwater (Maps 5 & 6, appendix 2) indicate that ground water flows in the northern aquifer is quite fresh (EC< 1 dS/m). Towards the lake, more salt is dissolved in the water. In the southern alluvial aquifer, ground water is more saline and EC values rises up to 8.0 dS/m which is basically classified as saline water.

The EC of the Lake's water varies between 4 to 15 dS/m. While higher values correspond to late summer months, immediately after a heavy rainfall and fresh runoff intrusion, the EC values reduces. Flows from submerged springs (NW of the LP) with ECs around 0.5 dS/m, can improve the Lake water quality but only within a few meters of the spring. However the better quality of water at these parts attracts many fishes.

Fingerlings gather close to the spring outlets

4.4 Water balance of Lake Parishan

Because of several components interacting with water resources of the Lake, interpretation of its hydrological attributes in determining the following components are somehow complicated: 1) The contribution of external resources (karst formation and Arjan wetland) to water supply of the LP, and 2) The volume of seepage inflows into the lake.

A generalized water balance at catchment level for an average hydrological year (Table 9) helps in estimating the contribution of Karst formations at about 31 mcm/year. This flow is assumed to come in from outside the catchment area, i.e. from Arjan Wetland catchment.

Another study on ground water resources of the wetland area [9] concluded that in 2007-08, a relatively dry year in which Arjan wetland was completely dry, a volume of about 10 mcm has been in-flowed into the area which could not have been from a source other than Karst formations.

Also an exercise of water balance at Lake Parishan has revealed that in a normal hydrological year, about 7 mcm flows into the lake through submerged springs and seeping foothills (Table 10).

Table 9
Tentative Water Balance Calculation in the LP catchment area

Description	Area, Km2	Quantity, mm	Volume, mcm/yr	
			In	Out
Precipitation over the catchment	275	450	124	
Evaporation from ground surface	245	55		13
Evaporation from the Lake	30	1680		50
CU by natural vegetation (range and pasture lands)	190	350		67
Domestic uses (negligible)				0
CU by cultivated crops	38	650		25
GW outflow from the basin				0
Total			124	155
Inflows from outside the basin (Karsts!)			31	
Balance			155	155

4.5 Water level variation in the Lake

Considerable information is available of water level variation of LP since 1973 with certain gaps due to different reasons. The summary results of observations are presented in Fig 7 and the data are given in Table 3 appendix 2.


Staff gauge in Lake Parishan, April 2007

Data indicates that higher water levels in the lake normally occur during February through June and lower water levels generally occur in late autumn. There are occasions that the water level falls lower than the (0) on the staff gauge. Such cases have been experienced in 1973, 74, 84 through 86 and during the long drought period of 2001-05 and 2007 to 2009. Aerial photo of 1967 (Map 7) indicates that the Lake was completely dry late in summer season such that one could walk/drive across the lake. The records from Kazeroun climatology station shows that, from February 1964 to March 1968, the total precipitation sums up to only 275 mm. With very limited number of wells during this period it is clear that severe drought is an undeniable fact and water resources in the Lake is directly related to regional precipitation. However with the current trends in climate changes, accelerated water abstraction from groundwater aquifer exacerbates the condition for the Lake and such droughts may occur more frequently and may last for a longer time.

Table 10
Water balance for the Lake Parishan in a normal year

Description	Area	Prec. /evap.	Flow	Coef.	Volume, mcm/yr	
	Km2	mm	mcm		In	Out
Precipitation over the Lake	25	450		1.0	11	
Surface runoff inflow from the catchment area	200	450		0.12	11	
Inflow from spring flows			35	0.6	21	
Direct evaporation from the Lake	30	1680		1.0		50
Outflows or water abstraction from the Lake						0
Changes in aquifer storage					0	0
Sub total					43	50
Groundwater inflows					7	
Balance					50	50

4.6 The quality of water resources

Several reports on Limnology of Arjan and Parishan provide some information on water quality of Lake Parishan. Table 11 gives the results of chemical analysis of different stations during 2001-2002. Some additional information on water quality is given in the Limnology chapter.

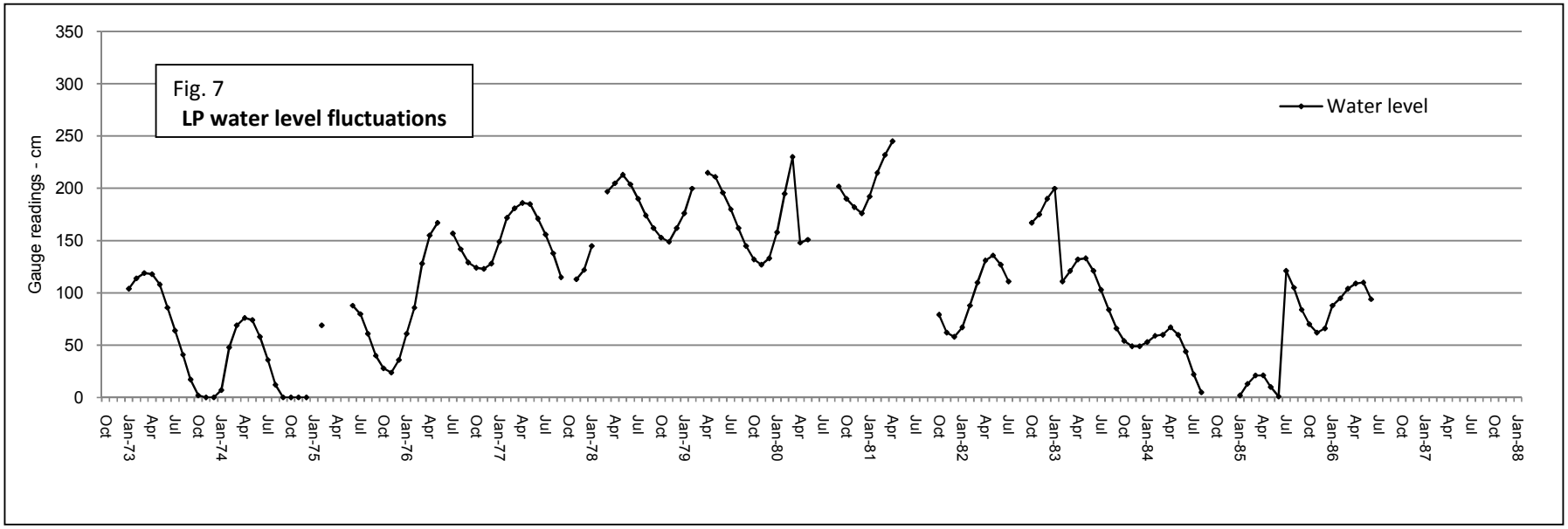
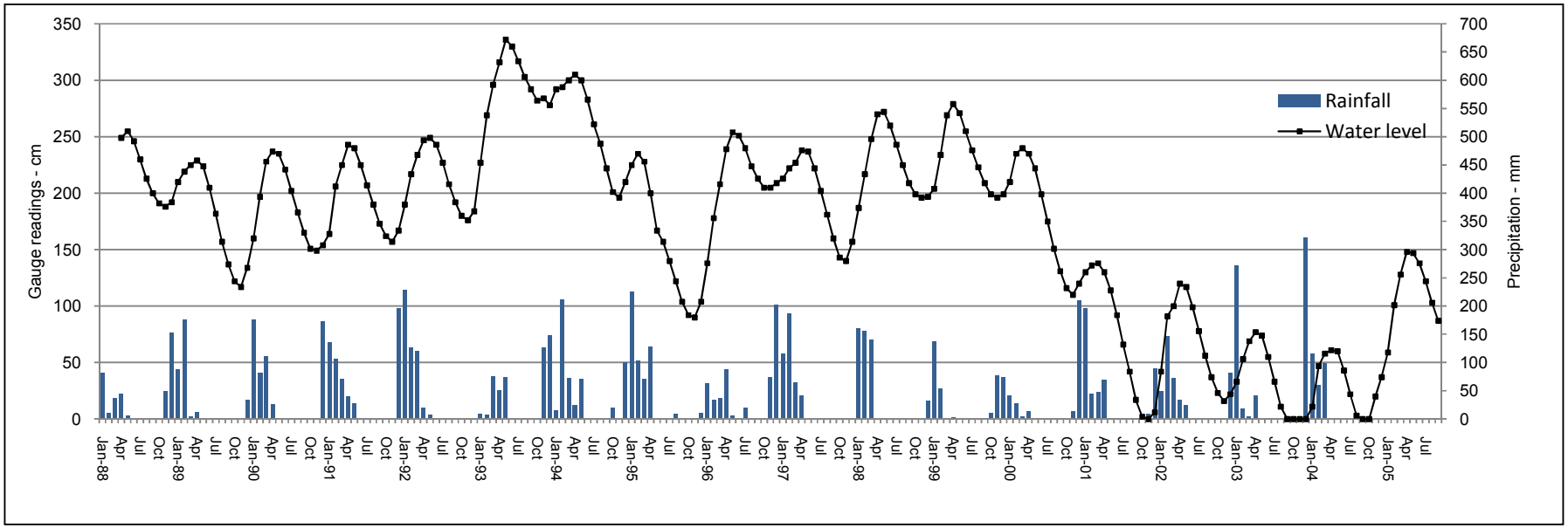
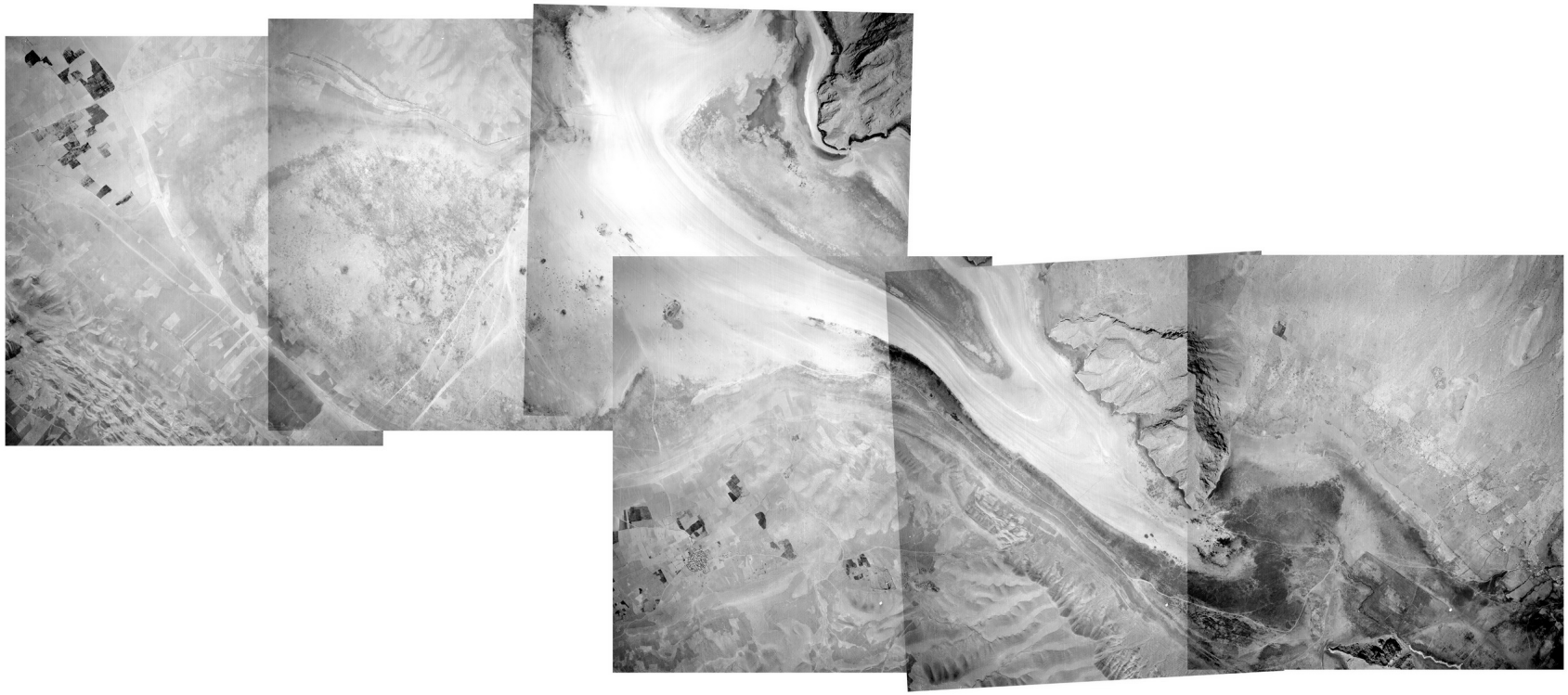


Fig. 7
LP water level fluctuations
Water level
Gauge readings - cm
350
300
250
200
150
100
50
0
Oct Jan-73 Apr Jul Oct Jan-74 Apr Jul Oct Jan-75 Apr Jul Oct Jan-76 Apr Jul Oct Jan-77 Apr Jul Oct Jan-78 Apr Jul Oct Jan-79 Apr Jul Oct Jan-80 Apr Jul Oct Jan-81 Apr Jul Oct Jan-82 Apr Jul Oct Jan-83 Apr Jul Oct Jan-84 Apr Jul Oct Jan-85 Apr Jul Oct Jan-86 Apr Jul Oct Jan-87 Apr Jul Oct Jan-88


Rainfall
Water level
Gauge readings - cm
Precipitation - mm
350
300
250
200
150
100
50
0
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
Jan-88 Apr Jul Oct Jan-89 Apr Jul Oct Jan-90 Apr Jul Oct Jan-91 Apr Jul Oct Jan-92 Apr Jul Oct Jan-93 Apr Jul Oct Jan-94 Apr Jul Oct Jan-95 Apr Jul Oct Jan-96 Apr Jul Oct Jan-97 Apr Jul Oct Jan-98 Apr Jul Oct Jan-99 Apr Jul Oct Jan-00 Apr Jul Oct Jan-01 Apr Jul Oct Jan-02 Apr Jul Oct Jan-03 Apr Jul Oct Jan-04 Apr Jul Oct Jan-05 Apr Jul



Map 7
Aerial photos of 1966-67
Severe drought in Lake Parishan

Table 11 Water quality analyses, Lake Parishan

Parameters	Zavali			Parishan			Halak			Kuhbozy			Center			Seifabad		
	09, Dec, 2001	07 March 2002	17 June 2002	09, Dec, 2001	07 March 2002	17 June 2002	09, Dec, 2001	07 March 2002	17 June 2002	09, Dec, 2001	07 March 2002	17 June 2002	09, Dec, 2001	07 March 2002	17 June 2002	09, Dec, 2001	07 March 2002	17 June 2002
Air Temp.	13.5	19.5	22.5	16.0	19.5	24	17	21	27	19	23	22	17.5	23	23	20	23	23
Water Temp	14.5	18	27.5	14.5	19	28	14.5	19	22.5	15	20	28	15	20	28	15	20	28
pH	8.8	8.48	8.7	8.8	8.6	8.9	8.8	8.7	8.9	8.6	8.7	8.8	8.8	8.6	8.9	8.9	8.6	8.9
EC, dS/cm	8250		5550	8250	4425	5475	8250	4387	5175	7500	4125	3525	8850	8250	4425	8250	3780	5400
DO, mg/l	5.4	6.6	5.2	4.6	6.6	7	6.4	6.6	6	4.4	7.4	7.4	5.8	7.4	8.4	6.6	7.4	5.6
BOD, mg/l	2	1.2	1.2	2	1.4	1.6	6	2	1.6	3.2	2	0.4	2.8	1.6	1.2	2	0.8	0.8
Alkalinity, mg/l	595	350	355	600	340	695	595	345	360	545	325	320	595	340	340	585	345	350
NH3, mg/l	0.01	0.03	0.038	0.017		0.082	0.03		0.095	0.02	0.022	0.041	0.09	0.034	0.082	0.02	0.045	0.082
NO3, mg/l	4.5	3.5	7.6	9.3	3.3	8.6	24.4	3.5	7	48	3.3	8.9	12.5	3.5	8.1	11.3	2.8	7.2
NH4, mg/l	0.2	0.3	0.1	0.2	0.3	0.2	0.4	0.3	0.3	0.6	0.2	0.1	1	0.3	0.2	0.2	0.4	0.2
PO4, mg/l	0.014	0.007	0.038	0.022	0.043	0.033	0.01	0.006	0.074	0.023	0.008	0.04	0.06	0.007	0.049	0.067	0.004	0.024
Total Coliform, MPN/100 ml	40	230	150	40	40	40	90	40	40	230	150	70	23	90	40	9	70	0
Facal Colifor, MPN/100 ml	0	0	90	0	0	0	40	0	0	90	0	0	4	0	0	4	0	0
Water depth	0.8	0.8		1.5	1.5		3.0	3.0		1.5	1.5		1.8	1.8		0.5	0.5	

Source: [5], after Fars DOE laboratories

5. LIMNOLOGY

5.1 Background information

Several sources of limnological information are available for Lake Parishan. These are Shilat Research Center of Bushehr, 1996; Jame Iran of 2002 and, a BSc dissertation of 2002.

The following descriptions are based mainly on the Shilat surveys of 1996. Later reports have used the same source of information. In Shilat surveys, 6 stations were observed for limnological attributes. These are:

1, Zavali as indicative for north western part of the wetland with intensive reed beds, and where fresh ground water comes in through submerged springs;

2, Parishan as indicative of north central part of wetland where water is deeper and no ground water seeps in;

3, Helek, in north east of the Lake where north-eastern flows from Pahlak spring enter the Lake and a narrow strip of reed bed exists;

4, Kuh bozy, in the east of the Lake where eastern flows by Famour canal enter the Lake through the intensive reed beds of this part;

5, Central station in the middle of the Lake which is away from all lake's edges;

6, Seif abad, a station in the southern shallow part of the lake where it receives irrigation return flows.

5.2 Key limnological attributes of LP

Depth of water: Depth of water in the Lake varies from very shallow (few centimeters in the southern, eastern and western gentle sloping lands to more than 4 meters in the northern parts. These variations are displayed in Map 8 which has been produced after a quick bathymetry survey. In this map contour "0" corresponds to the "zero" of the staff gauge.

Temperature: water temperature varies around 14C during winter and rises up to 19C and 28C during spring and summer months respectively,

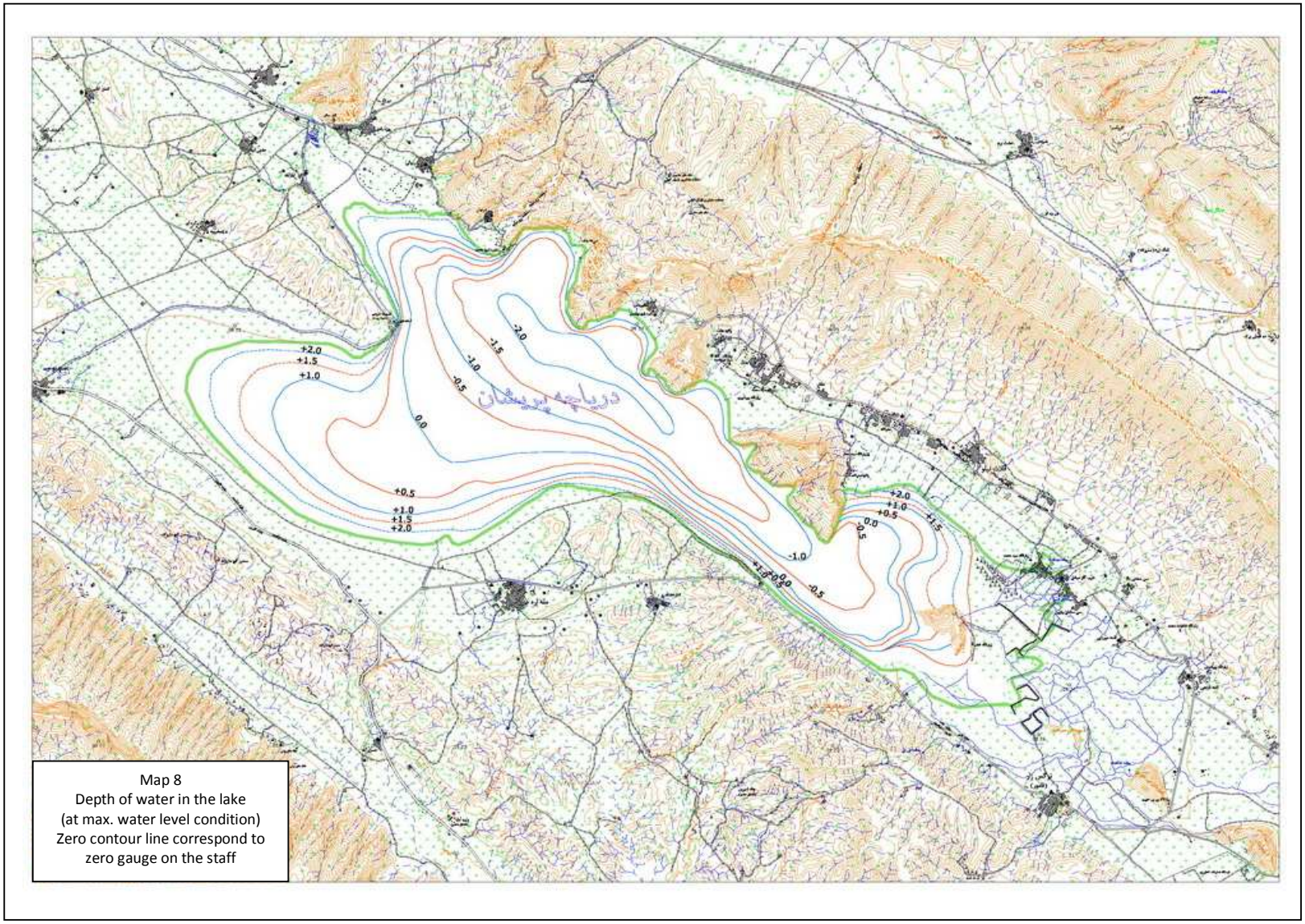
Turbidity: Except during heavy rainfalls when the Lake receives flood flows, the water in all parts of the Lake remains clear;

pH: pH of water in the Lake is generally very high (>8.5). This could be affected by high concentration of CO due to biological activities (respiration) of intense submerged vegetation. High pH prohibits normal growth of fish species.

EC: This is a spatially and chronologically variable attribute and depends on the rate of fresh inflows and evaporation. Close to submerged springs and at the mouth of inflowing channels in the east and west, it shows lower values (3-5 dS/m). High surface runoff inflows (after heavy rainfalls) can significantly affect Lake's water EC. Observations of EC values as low as 0.5 dS/m has been reported from the middle of the Lake. Higher values (8-12 dS/m) are measured in the middle and southern parts and later in the summer season. ECs of submerged spring flows are usually around 0.5-1 dS/m.

DO: Dissolved Oxygen in LP is generally above 4 mg/l. Occasionally, values above 10 mg/l have been measured.

BOD5: Unless in low water cases, the BOD_5 values are low and indicates acceptable quality of water.



Map 8
Depth of water in the lake
(at max. water level condition)
Zero contour line correspond to
zero gauge on the staff

Nutrients: Phosphates and Nitrates are two important nutrients in the Lake water. Phosphates do exist but in low concentration whereas NO_3 values are generally high and sometimes very high probably due to increase in the use of N nutrients for crop production particularly in the northern and eastern parts of the Lake where irrigated farms extend very close to the Lake water line, without any buffer zone.

Table 12
Physical and chemical attributes of Lake's water

Parameters	Units	Stations					
		Zavali	Parishan	Helek	Kuh buzy	centeral	Seof abad
December 9, 2001 (18-9-80)							
Ambient air temp.	o C	13.5	16.0	17	19	17.5	20
Water temp.	o C	14.5	14.5	14.5	15	15	15
pH		8.8	8.8	8.8	8.6	8.8	8.9
EC	dS/m	8.2	8.2	8.3	7.5	8.9	8.3
DO	mg/l	5.4	4.6	6.4	4.4	5.8	6.6
BOD5	mg/l	2	2	6	3.2	2.8	2
Alkalinity	mg/l	595	600	595	545	595	585
NH3	mg/l	0.01	0.017	.03	0.02	0.09	0.02
NO3	mg/l	4.5	9.3	24.4	48	12.5	11.3
NH4	mg/l	0.2	0.2	0.4	0.6	1	0.2
PO4	mg/l	0.01	0.02	0.01	0.02	0.06	0.07
Total coliform	MPN/ 100 ml	40	40	90	230	23	9
Fecal coliform	MPN/100 ml	0	0	40	90	4	4
Water depth	M	0.8	1.5	3	1.5.	1.8	0.5
March 8, 2002 (17-12-80)							
Ambient air temp.	o C	19.5	19.5	21	23	23	23
Water temp.	o C	18	19	19	20	20	20
pH		8.5	8.6	8.7	8.7	8.6	8.6
EC	dS/m		4.4	4.4	4.1	8.3	3.8
DO	mg/l	6.6	6.6	6.6	7.4	7.4	7.4
BOD	mg/l	1.2	1.4	2	2	1.6	0.8
Alkalinity	mg/l	350	340	345	325	340	345
NH3	mg/l	0.03	-	-	0.02	0.03	0.04
NO3	mg/l	3.5	3.3	3.5	3.3	3.5	2.8
NH4	mg/l	0.3	0.3	0.3	0.2	0.3	0.4
PO4	mg/l	0.01	0.04	0.01	0.01	0.01	0.004
Total coliform	MPN/ 100 ml	230	40	40	150	90	70
Fecal coliform	MPN/100 ml	0	0	0	0	0	0
Water depth	M	0.8	1.5	3	1.5	1.8	0.5
June 17, 2002 (27-3-81)							
Ambient air temp.	o C	22.5	24	27	22	23	23
Water temp.	o C	27.5	28	22.5	28	28	28
pH		8.7	8.9	8.9	8.8	8.9	8.9
EC	dS/m	5.6	5.5	5.2	3.5	4.4	5.4
DO	mg/l	5.2	7	6	7.4	8.4	5.6
BOD	mg/l	1.2	1.6	1.6	0.4	1.2	0.8
Alkalinity	mg/l	355	695	360	320	340	350
NH3	mg/l	0.04	0.08	0.1	0.04	0.08	0.08
NO3	mg/l	7.6	8.6	7	8.9	8.1	7.2
NH4	mg/l	0.1	0.2	0.3	0.1	0.2	0.2
PO4	mg/l	0.04	0.03	0.07	0.04	0.05	0.02
Total coliform	MPN/ 100 ml	150	40	40	70	40	0
Fecal coliform	MPN/100 ml	90	0	0	0	0	0

Planktons:

Planktons of the Lake are listed in Table 12 which depicts the numbers observed in 5 distinct habitats of the Lake, e.i.1) reed beds, 2) open water, 3) water body affected by springs, 4) open water affected by reed beds, and 5) the zone in between reed beds and open water.

Numbers of particular phytoplanktons are significantly high in spring observations. *Chlorella* of Chlorophyceae exists almost in all the seasons and is the most abundant species followed by *Diatom* and *Navicula* of Bacilliophyceae.

Benthos

Benthos species observed in the Lake are listed in Table 14. Similar classification as for plankton is used for distinguishing the type of habitat. As could be seen *Ostracoda* and *Gastropoda* comprise the most abundant benthos population during almost all the seasons.

Table 14
Bentos of Lake Parishan, Shilat 1996 surveys

Season / species	Stations				
	1	2	3	4	5
Summer 1995					
Ostracoda	1989	677	578	1006	1701
Gastropoda	923	677	2673	355	1669
Oligocheta	-	-	-	-	-
Polycheata	-	-	-	-	-
Chironomidea	934	7	84		27
Odonata	1847	102	30		223
Plecoptera	89	-	83	355	231
Gammarus	732	-	27	-	40
Fall 1995					
Ostracoda	1522	1010	522	936	720
Gastropoda	3337	1010	743	1755	780
Oligocheta	114	123	78	39	88
Polycheata	42	39	44	26	65
Chironomidea	96	11	39	13	55
Odonata	313	122	-	91	466
Plecoptera	-	-	-	26	-
Gammarus	-	-	-	-	-
Winter 1995					
Ostracoda	780	1086	33	702	590
Gastropoda	1534	1086	1248	1417	520
Oligocheta	26	78	26	52	43
Polycheata	91	78	52	78	35
Chironomidea	39	13		13	26
Odonata	52	26	26	39	35
Plecoptera	-	-	-	78	-
Gammarus	-	-	-	-	-
Spring 1996					
Ostracoda	3280	1253	-	-	-
Gastropoda	1092	1253	2158	1099	823
Oligocheta	65	78	78	83	89
Polycheata	91	65	26	78	99
Chironomidea	91	117	52	91	61
Odonata	117	130	104	135	56
Plecoptera	-	444	-	-	-
Gammarus	-	71	-	-	-

1) Reed beds, 2) Open water, 3) Open water close to spring inflows,
4) Open water and reed beds, 5) In between 3 and 4

Table 13

Phytoplankton in LP, Shilat surveys of 1995-96

Season/ species	Stations				
	1	2	3	4	5
Summer 1995					
Chlorella	258	279	243		221
Diatoma					1
Udorina			1		
Closterium					
Fall 1995					
Chlorella	532	476	551	393	509
Diatoma	8	16	8	4	4
Acromonas		1	1		
Udorina			1		
Closterium		1	1		1
Winter 1995					
Chlorella	500	500	500	500	500
Navicula	7	15	12	16	23
Asterionella	1	2	1	1	1
Ceratium	1	1		1	
Lynoserus	1	1		1	
Acromonas	1	1	1	3	1
Eulindae	1				
Diatoma					1
Spring 1996					
Chorella	2733	2850	2333	2950	2766
Udorina	22	3	59	13	14
Closterium	4	13	5		8
Mezujeluria	411	495	615	613	470
Diatoma	437	315	296	286	310
Navicula	533	551	567	813	505
Cyanophycea	4	3	5		2
Clomydomonas		5		6	6
Acromonas	10	21	6	12	9
Astrionella	1	10		15	3

Zooplankton in LP, Shilat surveys of 1995-96

Season/ species	Stations				
	1	2	3	4	5
Summer 1995					
Odonata	1				
Cladocera		1	1		1
Rotifer					
Cyclopida		1			
Copepoda	1				1
Refropetra	1				
Fall 1995					
Cladocera	4	4	4	4	4
Copepoda	4	12	16	4	8
Rotifer		4			4
Winter 1995					
Crustacea	12	16	12	12	8
Cladocera	13	11	11	11	7
Coleoptera	7	4	1	4	2
Hemiptera					1
Insect larva	2	1	1	1	1
Hydropsyche		1		1	
Spring 1996					
Calunos	23	23	10	8	18
Cyclops	27	25	12	32	22
Diaptomps	47	57	23	25	25
Cladocera	33	88	42	57	47
Insect larva	5	8	3	7	13
Miestedae larva	15	30	7	27	12
Coleoptera	2	3	3		3
Calocranos	5	3		2	4
Hemiptera				3	
Rotifer				2	2
Hydropsyche					1

Observation has revealed that benthic population increases in late summer /early fall when a moderate temperature is prevailing and decreases in very warm months of summer and cold months of winter time. Highest benthic production occurs in reed bed habitats.

Biomass

Shilat report of 1976 has given indications of the phytoplankton biomass in 5 above-said habitats of the Lake as presented in Fig 7. The figure shows that spring season is the month the plankton population (biomass) is highest while in the other seasons the value is dramatically lower.

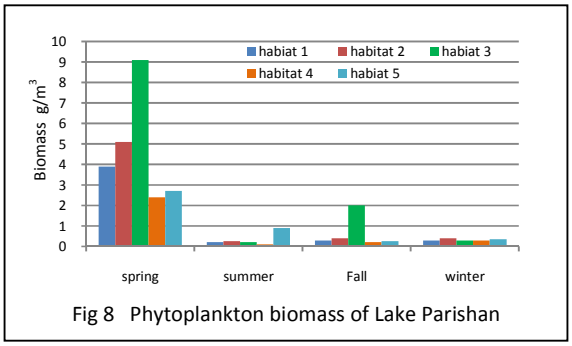
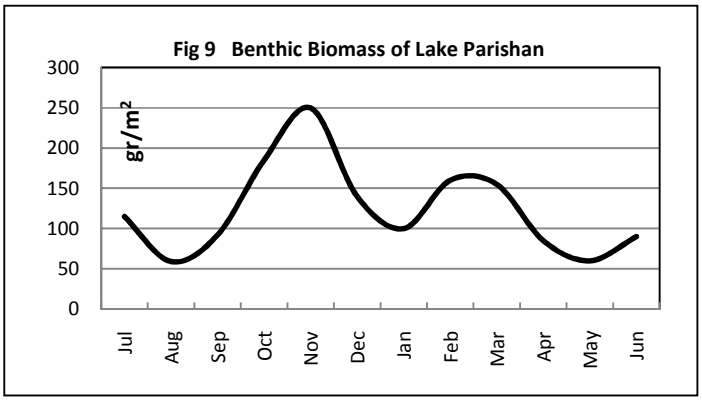


Fig 8 Phytoplankton biomass of Lake Parishan

The same surveys also conclude that benthic biomass of the Lake varies between 50 to 250 gr/m^2. Figure 8 displays the monthly variations that reveal higher values of biomass occur in November and February when season is mild and temperature is mediocre.



6. **Vegetation**

Although information on floral attributes of Lake Parishan is very important, most of the studies ever conducted have focused mainly on the flora outside the Lake. The only study with focus on the flora of Lake and its surrounding wetlands is that of Shilat 1996. Despite its valuable information on species diversity, this report only describes spatial distribution of the species without showing the information on a map. A detailed floral survey of the area is strongly needed to provide dependable information on species diversity and distribution as well as spatial extension and biomass of each species / communities.

6.1 Vegetation cover in the catchment area

Regarding the vegetation cover of the LP catchment area, three distinct vegetation units have been identified which include 1) *Ziziphus*, 2) *Amygdalus,* and 3) *Quercus*

The *Ziziphus* unit exists in the foothill part of the Famour mountain, north of the Lake at altitudes of 800-1100 meters, and covers about 7% of the corresponding area, of which about 5% (about 30 stands per ha) belongs to *Zizyphus* and the remainder (about 10 stands per ha) belongs to other trees. 83% of the area is covered with herbaceous species. Accompanying tree species are *Amygdalus scoparia* , *Pistacia khinjuk, Ficus carica* and *Populus sp.* The common herbaceous species in this unit are: *Anthemis rodocentra*, *Papaver aremone, Echinops endotricus, Avena wiestii , Ebenus stellata*, and *Achillea milifolia*.

Amygdalus unit exists in the higher altitudes of the southern steep slopes of Famour mountain, north of the Lake (altitudes 1100-1400 meters).

The area of the vegetation cover is about 20% (about 90 stands per ha) of which 12% (about 54 stands per ha) belongs to *Amygdalus* and 8% (about 36 stands per ha) to a variety of other trees. The remaining 80% of the land surface is covered with herbaceous species.

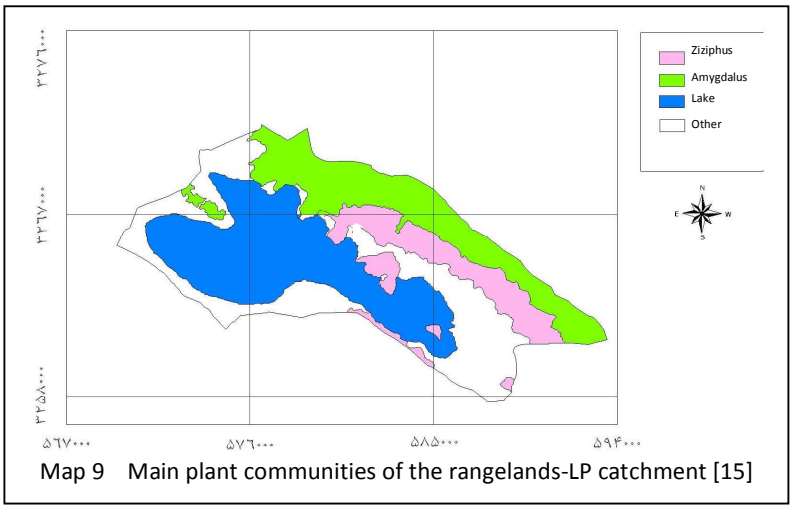
Fig 10 A typical view of the woodlands of the northern mountains in LP catchment

Trees accompanying this unit include: *Fraxinus persica, Ficus carica*, *Pistacia atlantica*, *Daphne mucromata*, *Cratagus acaralus*, and *Olea europea*. Some of the common herbaceous species in the group are: *Cireium congestum*, *Artemisia herbaalba*, *Astragalus ovalnus*, *Convolvulus pllosellafoaus*, *Medicago sative*, *Ebenus stellata*.

Quercus unit exists in the high altitudes (1400-2200 meters amsl), and covers about 40% of the surface of which about 30% belongs to *Quercus persicus*. Accompanying trees include *Amygdalus lycioides*, *Cerasus microcarpa*, *Pistacia atlantica*, *Rosa canica*, *Aygdalus elaegnifoli*, *Pistacia khinjuk*.

The herbaceous species in the unit include *Saliva atropatana*, *Tulipa clusiana*, *Lactuca orientalia*, *Alliu sp*., *Astragalus obtusifolius* , *Chaerophyllum macropodum*.

Juniperus polycarpus grows at altitudes above 2200 meters amsl. Because of the strong wood, these trees have been widely harvested and only few stands have survived and thus need to be protected.



Map 9 Main plant communities of the rangelands-LP catchment [15]

6.2 Vegetation cover in the wetland area

Wetland flora in LP area consists of meadow, emergent, floating and submerged vegetations. Considerable areas in the east, northeast and west of the Lake are water-logged. These are habitat for meadow type vegetation such as *Salix sp, Ricinus sp*,

Table 15 Plant species' distribution within LP area including springs and waterways. [22]

	Water source	Vegetation type																					
		Trees and bushes					Meadows								Emergent plants			Floating						Submerged	
		Salix	*Rubus*	*Ricinus*	*Tamarix*	*Myrtus*	*Juncus*	*Menthe*	*Ranunculus*	*Alisma*	*Veronica*	*Convolvolus*	*Polygonum*	*Portulaca*	*Phragmites*	*Typha*	*Scirpus*	*Potamogeton*	*Ceratophyllum*	*Nastortium*	*Zannichellia*	*Lemna*	*Ricciocarpus*	*Najas*	*Myriophyllum*
1	Lake Parishan								❋		❋	❋			❋	❋	❋							❋	
2	Pol-e Abguineh spr.		❋	❋				❋		❋	❋	❋	❋	❋	❋	❋	❋	❋							
3	Helak spring	❋	❋	❋				❋	❋			❋	❋	❋	❋	❋		❋	❋			❋	❋		
4	Jamshidi spring	❋	❋	❋				❋				❋		❋	❋			❋	❋						
5	Ghale narenji spring	❋	❋	❋	❋			❋	❋				❋	❋	❋			❋	❋	❋					❋
6	Ab syro spring		❋	❋	❋	❋		❋					❋		❋					❋					
7	Ab mordak spring		❋		❋	❋		❋						❋	❋					❋					
8	Ab garm spring		❋		❋	❋			❋	❋					❋					❋					
9	Helak spring							❋					❋		❋	❋			❋	❋					
10	Gap spring							❋	❋	❋	❋				❋	❋	❋								
11	Khajo spring							❋	❋		❋		❋		❋	❋	❋								
12	Bardakan spring							❋		❋					❋	❋	❋					❋		❋	
13	Abguineh canal	❋		❋			❋		❋				❋	❋	❋	❋	❋	❋	❋		❋				❋
14	Ayazabad canal													❋	❋							❋			
15	Joy-e- lor canal				❋		❋		❋				❋	❋	❋	❋	❋								
16	Araban canal				❋		❋			❋	❋		❋	❋	❋	❋	❋								
17	Ghale narenji canal							❋		❋					❋	❋		❋	❋						
18	Helak canal							❋		❋	❋		❋		❋			❋	❋						

Tamarix sp, *Myrtus sp*, *Polygonum lapathifolum, Mentha sp, Alisma plantago aquatic*, *Cyperus fuscus*, *Cyperus longus*, *Veronica anagallis*, *Cynodon sp*., *Porulaca sp.* In the north east of the wetland, north to the Araban outcrop, (SW of Arab gav-mishi) a large pasture land, which towards south turns into a more or less pure *Tamarix* community, is a significant floral feature.

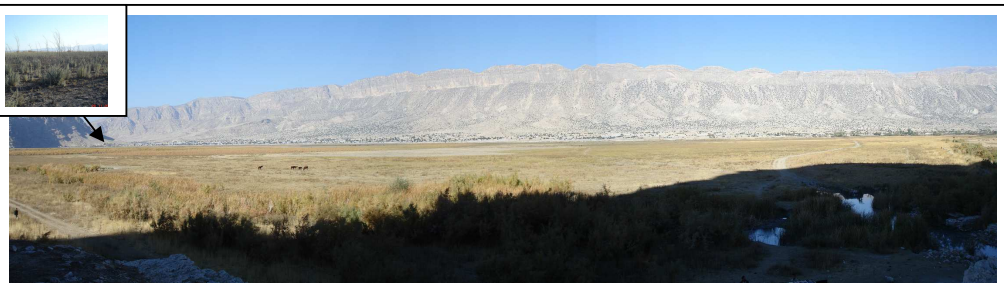


Fig 11 Pasture land and *Tamarix* community, NE of LP, south west of Arab-gav-mishi village. View from Araban outcrop

Among emergent plants, *Phragmites australis* is more distinct and covers vast areas in the east, west and north parts of the Lake. *Typha latifolia* and *Scirpus sp* are subsequent species with much smaller coverage.

Phragmites in west of Lake Parishan

Floating species of *Lemna minor*, and *Lemna marina* are existing in the canals and springs, and submerged species of *Najas minor* is the only submerged plant in the Lake, while it exists also in some of the spring ponds where it locally is accompanied with *Potamogeton pectinatus, Ceratophyllum demersum,* and *Myriophyllum.*

In the south western part of the wetland which has remained dry for several years, halophyte and xerophytes species have grown. Neither of the existing reports explains about these species nor includes a map of their spatial distribution. Several of the herbal species in LP area have different uses such as medical, fragrance, food, pasture and/or industrial uses. Narcissus is a flower which naturally grows in particular wet lands in south east of the lake and has good market as decorative flower.

Dense bulk of submerged Najas, Northern part of LP

Fig 12 Typical xerophytes cover SW of LP

Myrtus syriac, a fragrant species in the eastern part of the wetland around the springs is in red list of IUCN.

6.3 Human use of the wetland's flora:

Villagers around the lake harvest reeds to feed their livestock. Reeds are also used, but not widely, for fencing, roof insulation, and handy-crafts.

Narcissus yards are property of the government and Natural Resources Department leases them to agents who rent the yards for flowers.

Fig 12 Rural children in a Narcissus yard, east of LP

6.4 Bio-mass of the aquatic plants

Shilat surveys of 1995 has measured sample biomass of different aquatic plants of the wetland, which is indicated in the following table:

Table 16 Biomass of aquatic plants [22]

Plants	Weight gr/ m^2	
	Wet	dry
Phragmites (dense)	14700	5900
Typha	18650	7300
Scirpus	1900	480
Nastortium	5750	2080
Lemna	1330	360
Najas	8200	3280
Potamogeton	3200	1675
Ceratophyllum	3950	1740

7. Habitats

Lake Parishan with its extensive water body as well as two dense reed bed patches at its western and eastern ends provides diverse habitat for a variety of water birds and aquatic fauna.

The water body supports habitat for several species of indigenous and introduced fish. The fresher part of the water body at the eastern and northern verges of the lake (where it receives fresh groundwater seepages) is nursery habitat for fish larva and fingerlings. Also, some fish species use the rather dense submerged aquatic plants (Najas) at northern and particularly north eastern part of the lake as a nursery as well as feeding and sheltering habitat. Water courses in the eastern and northeastern part of the lake are spawning habitats for some fish species.

The migratory water birds use different parts of the wetland for feeding, sheltering and breeding. The water body in its central deeper parts (see map 6) is the main feeding habitat for piscivorous water birds. The dense reed beds at the eastern and western ends of the lake is habitat for several species of migratory as well as resident water birds that use them as sheltering, nesting and breeding site. The lake-ward verges of eastern reed beds are particularly important because it provides habitat for nesting and breeding Pelicans[1]. Farmlands at the south west of the lake (Seif abad area) are used by geese as feeding habitat. Several individual small patches of reed beds in the central as well as south western extension of the lake create isolated safe islands for some breeding birds.

1 - For breeding species see pp 36

The rather narrow strip of *Phragmites* reeds alongside the rocky shores at northern verges of the lake provide habitat for otter, *Lutra lutra*.

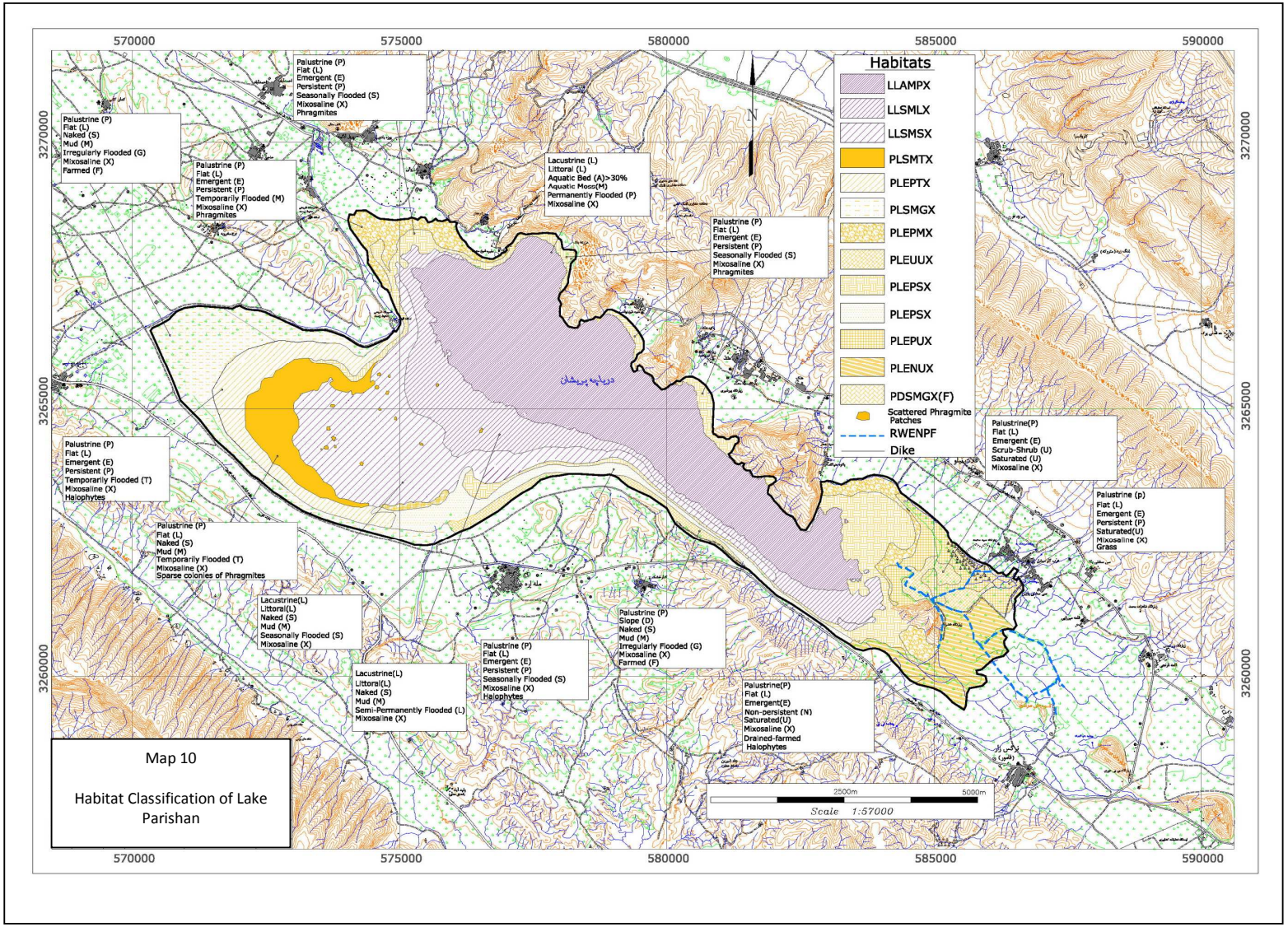
Open grasslands in north east of the lake are used for ranching horses (Fig 11). The shrub lands at the north east part of the lake are habitat for mammals particularly *Sus*

Sample habitats in Lake Parishan

scrofa. Some of the villagers at the northeastern side of the Lake breed water buffaloes that use the lake for feeding and resting / sheltering.

Wetlands in eastern waterlogged areas are habitat for Narcissus flower. A small area of Typha at the southeastern part of the lake seems to be a unique patch of this plant within the lake.

Using MedWet methodology, a habitat classification of the Lake area is presented in Map 1. As shown, 11 categories of habitat types are distinguished. Depth and status of water body, presence and type of vegetation and quality of bed material are the main parameters for categorizing. According to the definitions used in the classification, the deeper parts of the Lake are lacustrine and the remainder is palustrine.


570000
575000
580000
585000
590000
3270000
3265000
3260000
Habitats
LLAMPX
LLSMLX
LLSMSX
PLSMTX
PLEPTX
PLSMGX
PLEPMX
PLEUUX
PLEPSX
PLEPSX
PLEPUX
PLENUX
PDSMGX(F)
Scattered Phragmite Patches
RWENPF
Dike
N
Palustrine (P) Flat (L) Emergent (E) Persistent (P) Seasonally Flooded (S) Mixosaline (X) Phragmites
Palustrine (P) Flat (L) Naked (S) Mud (M) Irregularly Flooded (G) Mixosaline (X) Farmed (F)
Palustrine (P) Flat (L) Emergent (E) Persistent (P) Temporarily Flooded (M) Mixosaline (X) Phragmites
Lacustrine (L) Littoral (L) Aquatic Bed (A)>30% Aquatic Moss(M) Permanently Flooded (P) Mixosaline (X)
Palustrine (P) Flat (L) Emergent (E) Persistent (P) Seasonally Flooded (S) Mixosaline (X) Phragmites
Palustrine (P) Flat (L) Emergent (E) Persistent (P) Temporarily Flooded (T) Mixosaline (X) Halophytes
Palustrine (P) Flat (L) Naked (S) Mud (M) Temporarily Flooded (T) Mixosaline (X) Sparse colonies of Phragmites
Lacustrine(L) Littoral(L) Naked (S) Mud (M) Seasonally Flooded (S) Mixosaline (X)
Lacustrine(L) Littoral(L) Naked (S) Mud (M) Semi-Permanently Flooded (L) Mixosaline (X)
Palustrine (P) Flat (L) Emergent (E) Persistent (P) Seasonally Flooded (S) Mixosaline (X) Halophytes
Palustrine (P) Slope (D) Naked (S) Mud (M) Irregularly Flooded (G) Mixosaline (X) Farmed (F)
Palustrine(P) Flat (L) Emergent(E) Non-persistent (N) Saturated(U) Mixosaline (X) Drained-farmed Halophytes
Palustrine(P) Flat (L) Emergent (E) Scrub-Shrub (U) Saturated (U) Mixosaline (X)
Palustrine (p) Flat (L) Emergent (E) Persistent (P) Saturated(U) Mixosaline (X) Grass
2500m
5000m
Scale 1:57000
Map 10
Habitat Classification of Lake Parishan

8. FAUNA

While the catchment area of Lake Parishan supports habitat for several mammal species, the wetland itself is particularly important for the habitats it provide for fish and water birds. The fauna in the entire catchment area is summarized in the following tables. It should be noted that larger mammals particularly Artiodactyla and Carnivores usually reside in Mian Kotal elevations:

8.1 Mammals:

Mammals observed in the area are listed in the following table:

Table 17 Mammals in LP area

Artiodactyla	
- *Sus scrofa*	
- *Dama mesopotamica*	
- *Ovis orientalis laristanica*	
- *Capra aegagrus*	
Carnivora	
- *Canis lupus*	
- *Ursus arctos*	
- *Martes foina*	
- *Meles meles*	
- *Lutra lutra*	
- *Herpestes edwardsii*	
- *Herpestes auropunctatus*	
- *Hyaena hyaena*	
- *Felis catus*	
- *Felis chaus*	
Leporidae	
- *Lepus capensis*	
Insectivora	
- *Paraechinus hypomelas*	

Rodentia	
- *Sciurus anomalus*	
- *Cricetulus migratorius*	
- *Microtus irani*	
- *Microtus socialis*	
- *Gerbullus nanus*	
- *Tatera indica*	
- *Meriones persicus*	
- *Meriones libycus*	
- *Meriones crassus*	
- *Acomys cahirinus*	
- *Mus musculus*	
- *Apodemus sylvaticus*	
- *Hystrix indica*	
Chiroptera	
- *Rhinopoma hardwickii*	
- *R. microphyllum*	
- *Rhinolophus ferrumequinum*	
- *R. blasii*	
- *R. hipposideros*	
- *R. mehelyi*	
- *Asellia tridens*	
- *Triaenops persicus*	
- *Myotis blythii*	
- *Pipistrellus pipistrellus*	
- *Pipistrellus kuhlii*	
- *Eptesicus serotinus*	

Table 18 Amphibians and Fishes

Amphibians	
Sallentia	
- *Rana ridibunda ridibunda*	
- *Hyla savignyi*	
- *Bufo viridis arabicus*	
Fishes	
- *Barbus grypus*	
- *Barbus barroisi*	
- *Barbus luteus*	
-	

Fishes	
- *Anguilla mastasimbelus*	
- *Cyprinion tenuiradius*	
- *Mugil abu*	
- *Capoeta trutta*	
- *Capoeta fusca*	
- *Hypophthalmichthys molitrix*	
- *Clenopharingodon idella*	
- *Cyprinus carpio*	
- *Gambusia affinis*	

Table 19 Reptiles

Testudinidae (Turtles)	**Sauria**
- *Testudo graeca zarudnyi*	- *Laudakia nupta*
- *Mauremys caspica ventrimaculata*	- *Trapelus agilis*
- ***Serpentes* (Snakes)**	- *Trapelus persicus persicus*
- *Typholops vermicularis*	- *Hemidactylus persicus*
- *Coluber najadum najadum*	- *Tropicocolotes tielena tielena*
- *Coluber rhodorachis*	- *Ermias persica*
- *Coluber ventrimaculatus*	- *Ermias niyrolateralis*
- *Coluber ravergieri ravergieri*	- *Lacerta princeps*
- *Eirenis rechingeri*	- *Mesalina watsonana*
- *Eirenis collaris*	- *Lacerta zagrosica*
- *Pseudocyclophis persica*	- *Varanus griseus*
- *Natrix tessellate tessellate*	- *Ablepharus pennon*
- *Spalerosophis diadema cliffordi*	- *Eumeces Schneider*
- *Spalerosophis microlepis*	- *Ormastyx asmussi*
- *Psammophis lineolutus*	- *Mabuya aurata septemtaeniata*
- *Echic carinatus*	
- *Vipera lebetina*	
- *Walterinnesia aegyptia*	

8.3 Water birds

Part of the international importance of Lake Parishan is because of the supports it provides to the migratory birds that use it either as wintering, feeding or as breeding habitat.

As in other wetlands, water birds in Lake Parishan are annually counted in January, and the information is available since 1974, the first year after which, the Lake was registered as a Ramsar Site. For preparing the present report, use has been made of the data which was provided through DOE Tehran.

The annual winter counts of water bird species is summarized in Table 1,Annex 3. Despite the attempts made to obtain the complete set of data, this table lacks considerable parts of the census from 1974 to 1990, while there are indications that the highest bird populations have occurred in 1970s and 1980s. In particular bird population data of 1987, 88 should show highest populations ever recorded in LP. This to some extent reflects the difficulties which presently exist in data collection, data processing, data archiving and data releasing.

The table also indicates the peak counts of individual species against the 1% thresholds criterion of the Ramsar Convention for international importance. As could be seen, the wetland frequently hosts water birds in populations greater than the Ramsar Criterion.

Also the table indicates that in many years during the recording period (7 out of 18 accessed), the total number of birds exceed the 20,000 criterion of Ramsar Convention for international importance.

There is no record of monthly variation of water birds in the Lake. Therefore no discussion could be made of bird population variation during the seasons. However local people believe that the periods with dense population of water birds are during winter months, while considerable number of Marbled Teal may occur in summer time.

High water bird population has been recorded for Parishan Lake, for example, an average of 25,000 ducks and 120,000 *Fulica atra* in four winters in the 1970s, and Marbled teal population of over 2000 in the 1970s and up to 5500 in late 1980s.

However, increase in cultivated areas around the wetland has provided better feeding areas for some species, i.e. *Anser anser* and *Grus grus*, while increase in fishing activities and particularly disturbances due to motor boat traffics has caused significant decrease in population of ducks (Fig 14-7).

Worth to mention is that in the last dry years (2009-10), recession of Lake's water surface has caused dramatic decrease of bird population in the area.

Breeding species

While the Lake is evidently a habitat for breeding of several species, there are not enough documented records to quantify the breeding species. However, dense or moderately dense reed beds around the wetland form good breeding habitats for several species.

Pelecanus crispus Dalmatian Pelican is the well known species that breeds in the wetland. Other species which have been observed at breeding position are (Rahbar 2004):

- *Marmaronetta angustirostris*, Marbled Teal
- *Anas strepera*, Gadwall

Dr. B. Behrouzi, (ornithologist) believes that four following species breed in LP:

- *Egretta garzetta;*
- *Ardea cinerea;*
- *Pelicanus crispus*
- *Plegadis falcinellus*

D. Scott has reported[1] the breeding species in Arjan and Parishan (combined) as follows, In the same report he has indicated that most of the species are using Parishan Lake rather than Arjan:

- *Podiceps cristatus* (50-100 pairs)
- *Podiceps nigricollis* 20 prs
- *Tachybaptus ruficollis* breeds
- *Pelecanus crispus* 5-10 prs
- *Ixobrychus minutus* 15-20 prs
- *Nycticorax nycticorax* 100 prs
- *Egretta garzetta* 100 prs
- *Ardeola ralloides* 200 prs
- *Ardea purpurea* 5-10 prs
- *Plegadis falcinellus* 30-100 prs
- *Platalea leucorodia* 50-400 prs
- *Marmaronetta angustirostris* (200-300 pairs in 1976-77)
- *Aythya nyroca* several pairs
- *Oxyura leucocephala* several pairs
- *Porpyhyrio porphyrio* breeds
- *Himantopus himantopus* 10+ prs
- *Glareola pratincola* 30 prs
- *Charadrius alexandrinus* 20 prs
- *Vanellus indicus* 20 prs
- *Vanellus leucurus* 20+ prs
- *Sterna hirundo* 5+ prs
- *Sterna albifrons* 10+ prs

1 - D. Scott,1995, A Directory of Wetlands in the Middle East.

Table 20 List of breeding species in Lake Parishan (after Mr. Farhadpour)

	Species		Timing		Remarks
			Summer	Winter	
1	*Phalacrocorax pygmeus*	Pygmy Cormorant			Since early 2000s, more than 750 pairs use the Lake and seems that they are getting resident
2	*Pelecanus crispus*	Dalmatian Pelican	√	√	
3	*Pelecanus onocrotalus*	White Pelican	Few	√	
4	*Botaurus setellaris*	Bittern	√	√	
5	*Ixobrychus minutus*	Little bittern	√	√	
6	*Nyctycorax nyctycorax*	Night Heron	√	√	
7	*Ardeola ralloides*	Squacco Heron	√	√	
8	*Bubulcus ibis*	Cattle Egret	√	√	
9	*Egretta garzetta*	Little Egret	√	√	
10	*Ardea purpurea*	Purple Heron	√	√	
11	*Ciconia ciconia*	White Stork	√	√	
12	*Plegadis falcinellus*	Glossy Ibis	√	√	
13	*Platalea leucorodia*	Spoonbill	√	√	
14	*Tadorna ferruginea*	Ruddy Shelduck	√	√	In the rocky areas around the Lake
15	*Podiceps cristatus*	Great Crested Grebe	√	√	
16	*Tachybabtus ruficollis*	Little Grebe	√	√	
17	*Podiceps nigricollis*	Black necked Grebe	√	√	
18	*Marmaronetta*	Marbled Teal	√	√	
19	*Netta rufina*	Red Crested Pochard	Suspect	√	
20	*Aythya nyroca*	Ferruginous Duck	√	√	
21	*Oxyura leucocephala*	White Headed Duck	√	√	
22	*Rallus aquaticus*	Water Rail	√	√	
23	*Gallinula chloropus*	Moorhen	√	√	
24	*Porphyrio porphirio*	Purple Gallinule	√	√	
25	*Glareola pratincola*	Collared Pratincole	√	√	
26	*Charadrius dubius*	Little Ringed Plover	√	√	
27	*Vanellus indicus*	Red Wattled Plover	√	√	
28	*Vanellus leucurus*	White Tailed Plover	√	√	
29	*Sterna albifrons*	Little Tern	√	√	
30	*Halcyon smyrnensis*	White Breasted Kingfisher	√	√	
31	*Ceryle rudis*	Pied Kingfisher	√	√	
32	*Alcedo atthis*	Common Kingfisher	√	√	
33	*C .hybrida*	Whiskered Tern			Occasionally in some years
34	*Chlidinias leucopterus*	White Winged tern	√	√	On floating plants in shallower parts
35	*Lusciniola melanopogon*	Moustached Warbler	√	√	
36	*Acrocephalus palustris*	Marsh Warbler	√	√	
37	*Acrocephalus stentoris*	Clamorous Reed Warbler	√	√	

Fig 14-1
Winter counts of **Grebes** in Lake Parishan

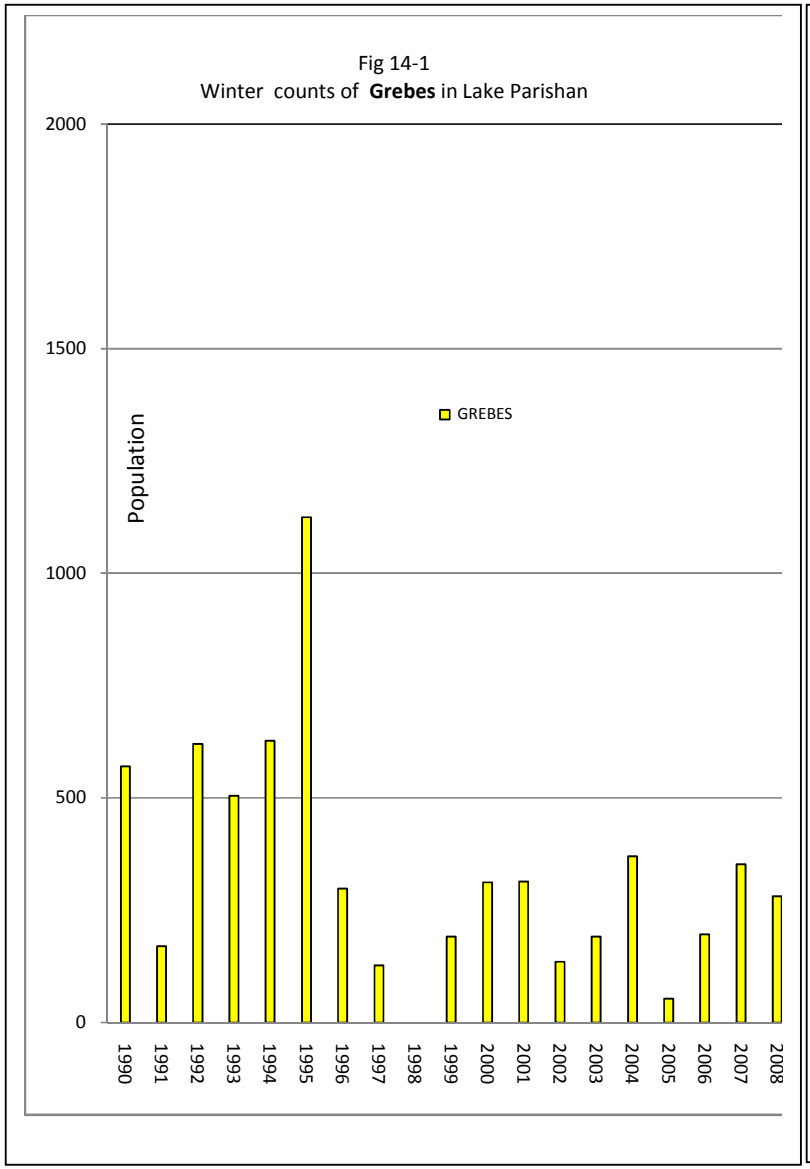


Fig 14-2
Winter counts of **Pelicans** in Lake Parishan

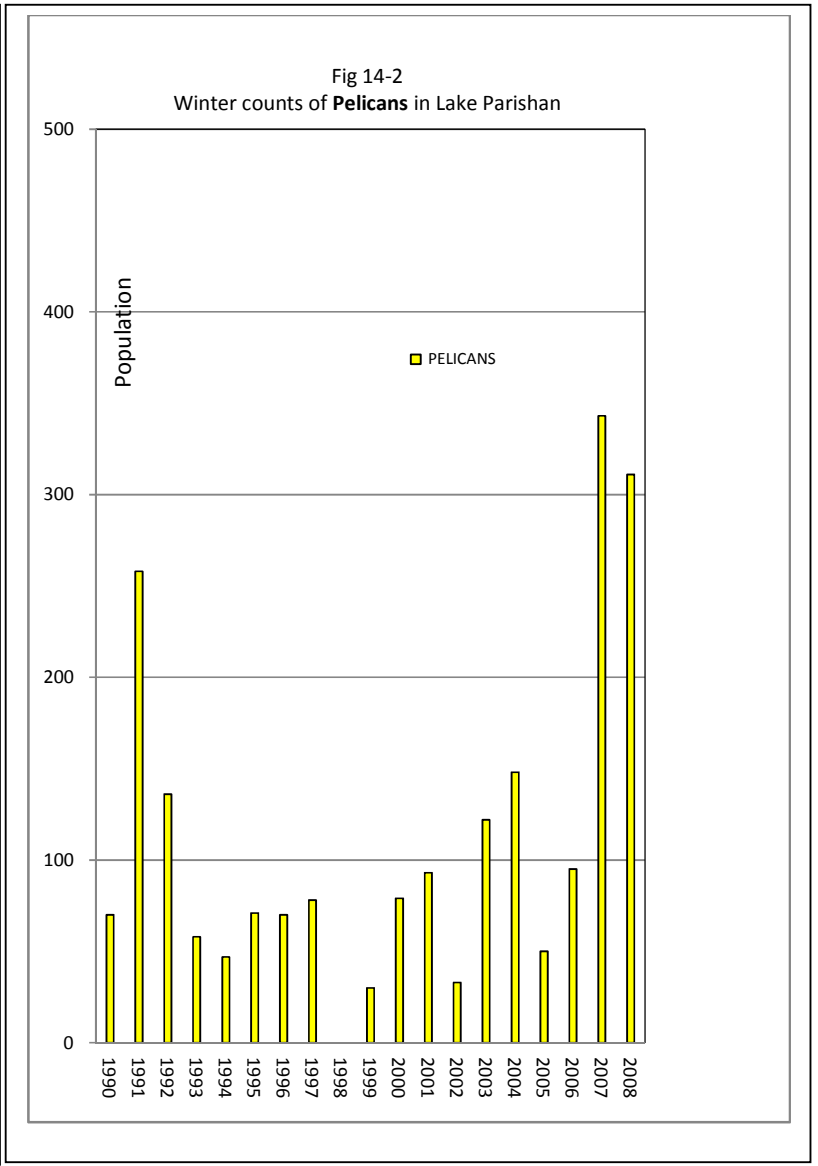


Fig 14 -3
Winter counts Of **Herons and Egretes** in Lake Parishan

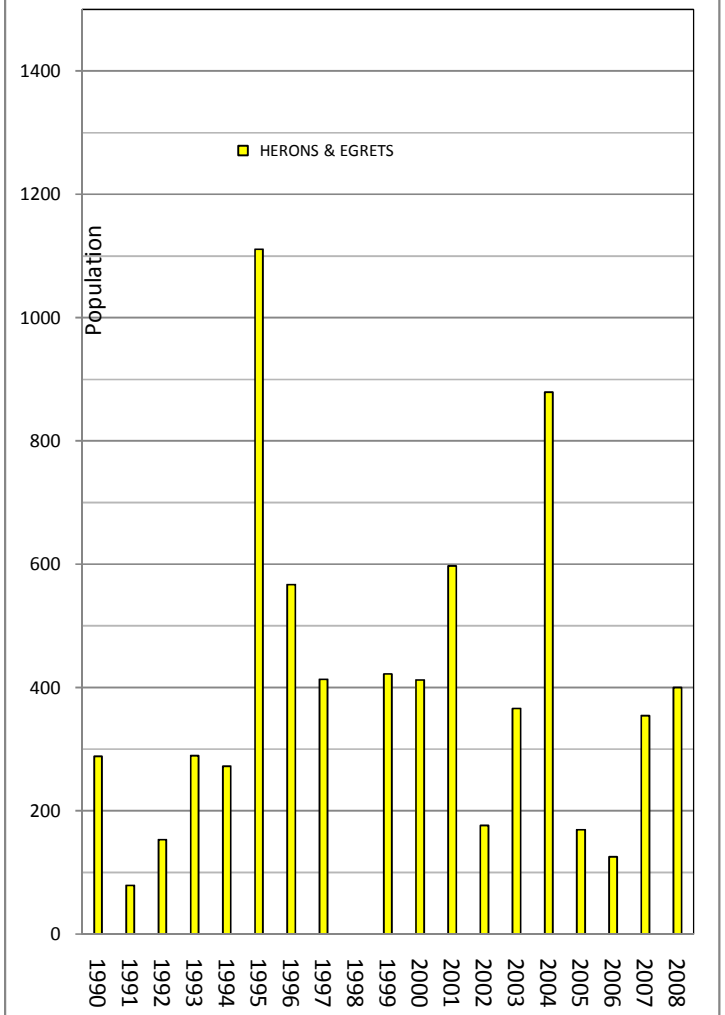


Fig 14-4
Winter counts of **Cormorants** in Lake Parishan

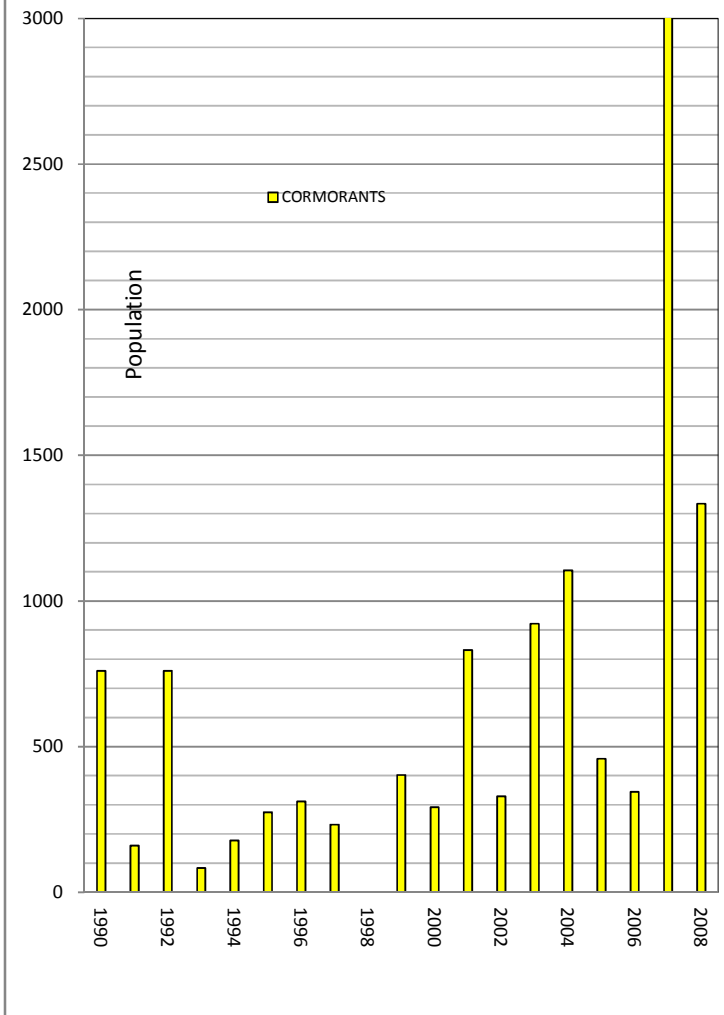


Fig 14-5
Winter counts of **Ibises** in Lake Parishan

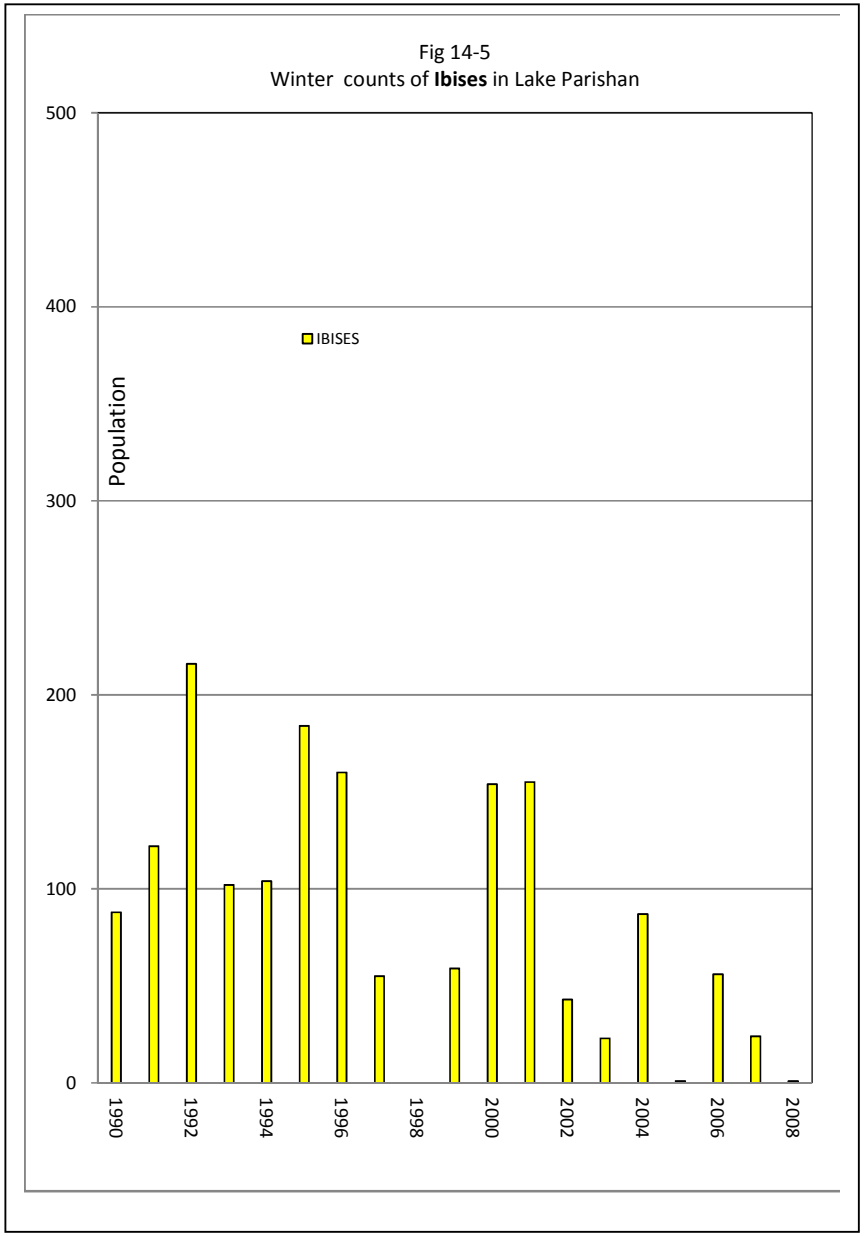


Fig 14-6
Winter counts of Flamingoes in Lake Parishan

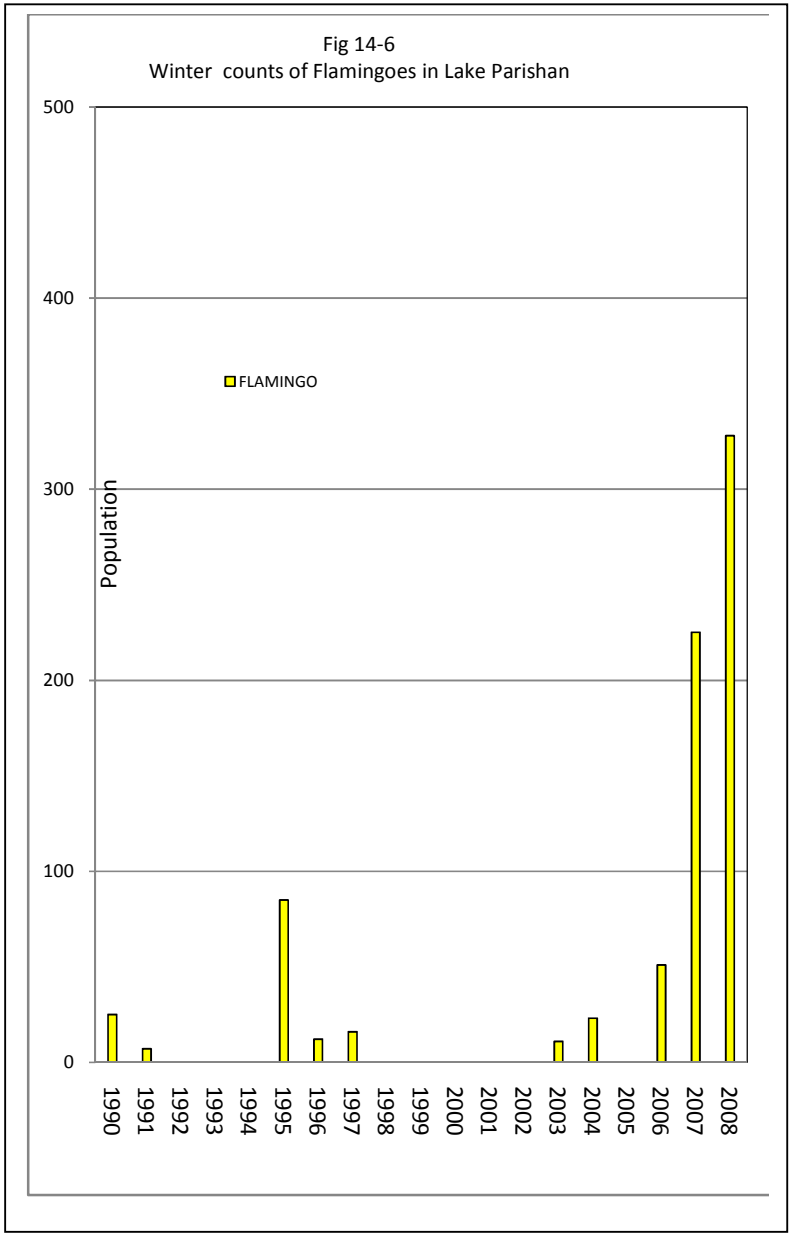


Fig 14-7
Winter counts of **Swans, Geese** and **Ducks** in Lake Parishan

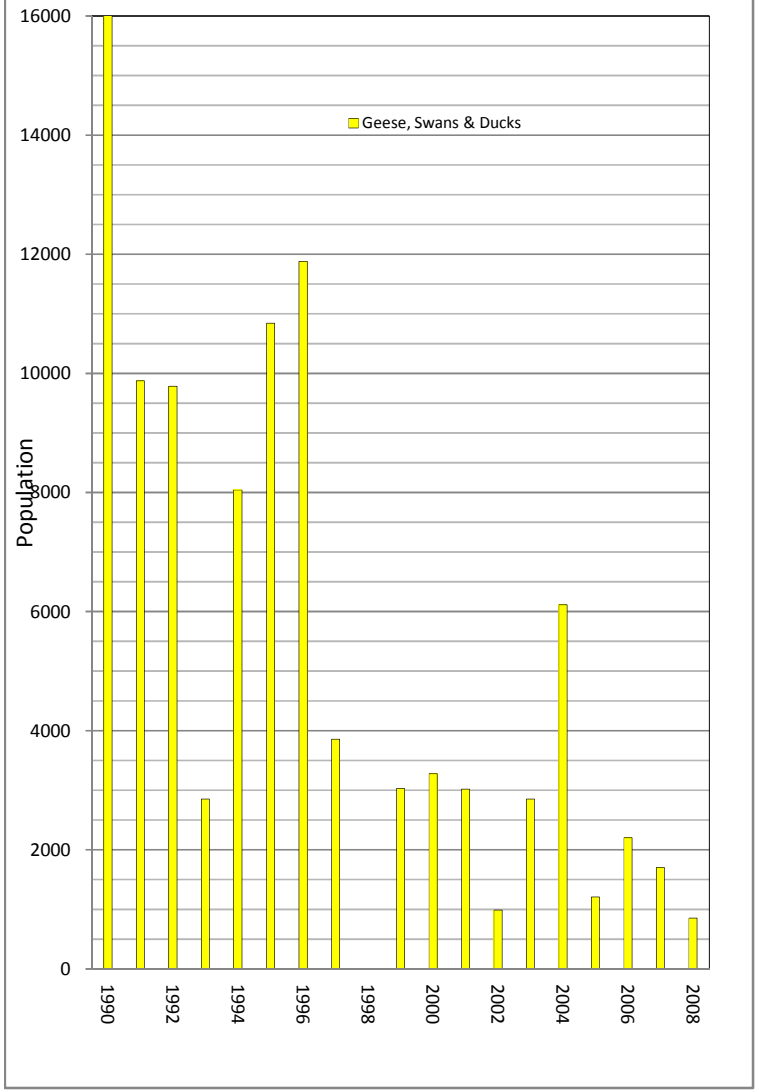


Fig 14-8
Winter counts of **Cranes** in Lake Parishan

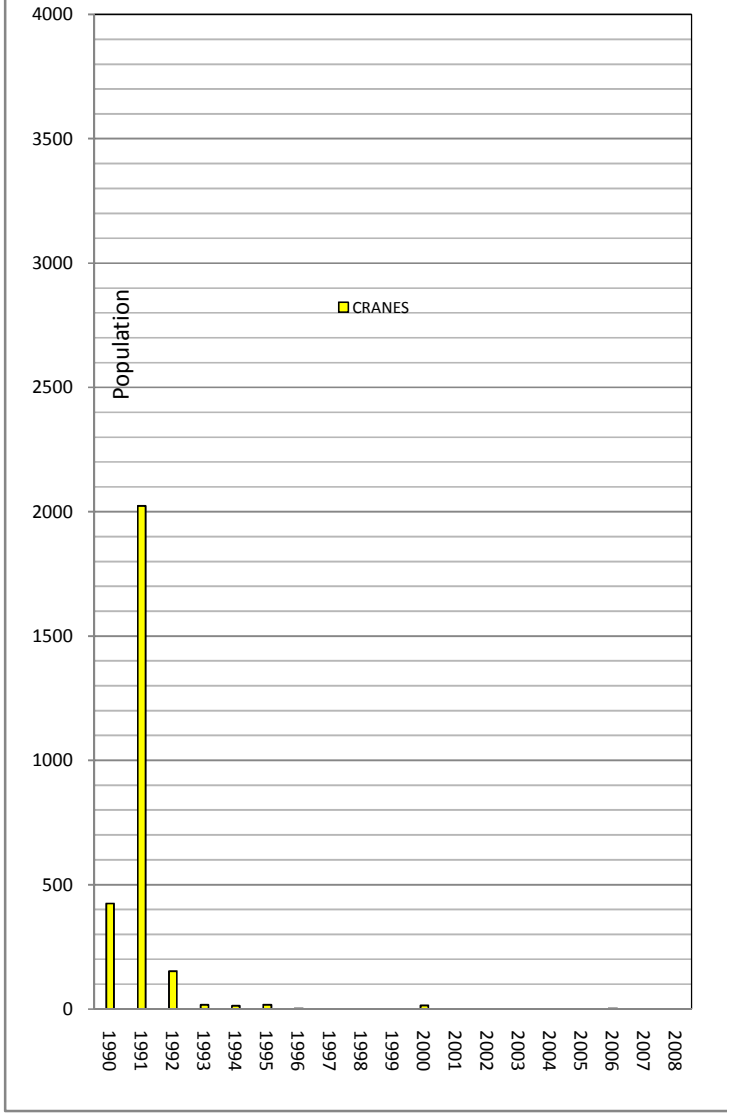


Fig 14-9
Winter counts of **Rails, Gullinules** and **Coots** in Lake Parishan

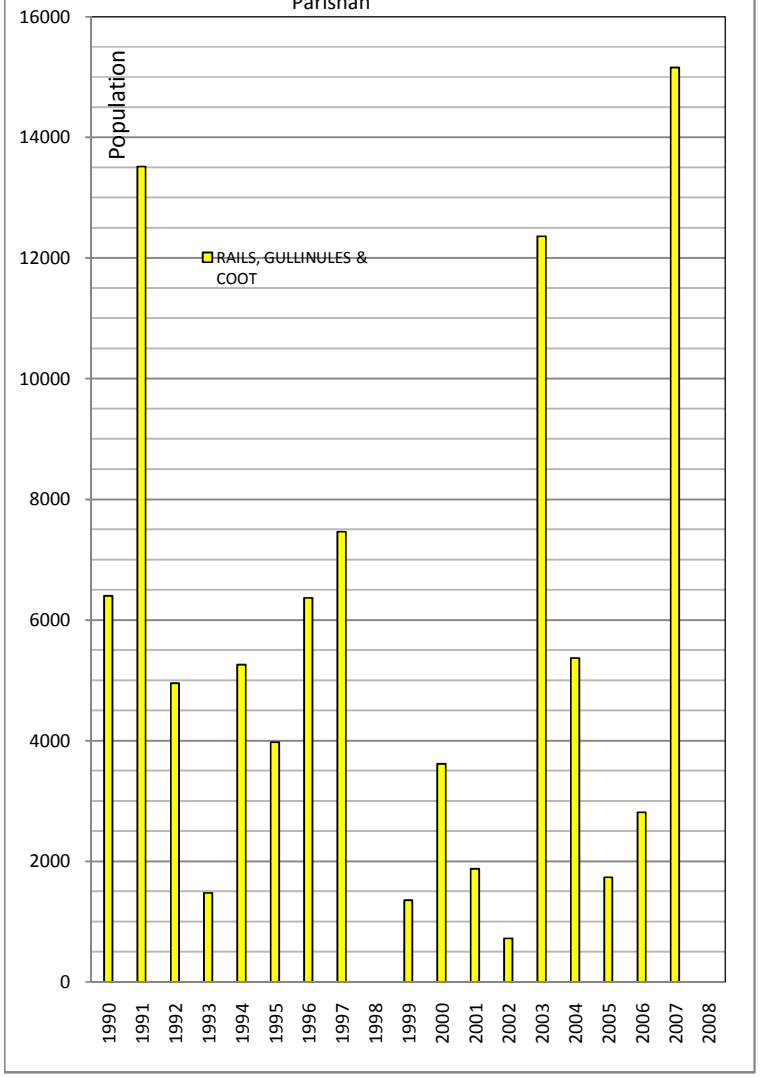


Fig 14-10
Winter counts of **Waders** in Lake Parishan

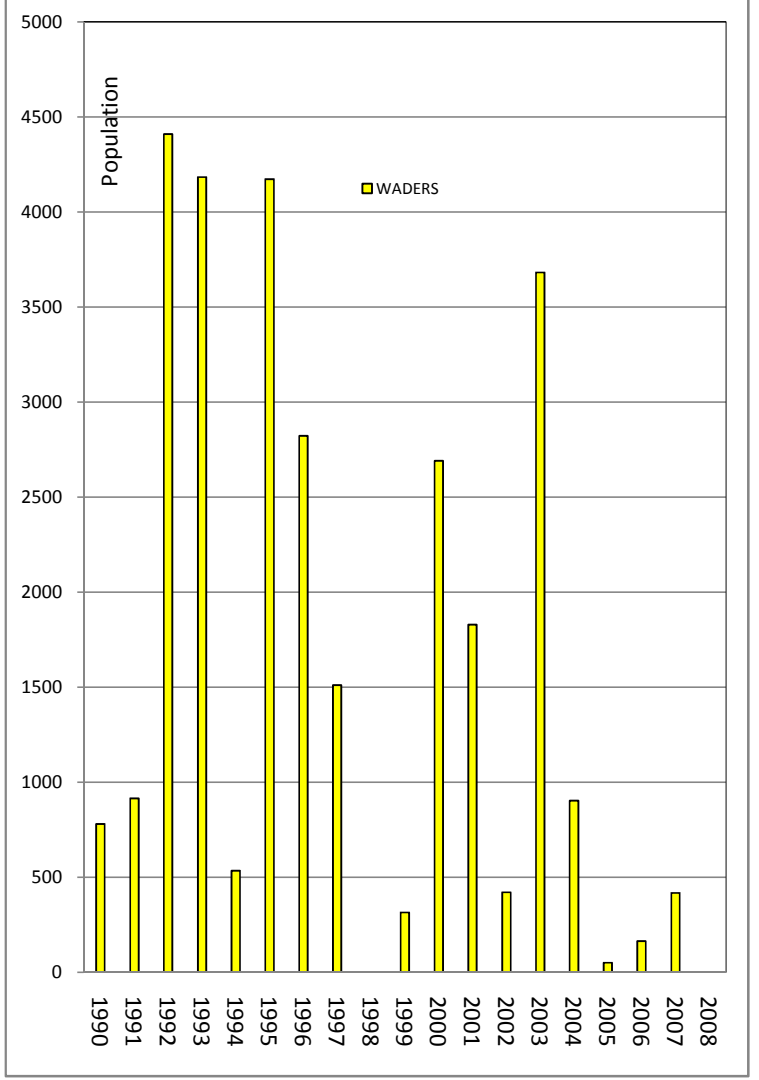
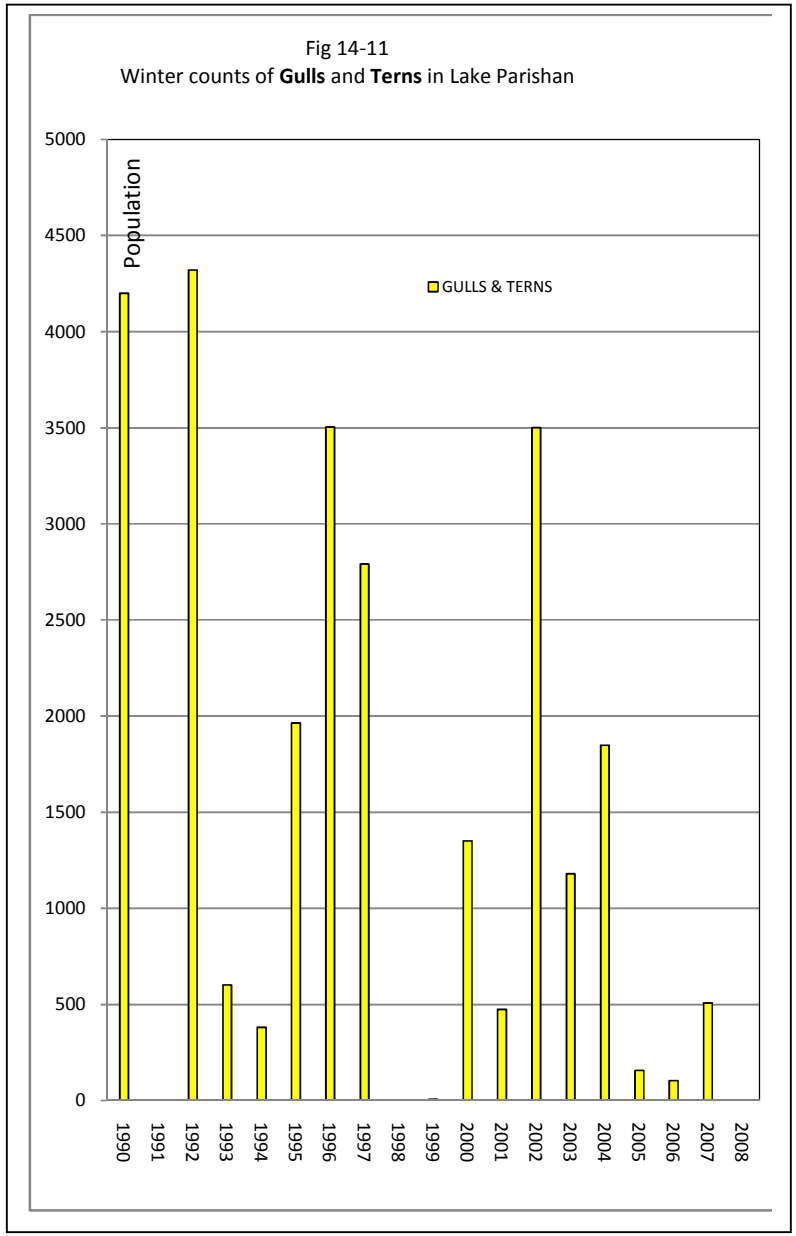


Fig 14-11
Winter counts of **Gulls** and **Terns** in Lake Parishan



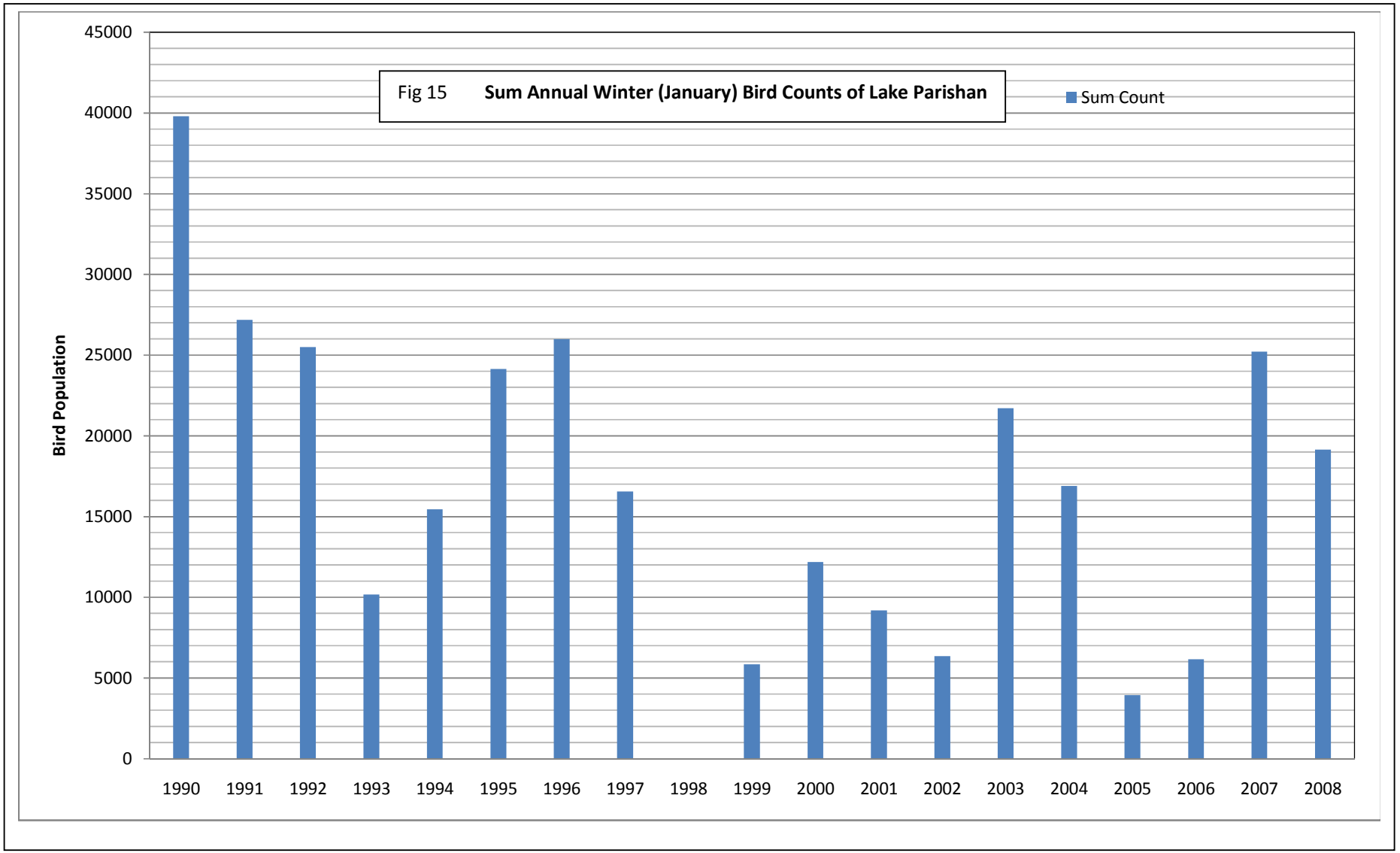


Fig 15 Sum Annual Winter (January) Bird Counts of Lake Parishan
Sum Count
Bird Population
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008

And finally Mr. Farhadpour (ornithologist) has valuable information on the water birds of LP. Part of the information thus obtained for this report is presented below:

Globally threatened waterbirds

Following the IUCN criteria, the following records of globally threatened waterbird species were made: *Aythya nyroca* (LR Near threatened, Vu.) (max count 250, 1991), *Marmaronetta angustirostris (*Vulnerable*)* (max count 5500, 1991), *Oxyura leucocephala (*Endangered*)* (max count 127, 2004), *Phalacrocorax pygmaeus* (LR Near Threatened) (max count 5478, 2006), and *Pelecanus crispus.*

Important waterbird populations

Based on the existing data, the annual counts of water birds frequently exceeds the Ramsar convention criterion for international importance (20,000). Furthermore, the following species were recorded in numbers which exceed 1% of their biogeographical population: *Podiceps cristatus,* Great Crested Grebe*, Phalacrocorax pygmaeus* Pygmy Cormorant*, Anser anser,* Greylag Goose, *Oxyura leucocephala* White-headed Duck, *Larus ridibundus* Black-Headed Gull,*Tadorna ferruginea* Ruddy Shelduck. Parishan Lake is therefore of considerable international importance for its waterbird populations. However, because of prolonged drought during 1990-2008, the total numbers shows a significant decline.

9. HUMAN POPULATION

9.1 Background / available information

The earliest documents for population data is that of 1956 national census. Since then, population information is updated through 10 yearly national censuses. Information on population is obtainable from Census Center. Presently rural health houses also collect information on changes in village population (deaths and births). In 2001 studies, Jame-e-Iran conducted a rapid population survey through questionnaire.

9.2 Administrative boundaries

There are 19 villages around the wetland and within its hydrological boundaries. These villages are within the administration of 2 districts (Bakhsh) namely Markazy with 8 villages totally in Belian sub-district (Dehestan), and “Jareh Bala deh” with 11 villages in Famour sub-district. The central administration of these districts is Kazeroun city, about 12 kilometers west of the Lake. The population in these villages constitutes not more than 5% of the total population of the Kazeroun County (Shahrestan).

9.3 Population and Ethnic status

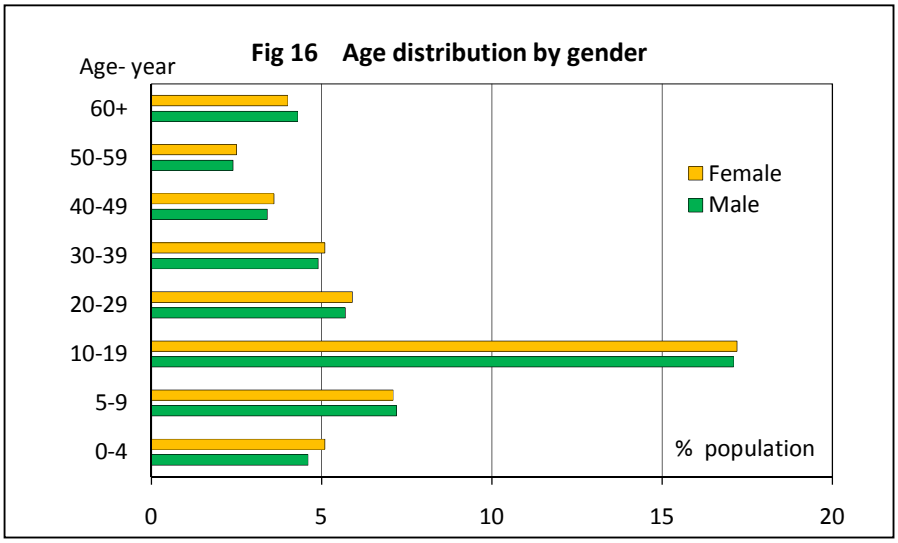
According to the 2006 national census, the total population of the villages in the wetland area is close to 12000 (Table 21). Comparing this with the populations of the previous decades indicates a growth rate of 1.2% (1986/96) and 1.8% (1996/06) which is much lower than the growth rate in the rural areas of Iran. During 2001-06, the growth rate has been 1.07%. This should be an indication for a considerable immigration rate. Indeed Kazeroun city and Shiraz (the province capital) have great capacity to attract rural population. The lack of welfare facilities as well as very little occupation opportunities are the main reasons for migration of youths for either education or employment.

9.4 Age distribution

Based on the 2001 information, age distribution of the population is indicated in Fig 16. Ages between 10-20 constitute the most significant category. This is because of the very high population growth of the 1980s. Also close to 90% of the population is younger than 40. This means that:

Table 21
Population around Lake Parishan, 2006 Census

	Village	No. Families	Population			Literate population		
			Total	Male	Female	Total	Male	Female
1	Ayazabad	51	254	115	139	180	84	96
2	Pouzeh bady	76	344	185	159	231	135	96
3	Zavali	121	634	311	323	441	233	208
4	Pole abguineh	83	365	178	187	275	139	136
5	Seifabad	441	2,004	1,025	979	1,480	792	688
6	Abu Ali	299	1,627	857	770	1,286	702	584
7	Shahrenjan	60	290	154	136	201	112	89
8	Karaee	31	174	84	90	125	62	63
9	Ghaleh Mirzaee	14	62	33	29	44	26	18
10	Molla Arreh	256	1,105	569	536	801	426	375
11	Ghaleh Narenji	70	354	163	191	255	127	128
12	Konar khoshk	59	293	143	150	199	102	97
13	Nargess zar	185	797	404	393	563	308	255
14	Sisakhti	38	169	85	84	120	64	56
15	Arab Gav mishi	293	1,292	646	646	834	471	363
16	Ghalat Niloo	182	857	438	419	548	303	245
17	Parishan	21	89	47	42	55	35	20
18	Deh Pagah	166	868	432	436	599	323	276
19	Helek	164	937	483	454	613	343	270
Total villages		2,559	12,261	6,237	6,024	8,850	4,703	3,967
Kazeroun City		30,257	128,943	66,031	62,912	102,695	54,447	48,248
Kazeroun county		58,036	258,097	130,345	127,752	195,839	103,875	91,964



- Good portions of the population are in the educating ages, are adaptable and have the capacity to digest new areas of knowledge including wetland conservation and ecosystem management;
- A considerable part of the population in the Lake area has the potential for being economically active;
- Creating job opportunities is an indispensable requirement for the area.

9.5 Literacy in the rural area

The 2006 census reveals that 71% of the population in the wetland area is literate. Males and females respectively constitute 54% and 46% of the literate population. In Ghaleh Narenji and Ayaz abad literate females equal or slightly exceed male literate population. In all the villages, younger population constitutes the main composition of literate population.

9.6 Occupation

The main occupation of the rural population is irrigated agriculture and animal husbandry. Fishing is also an auxiliary occupation for some of the rural people particularly some villages in the northern villages. Occupation is mainly in male population and females possess minor part in occupation. In Arab settled villages which animal husbandry is a more distinct occupation, females are more occupied. These are mainly engaged with animal husbandry works (milking, feeding, grazing, etc.).

Rural females are mainly engaged with animal husbandry

9.7 Ethnic attributions

While the majority of the population in the villages are Fars, Turks of “Ghashghaee tribes”, Lors of Kohguiloyeh region and Arabs “of Fars tribes” are also present as minorities. Sisakhti and Arab Gavmishi are villages with population domination of Lors and Arabs respectively. Ghashghaee Turks are well mixed with population of almost all villages. No document is available to declare the population in each of the above groups. All the population is Shiite Muslims. While each tribe uses his native language for communication among themselves, the formal language of the region is Farsi, and all the teaching texts are in Farsi too.

9.8 Cultural attributes

People in this area have the general culture of Fars rural people. They are generally sympathetic and hospitable and to some extent smooth and easy.

Men usually dress dark color coats and trousers while women and girls wear gleaming colorful petticoats, multilayer long skirts and colorful scarf.

Both men and women take part in public and or family ceremonies. However, in all the public and many of the family events, men and women stay separate but not necessarily out of sight of each other, particularly when the ceremonies are held in open yards. Normally each village has a special space for public open ceremonies.

Respecting community leaders and older persons used to be a common tradition and such persons used to have great influence on village population for settling disputes among families and persons. Within the family, usually older males (grandfather and father) are ruling the family and are responsible for family’s position and welfare. However since past decades, all these traditions are slightly fading out.

Dancing is a common practice by men and women in joyful ceremonies. They use typical Fars music played by oboe and drum and have very typical singing style which is usually sung by men. Women usually dance calmly in round circle and wave colorful scarves above their head. Men dance in couple and continuously wave a 1-1.5 long stick which is an indispensable tool for dancing. After some-while of foot dancing by both dancers, one dancer starts attempting to strike the other’s leg with his stick while the other should defend. Both couple play in turn the attack and defend games until one of them receives the first strike upon which the dance terminates.

9.9 Land tenure

Most of the agricultural lands around the Lake are owned by the villagers. Natural woodland and forests on the higher altitudes are natural resources and are owned by the Government. Natural Resources Department of Ministry of Jihad Agriculture is responsible for these lands. The Lake itself is the property of Government and is managed by DOE.

The natural boundary of the wetland is naturally established by water marks. In the south-western part of the wetland, DOE has dug a shallow channel around the wetland and claims that has purchased, in 1960s, all the private lands within this line. However because of the lack of adequate documents, this is a subject of dispute between the villagers and DOE. Farmers have made their own embankment to separate lands that they claim belongs to them. These lands are naturally subject to inundation by high water levels of the Lake. See paragraph 10-10 for location of disputed lands. As part of the current wetland management program, the boundary of the wetland will be delineated and hopefully the disputes will be settled through a common effort by involved parties.

9.10 Land use

The main occupation of the rural population is irrigated agriculture and animal husbandry. About 6500 hectares of the land within the catchment area is used for irrigated farming. The main source of water for irrigation is supplied from spring flows and ground water. More than 800 wells (10-50 meters deep) are pumping water from alluvium aquifer. Few deep wells (more the 50 meters deep) are also under operation.

Presently the main common crops are wheat, barley and colza as winter crops and, melons, cucumber, tomato, egg plant, pumpkins, pepper and green beans as spring / summer crops. In some normal years, when adequate water is available, rice is also cultivated. Because of limitations in farming lands in the villages north to the lake, the cropping pattern is more inclined to summer cash crops. In these villages, early plantation of cucumber and egg plant under plastic galleries has been developed for pre-season harvesting. In the southern villages, because of restrictions in water resources, most of the lands are used for producing cereals, corn and sunflower. In general about 60% of lands are used for producing cereals and 40% is under vegetables and summer crops. Extensive lands in the south west of the wetland (Seyf abad, Molla arreh,..) which do not have permanent access to irrigation water are normally used for rain-fed cultivation of wheat and barley. In general the recent prolonged drought has inversely affected the water yield of wells, particularly in the southern parts and thus has reduced the cultivated area and crop production.

Table 22
Existing Facilities in the Villages around Lake Parishan

	Elect-ricity	Tap water	Gas net works	Post office	Rural phone center	Mobile phone	Prim. school	Sec. school	Health house	Health center
Ayazabad	√	√			√	√	√			
Pouzeh bady	√	√				√	√			
Zavali	√	√		√	√	√	√	√	√	
Pole abguineh	√	√		√	√	√	√		√	
Seifabad	√	√	√	√		√	√		√	
Abu Ali	√	√	√			√	√			
Shahrenjan	√	√				√	√			
Karaee	√	√				√	√			
Ghaleh Mirzaee	√	√				√	√			
Molla Arreh	√	√		√	√	√	√	√	√	
Ghaleh Narenji	√	√				√	√	√		
Konar khoshk	√	√				√	√			
Nargess zar	√	√		√	√	√	√	√	√	√
Sisakhti	√	√			√	√	√	√		
Arab Gav mishi	√	√			√	√	√			
Ghalat Niloo	√	√			√	√	√			
Parishan	√	√				√	√			
Deh Pagah	√	√		√		√	√		√	
Helek	√	√				√	√			

Source: Census Center 2006

Under plastic cultivation of vegetable crops in the northern foothills

9.11 Rural facilities

Rural facilities available in most of the villages are restricted to Electricity, Tap water and primary schools. Also all the villages are covered by the national and provincial radio and television as well as mobile network. Several villages have health house which can provide elementary health care and first aids by a health technician. Narges Zar is the only village with somehow more advanced services provided by a part time medical doctor.

9.12 Rural economy

The economic condition of the rural families is directly dependent on the size of their land tenure and the crops they grow. The family's deposits to provide necessary cash money to supply farm inputs is another factor which affects the farmer's income. In many cases farmers have to borrow money from middle men on the credit of their cultivation. In this process the middle men purchase in advance the farmer's product in much lower price than is at the time of harvest. It seems that credit facilities provided by formal credit agencies (banks and cooperatives) do not suffice the farmer's requirements.

In general, with the exception of few families in each village who have been able to provide sufficient economic resources and / or have been lucky in their successful investments and business in Kazeroun or, the remainder rural families are generally suffering from lack of adequate economic facilities/opportunities, and hardly can obtain sustaining incomes. Rural youngsters particularly educated ones who have left the village hardly have opportunities in their village for a satisfactory job.

10. DESCRIPTION OF MAIN HUMAN ACTIVITIES AND THEIR IMPACTS

Shapour, the ancient Sassanid town in the vicinity of Kazeroun had been an important historic area of pre-Islamic era. Rich karstic water resources in this area should be one of the main reasons for attracting the ancient communities and establishing glorious civilization. Also one should consider the value of Lake Parishan as a rich source for food which could support such communities.

A view of Shapour ruins

10.1 Agricultural activities

Agriculture has been and still is the main activity in the rural society. Before motor pumps were introduced to the area, main source of water supply for irrigated farms was gravity diversion from the spring flows. At this time only villages in the east ((Famour, Arab gavmishi, Ghaleh mirzaee, Ghaleh narenji) and west (Zavali, Ayaz abad, ..) of the Lake that had access to spring flows were practicing irrigated agriculture. The villages in other parts around the lake had their main occupations in rain-fed cultivation (wheat and barley), animal husbandry and fishing from the Lake.

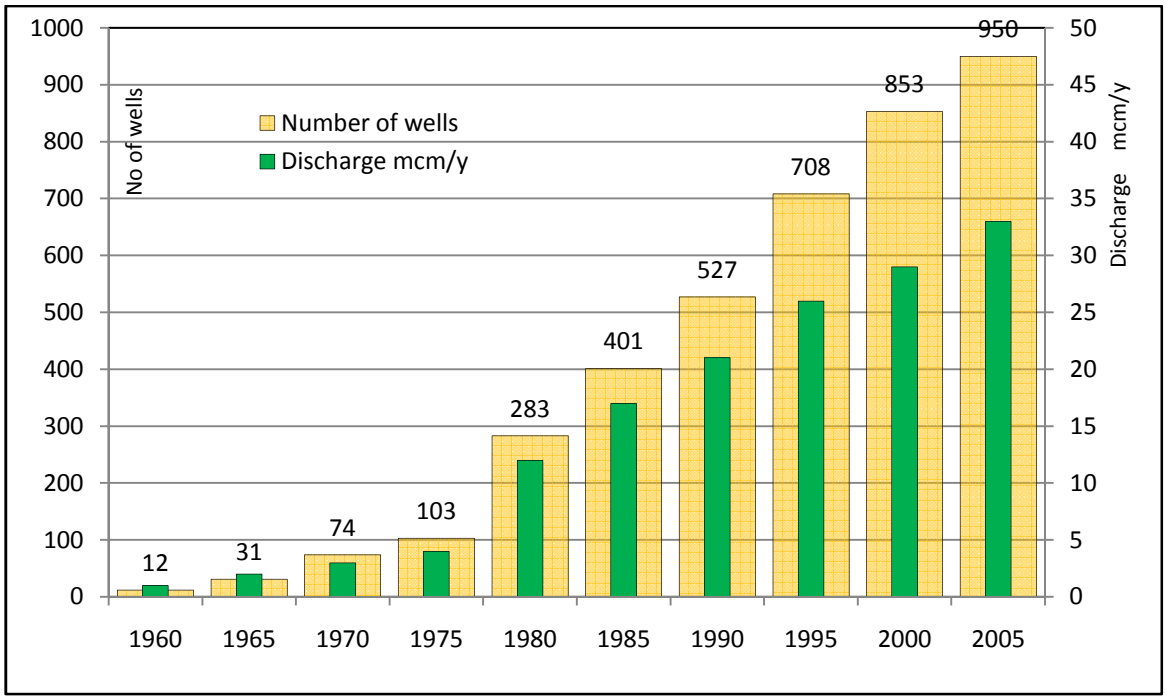


Fig17 Trends in construction of wells and discharging ground water
Source : [11]

The earliest pump-wells were constructed in Parishan area late in 1950s. The number of wells increased rather slowly during the next decade. In 1967 the first studies for investigating ground water resources and their potential for development were initiated by the Ministry of Energy. At the same time soil and land resources of the region was investigated to evaluate their capacity for irrigation development. Investigations for evaluation of ground water potentials continued during later decades and the further potentials for groundwater development from karstic formation were discovered (None of these studies considered the water requirement of the Lake). This allowed and encouraged local people to construct their

An example shallow well

shallow (hand dug) wells to pump ground water for growing crops. Figure 16 displays the pace with which construction of wells and extraction of ground water developed during the decades.

Table 23
Trends in agricultural development around the Lake

		1365	1373	1383	1387-89
No of wells;		400	640	834	949
Volume of water, 10^6 m^3	springs		45	28	4
	wells	16	21	33	28
Areas cultivated, ha			5800		6650

Increase in the volume of ground water supply and the areas under irrigated farming has been the most significant developments around Lake Parishan, which at the same time has imposed crucial impacts on the Lake's status.

The increase of water wells for abstraction of ground water has probably been the most important impact such development has had on the Lake conditions. Most of the wells are shallow and located in the northern foothills (see map 6). These wells are extracting groundwater which otherwise would flow towards and enter the Lake, in other words increase in groundwater extraction in the northern foothills could be interpreted as abstraction of water directly from the Lake.


Farms stretching to the verge of Lake's water


Extension of farms to water line in the North

Agricultural developments in the areas around the lake not only consume additional water resources (on the costs of Lake's water budget) but also releases into the Lake considerable amount of contaminants such as nutrients and pesticides. Presently cultivated farms in some locations extend down to the Lake's water verge, and the other parts are more or less very close to it. This will cause that residues of nutrients (P and N) and pesticides enter the Lake through surface runoffs and/ or seepage. Existing data shows that each year about 2300 tons of chemical fertilizers and 25 tons of different pesticides and herbicides are used in the farms around the Lake. Common chemicals are Dianzinon, Sevin, Mancozeb, Paraguat, Rundap, Terflan, Endosulphat, etc. It is notable that farmer's knowledge about use of chemicals is very low and superficial and this is an important factor in dissemination of contaminants into Lake's water. An extensive work would be needed to train farmers for improved on-farm water and chemical uses.

No direct record of the portion of these chemicals which actually enter the Lake is available.

10.2 Fishing

Fishing is usually the secondary occupation of some villagers particularly in the northern villages including Zavali, Shahrenjan, Helec, Dehpagah, Molla arreh, and Narges zar. The exact number of professional fishers is not known. However in 1997, 62 fishermen were registered as members of fishery cooperative of Parishan. Recently, 2009, more than 430 villagers around Lake Parishan has requested for registration in the fishery cooperative.

Fishing with net

Based on Shilat surveys of 1997, and depending on the hydrological conditions, annual harvest in Lake Parishan varies between 200-400 tons in dry and wet years respectively.

Fishing is usually practiced by gillnet fixed nets, which are normally installed in the evenings. The net remains in place all night and is collected early next morning.

Fishing periods are controlled by DOE personnel (Lake guards). DOE Kazeroun has announced only 45 days (from late December to early February) as allowable for fishing. However, fishermen frequently disobey the rules and do fishing in illegal periods and places. On many occasions, control of fishing activities turn into serious clashes between Lake guards and the violators.

Shilat which is responsible for managing the fish species and population, has frequently tried to propagate native fish species to enrich Lake's fish reserves. They grow fish larva in Marvdasht growing / nursery ponds and release fingerlings of about 5 grams in the Lake.

10.3 Harvesting and burning reeds

Villagers around the Lake and particularly those in the western part do harvest reeds for feeding animals, producing mats, and covering ceilings. No estimation is available of the volume of harvest.

Fig 18 Remnants of burnt reeds, west of LP

On several occasions villagers intentionally, or due to neglect put the reeds into fire. Also sometimes the dry reeds catch fire because of ambient heat and friction. Unfortunately villagers do sometimes put fire in the reeds to force birds to leave their nests so that they can hunt them. Another case for burning reeds is when the violating fishers or hunters are forced to stop violation or their instruments (net, gun, etc.) are arrested by environmental guards. They put fire into the reed just as a reaction.

10.4 Boating

Motor boats are usually used as means for transporting visitors around the Lake. These boats sometimes move very fast and very close to the reed beds in the west, causing much disturbance. Environmental guards also use motor boats. Many local people use shovel boats. The main stations for motor boats are in Shahrenjan in the northwest and Environmental Station in the southwest.

10.5 Plastic residues

Many farmers around the Lake use shallow galleries made with plastic sheets for growing early vegetables. At the end of the season, farmers usually do not collect these plastic sheets. This causes a very bad view on the farm, and sometimes they bother the geese that graze in them.

Fig 19 Plastic residues on the farm, Seifabad

10.6 Hunting

Hunting birds in Lake Parishan is generally prohibited. However on several occasions local people either from
Kazeroun or villagers do hunt. Lake guards oppose these violators, but sometimes they do not succeed.

10.7 Tourists and visitors

The fantastic sceneries of the Lake attract many tourists from Kazeroun and other places for recreation around the Lake. A small park with limited facilities is provided just beside the Environmental Station for use by the visitors. In many cases, the rubbish the visitors leave in place is considerable.

10.8 Road construction around the wetland

Some of the villages in the north of the Lake do not have easy access to public roads. On a request from these villages, a road is designed to connect these villages to the eastern public road. This road had to pass very close to the Lake and if constructed would be a threat to the habitats in this part. In an attempt to clear the right of way, reed beds were put to fire and numbers of turtles were killed. Road and DOE officers are debating to find a reasonable solution for this development.

10.9 Exotic species

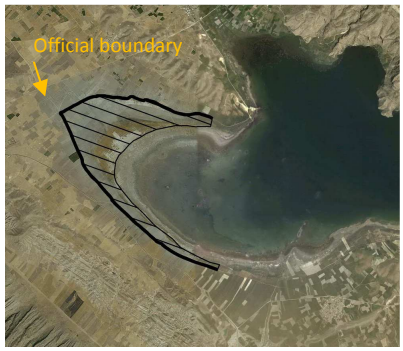
Although Fars Shilat denies releasing of exotic fish species into the Lake, existing information from 1990s on the volume of carps harvest from the Lake proves that sometime this has happened. However reports are explaining that Shilat propagates native species in Marvdasht reproduction ponds and releases fingerlings into the Lake. This valuable process not only enriches aquatic resources of the Lake, but also supports sustaining the native species particularly during drought periods.

10.10 Land disputes / Dike construction

In the south-western part of the Lake where the lands are less frequently inundated, villagers claim for the ownership of the lands as farming lands. There is a dispute between

these villagers and DOE on this issue which is not yet properly settled. To protect these lands from inundation, villagers have constructed a small earth embankment. There are clear evidences that these lands are periodically covered by water and therefore should be accounted as part of the wetland.

Fig 20: Earth dike constructed by rural people



Disputed area, dark line shows official boundary of the Lake

10.11 Drainage system

An attempt has been made in the past to dry up the water logged lands east of the Lake by constructing parallel subsurface drainage system to evacuate shallow ground water. Because of shallow depth of drains, this system did not work effectively and was abandoned.

Fig 21 Abandoned drainage system

10.12 Village effluents

Effluents from septic wells as well as surface runoff from the villages eventually discharge into the Lake and are source for nitrification of water. In most of the villages, sewages are collected in septic wells and through alluvial deposits flow towards the Lake.

10.13 Power plant

A power plant has been constructed about 5 kilometers west of the Lake. Although this is out of the catchment, its heat release from elevated chimneys may have some affect on the birds flying around or passing near / over them.


Thermal Power plant in Kazeroun

10.14 Stakeholders

Based on the present analysis, the stakeholder groups in LP area are listed in the following Table 24.

Table 24 List of stakeholders

	Stakeholder	Use/benefits received	Impacts on Wetland
1	Farmers	• Modified microclimate (temperature and humidity,evaporation), • Modified irrigation req't. •	• Compete with Lake's water resources • Discharge chemicals into the Lake • Encroach into the boundaries
2	Livestock herders	•	• Accelerate soil erosion due to extensive grazing in the catchment
3	Fishermen	• Fishing in the Lake	• Unauthorized harvesting
4	Hunters	• Bird hunting	• Unauthorized hunting • Burning reeds
5	Reed harvesters	Reed harvesting	
6	Villagers around the Lake	• Modified microclimate (temperature, humidity). landscape	• Discharging sewages and garbage • Burning reeds
7	Fars Water Authority	•	• Management of water resources
8	Fars DOE (Kazeroun)	•	• Wetland management
9	The public	• Recreation, • Landscape;	• Leaving garbage

11. ENVIRONMENTAL POLICY AND LEGISLATION CONCERNING LAKE PARISHAN

Lake Parishan together with Arjan Wetland is registered as a protected area, Ramsar site and Biosphere Reserve. From administrative point of view, Lake Parishan is under jurisdiction of DOE office of Kazeroun which is affiliated to Fars DOE head office. This section provides an overview of the existing policy and legislation relevant to Lake Parishan. It describes the national policies and the key environmental legislation relevant to the Lake.

The key policy for conservation of environment is described in Article 50 of constitutional laws of IRI. It states:

> "C*onservation of the environment in which the existing as well as the future generations of IR. Iran should sustain their progressive social life, is considered as a public duty. Thus, economical or any other activities that may cause contamination over, or endanger the environment, would be prohibited."*

The details of policies for conservation of the environment are determined within the Five Year National Plans for the Social, Cultural and Economical Development (FYP). As far as the environment is concerned, the general content of the policies included in the previous FYPs are summarized below:

- Emphasis on the conservation, restoration, improvement and optimal utilization of natural resources;

- Developing the criteria, standards and indicators on all environmental issues and improving the existing legal and administrative frameworks in the areas relevant to conservation of the environment;
- Conservation and restoration of the renewable natural resources; preservation of rare and threatened flora and fauna; control of desertification processes and attempts to restore the affected lands; controlling the contamination of the soil, air, surface and ground water resources as well as the marine environment; controlling damage to wildlife habitats;
- Optimum use of agricultural chemicals (fertilizers and pesticides, etc), and promoting integrated pest management approaches.

The FYPs also include articles related to policies of the Ministry of Energy, which are relevant to water bodies and wetland areas. These are mainly in the field of controlling the use, measuring the quantity and monitoring the quality of water resources. Similarly MoJA follows the general policies to optimize the use of agro-chemicals and to control the use of dangerous pesticides.

11.1 National Legislation on conservation of the environment

Many different laws, by-laws and regulations have been developed to describe and instruct different areas in conservation of the environment. DOE has collected many of these laws, by-laws, etc. in a publication titled: "Collections of the Laws and By-Laws in Conservation of Environment, DOE, 1997, revised 2004". Those legislations relevant to LP are summarized below:

- The Law of "Conservation and Enhancement of the Environment" issued and approved in 1974 and amended in 1992. This law includes many of the important articles that are now governing the activities of the DOE.
- The Executive By-law of "Conservation and Enhancement of the Environment" issued in 1976, amended in 1995. This By-law includes regulations and instructions which are effective in management of the National Parks, National Natural Heritages, Wildlife Refuges, and Protected Areas;
- The Executive By-law for "Prevention of water resources from being contaminated" issued in 1994. This By-law determines the shared responsibilities of DOE, and the Ministries of Energy, Jihad-Agriculture, Industries and Mining, Interior, Medication, Hygiene and Medical Education, to prevent the water resources from being contaminated.
- The Law of "Protection and Utilization of the Aquatic Resources" issued in 1995 and its Executive By-law issued in 1999. This Law and By-law originally determines the authorities and responsibilities of Shilat (Fishery) Organization in improving, enriching and developing the aquatic resources within the inland waters, and the shared authorities and responsibilities of the Shilat and DOE wherever these inland waters are among the protected areas or internationally important wetlands;
- The Executive By-law for hygienic controlling and supervision over the chemical materials and poisons issued in 1999. This By-law focuses on the control of, and supervision over, the packing and distribution of chemicals and poisonous

materials. DOE is one of several members of the committee which coordinates the supervision and control measures and draws up the instructions;

- Instructions for grazing of domestic animals in the Protected Areas and Wildlife Refuges.
- Standards for waste discharges from different sources

Specific implications of legislation currently applied to the protection of wetlands

The executive by-law for Conservation and Enhancement of the Wildlife Refuges. Approved and issued on Feb. 21, 1976, this by-law includes 49 articles in 9 sections. Section two of this by-law covers the regulations for protection not only of the Wildlife Refuges but also the National Wildlife Parks, National Natural Heritages, and Protected Areas:

- o Entrance to the wildlife refuges and protected areas for scientific research, sight-seeing, photography and recreation is allowable provided that no damage is imposed over the vegetation cover and no disturbance is made to the wildlife;
- o Harvesting of trees and bushes, encroaching into the wildlife habitats and any type of disturbance to the natural condition within the wildlife refuges and protected areas is prohibited.
  - NB 1. Exception to this regulation is the erection of industries and workshops which are permissible according to the regulations and laws;
  - NB 2. Grazing of domestic animals in the wildlife refuges and protected areas is allowed provided the quantity and quality of the grazing is in compliance with the regulations established by the DOE and the Natural Resources Department of MOJA;
  - NB 3. Grazing of domestic animals in the protected areas and the wildlife refuges requires permission from the DOE and an advance subscription. Grazing of animals without such permission or beyond the permitted quantities is prohibited. Such animals would be driven out of the protected areas and the herd-keepers would be fined;
  - NB 4. Fishing and hunting within the protected areas and wildlife refuges requires advance subscription and permission from the DOE or its regional offices;
- o Ministries and governmental organizations are allowed to perform studies and investigations within the wildlife refuges and protected areas, provided the protective measures and regulations are carefully observed;
- o Carrying any type of guns / armor within the protected areas and wildlife refuges for the non locally-resident individuals is prohibited, unless they have received in advance the permission from DOE or its regional offices.

11.2 International Conventions

IR Iran is a Contracting Party to several international conventions related to the

environment. The most significant of these relating to LP are described below:

Ramsar Convention on Wetlands

IR Iran is the birthplace of the Ramsar Convention, the Final Act of the Convention having been negotiated in the town of Ramsar on the Caspian Coast in 1971. IR Iran ratified the Convention in 1975, and up to now has designated 22 wetlands of international importance under the Convention (so-called “Ramsar Sites”). The main obligations of Iran under this Convention are:

- To designate wetlands of international importance as Ramsar sites
- To maintain the ecological character of designated Ramsar sites
- To make wise use of all wetlands within the Iranian territory
- To establish reserves on wetlands
- To cooperate internationally for wetland conservation

Convention on Biological Diversity

IR Iran ratified this Convention in 1996. The objectives of the Convention are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of the genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources. Some of the articles of the Convention are summarized below:

- Develop national strategies or adapt existing strategies, plans or programs for the conservation and sustainable use of biological diversity;
- Integrate as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programs and policies;
- Identify components of biological diversity important for its conservation and sustainable use;
- Monitor the components of biological diversity, paying particular attention to those requiring urgent conservation measures;
- Identify processes and activities which are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity;
- Establish protected areas where special measures need to be taken to conserve the biological diversity and develop the necessary guidelines for their management;
- Regulate or manage biological resources important to conservation of biological diversity within the protected areas;
- Promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species;
- Promote environmentally sound and sustainable development in areas adjacent to protected areas with a view to furthering protection of these areas;
- Rehabilitate or restore degraded ecosystems and promote the recovery of

threatened species;

- Develop or maintain necessary legislation and/or other regulatory provisions for the protection of threatened species and populations;
- Regulate or manage the processes that have significant adverse effect on biological diversity.
- Cooperate in providing financial support;

12. GAPS IN INFORMATION

It was already mentioned in the report that during the last decades several studies have been conducted which was resulted in documenting useful information. Also during the last few years, CIWP has supported undertaking several study programs that all together have produced good information about the wetland and its functions and values. However still there are certain gaps in information or deficiencies and inaccuracies in existing data.
From the other side developing ecosystem management program for the wetland requires more accurate knowledge of factors affecting the wetland or those which are affected by a management plan such as villages and villages around the Lake. Furthermore the nature of ecosystem approach for the wetland management implies the changes inside or around it to be monitored and evaluated appropriately. Main issues which are in need of further information are addressed below:

1- Detailed study for wetland water resources: Water resources are the most important factor which affects the wetland sustainability and its quality and functions. The volume of water resources, its quantity and quality variations, seasonality, trends in probabilities etc are components which are most crucial for appropriate management of the wetland. The most important issue which has remained unclear is the role of Karst aquifers in supplying water for the wetland area, and the source for recharging this aquifer. Clear knowledge on these components are without any doubt very crucial for managing land and water as well as wetland resources for a sustainable livelihood of the rural people. It need to be noted that such a study is complicated and requires specialized teams and competent expertise.

2- Annual analysis and reporting of water resources: The Fars Water Authority conducts monthly observation of ground water resources (wells and springs), but analyses these information on 5-7 years periods. Considering the high sensitivities of groundwater resources in the wetland area, it is suggested that such analyses and reports to be undertaken annually with appropriate focus on the following issues:

   - Changes in Karst water resources;
   - Inflows into the wetland;
   - Appropriate recommendation for water resources management according to the situation.

3- Improving the physical condition of Parishan staff gauge: Presently the staff gauge in Parshan Lake is disconnected from water when it drops below “0” datum. It is a major missing in following lake’s water level fluctuation and relevant analysis for Lake’s water storage. Therefore the staff gauge needs to be connected to the lower (deeper) part of the lake through an open ditch or covered conduit. This is practically an easy task when there is no water in the lake (the current situation).

4- Water use efficiency and on-farm water management practices: Farm irrigation is the main source for water consumption in the villages around the Lake. Particularly in the

northern foothills, the steep lands and their high intake rates causes high water losses, i.e. low productivity. Current knowledge ensures that great areas of improvement in water use and crop production exists if appropriate training programs could be conducted towards raising farmers sensitivities and knowledge for better use of water at farm level. Experiences of agricultural extension agents in demonstration farms could be well utilized in this respect.

5- On farm chemical use management: Chemicals used in the farms around the Lake are the main sources for contaminating the Lake's water. These reveal particularly important when we note that the knowledge of the farmers in using these chemicals is very low, and farms all around the wetland stretch very close to the verge of lakes water line. At the same time our knowledge of the inter-relation between farm practices in chemical use and contamination level in the lake's water is not well clear. It is recommended therefore that along with monitoring the contamination level of water, appropriate training program be undertaken to increase the knowledge of the farmers in this area and to show them the impact of their practices on the quality of wetland water.

6- Detailed survey on the rural economy of the villages around the wetland: The level of acceptance and degree of obedience of the rural population of the wetland management programs very closely depend on the level of their livelihood and welfare. Our knowledge of the economical status of the rural population is very low and needs to be increased through a detailed survey by competent socio-economsts.

7- Improve the physical condition of the climatological station in Parishan: The climatology station is Parishan is not well located and does not use enough accurate instruments and procedures, while it has important role in programs for monitoring the Lake condition. It is recommended that the station be upgraded through using more accurate digital (and recording) instruments, well trained operator, and relocate the site for more accurate measurements.

8- Evaluate the role of the wetland in livelihood of the rural people: The role the wetland currently does or potentially can play in the livelihood of the rural population is particularly important for the success of the wetland management plan. Our knowledge on this respect is very qualitative and general, and needs to be improved through a detailed survey and analysis.

9- Detailed survey of flora and vegetation around and inside the wetland: Previous surveys describe the floral species without indicating their distribution pattern. Considering that good knowledge of plant and their spatial distribution can help better management of the wetland, it is recommended that such a survey be conducted and appropriate floral map be prepared.

10- Study the relation between use of chemicals in the farms and level of contamination in the Lake water: This study is recommended to determine the level of impact of the agro-chemicals which are used in the farm practices on the level of contamination in Lake's water.

13. RECENT ACHIEVEMENTS FOR THE CONSERVATION OF LAKE PARISHAN

This summary report is largely based on recent historical information collected up to within 2-3 years of the date of publication. However during this most recent period, significant work has been undertaken for the conservation and better management of Lake Parishan

through the Conservation of Iranian Wetlands Project. This final chapter therefore provides a brief progress update to the end of 2010.

13.1 Conservation of Iranian Wetlands Project (CIWP)

CIWP is a project of the Iranian Government, led by the Department of the Environment, with international technical and financial support from UNDP and the Global Environment Facility (GEF). The project was launched in 2005 and will end in 2012.

The project aims to improve the management of Iranian wetland ecosystems by building national and local capacity to apply integrated, participatory approaches and ecosystem-based management.

The Ecosystem Approach is the primary framework for action under the Convention on Biological Diversity (CBD). It is defined as “A strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way”. Ecosystem-based management therefore promotes conservation of environment AND allows for wise use of the economical resources. It puts people, and in particular indigenous communities, in the center of the ecosystem and recognizes the importance of working at ecosystem-scale, which for wetlands is normally within their watershed/basin system. In such a system conservation of the environment is a duty not only for environmental bodies, but for all the organizations and stakeholders that benefit or impact upon the wetland. Management activities therefore require the participation of all stakeholders and the indigenous population. Such a system changes attitudes from top-down governmental control, to bottom-up, participatory, inter-sectoral working, which provides a very strong and suitable ground for both conservation of the environment and sustainable development.

The main goal of CIWP is to catalyze the sustainability of the Iran’s system of wetland protected areas thereby enhancing its effectiveness as a tool for conserving globally significant biodiversity. The project objective is to systematically remove or substantially mitigate threats facing globally significant biodiversity and sustainability at three demonstration sites (Lake Uromiyeh, Lake Parishan and Shadegan Wetland). The lessons learned through work at these sites will be used to enhance the management systems in other wetland protected areas throughout the country. The approach is built on the premise that if the local communities, managers of the governmental organizations, and the public are aware of the values and functions of the wetland, and if stakeholders could participate in management decisions related to the wetland, they would better cooperate in its management and support its conservation. Based on the above target and approach, the following objectives were defined:

- Raising knowledge of decision-makers and awareness of stakeholders in relation to wetlands;
- Developing capacity among stakeholders (training, provision of equipment, participation);
- Providing mechanisms for sustainable management of the wetland (inter-sectoral committees, basin-wide management plans, laws and regulations, monitoring)

It is expected that with the execution of the project, the capacity for local management of wetlands will raise, inter-sectoral cooperation will be established, and necessary institutions will be organized for sustainable management of the wetland.

13.2 Key outcomes from CIWP at Lake Parishan

Project activities including preparatory works, coordination, training, awareness raising, studies and surveys, planning and implementations for LP wetland started from the earliest stages of the project and are ongoing. Key outcomes and crucial changes which are expected to occur are listed below:

1- Developing an ecosystem-based management plan: The first step in undertaking the project was to raise awareness on the ecosystem approach, and prepare for developing an integrated management plan in collaboration with and participation of all the main stakeholders. Several training and consultation workshops were arranged in Shiraz and in Kazeroun to discuss the threats and opportunities, strengths and weaknesses, desires and requirements in relation to the wetland resources. This enabled all of the stakeholders, particularly the local communities to agree a common VISION and GOAL for the Lake as below:

VISION: In 25 years, Lake Parishan will have a rich biodiversity, beautiful landscape and high water quality, so that it can support a healthy and prosperous local community

GOAL: To apply an ecosystem based approach for restoring and sustaining Lake Parishan for the benefit of the present and future generations

The objectives, required actions and responsibilities in order to achieve this goal were then defined in the management plan by all stakeholders. The management plan was finally approved by the Provincial Higher Planning Council and enforced by the Board of Ministers and now is an official working document for management of the wetland. It was formally launched at a local signing ceremony involving community representatives. In the later steps the mechanisms for application of the plan was reviewed and approved by the provincial Water and Agriculture working group. The final steps were to organize the technical provincial as well as local committees in November 2009.

Along with the development of the management plan, a monitoring plan was also developed to facilitate and instruct monitoring and evaluation of the performances in wetland management. DOE-Fars was assigned to conduct this annual monitoring and evaluations.

2- Organizing provincial and local committees for managing Lake Parishan: The following committees were organized and activated within the framework of the management plan.

- Local Committee (LC): This committee includes representative members from relevant governmental offices of Kazeroun, representatives from local communities and NGOs and is responsible for implementing the management plan. Whenever necessary, technical sub-committees are organized to carryout technical assignments.
- Provincial Coordinating Committee (PCC): Water and Agriculture working group in Provincial Planning Council is responsible for coordinating inter-sectoral activities of different organizations at provincial level.
- Provincial Technical Committee (PTC): For easier consultation and faster decision making on technical issues which are raised/proposed by LC, each member of PCC introduces a representative to organize PTC. This committee works with the Local Committee to evaluating the feasibility of the technical solution proposed and cost

estimates made by LC; evaluations are reported to PCC for final approval and assigning required budget.

3- Habitat Classification and Zoning of the wetland: Following MedWet methodology, the habitat classification map of the wetland was prepared. Also in collaboration with the local communities and through consultation workshops, zoning maps of the wetland were drawn up to provide protection to the most sensitive zones, and to identify areas where different human activities could occur.

4- Marking LP's boundaries: To resolve the present conflicts on land property and to prevent future disputes over the boundary of the wetland, a plan has been developed and is carrying out for delineation and marking of the wetland boundaries.

5- Developing LP Monitoring Plan: Monitoring changes in the condition and use of the wetland is an indispensable requirement for ecosystem-based management. A monitoring plan has been developed and additional instructions were provided for conducting monitoring in LP. The first integrated monitoring report was prepared for the year 2009.

6- Collection and Evacuation of Garbage: One important potential source of pollution of the wetland is the garbage produced in the villages around the lake. Collection and disposing of these wastes is one of the priority actions for preventing/reducing contamination in lake's water. A plan is prepared and partly activated for establishing a collection and disposal system for garbage.

7- Public Awareness: Many activities have been conducted to raise public awareness in wetland values and functions, mainly with the participation of local communities. The first Iranian wetland festival was organized at Lake Parishan in March 2009 with great success. There have also been numerous media broadcasts and publications about the wetland.

8- Alternative/supplementary livelihoods for villagers around the Lake: Challenges for livelihood of the increasing population around the Lake and impacts from severe drought in the last decade implied searching for alternative sources of income for the villagers. CIWP has prepared a plan and is supporting introducing appropriate alternative sources of livelihood for rural population (see below).

9- Management of Fishing in the Lake: Fish are an important ecological resource of the Lake and fishing is a significant source of livelihood for some of the local communities in villages around it. In order to develop a more sustainable fishery, consultation workshops were held with the participation of the local communities, Shilat and DOE. It was agreed that a fishing cooperative be established and the Local Committee for wetland management was assigned to pursue the process.

10- Wetland Visitor Center: For the purpose of increasing public awareness of the wetlands' values and functions, and to stimulate public support for its conservation, a visitor center is planned to be constructed near to the Lake. The LP Local Committee is following the process.

11- Developing A Strategic Plan for Ecotourism: Local workshops were held for consultation on developing ecotourism in which all the stakeholders encouraged the idea as a potential source for alternative livelihood for local communities. This has resulted in a number of preparatory actions, and a draft strategic plan has been developed. The Local Committee has been assigned to follow it up.

12- Water management and sustainable agriculture: Studies have been conducted to estimate the water requirements of the lake. These have revealed that the use of groundwater for agriculture is an important contributory factor to the drying of the Lake under the ongoing drought conditions., Different options for sustaining /restoring the Lake, and sustaining agriculture in drought conditions have been evaluated and the management options were considered by the Water and Agriculture Sub-Committee as well as with local communities around the Lake. A pilot village for conducting water efficiency and sustainable agriculture measures has been selected through a participatory consultation, and a plan for next steps was developed and activated.

13- Conservation of Lake's Bio-diversity: To protect the bio-diversity of the Lake and to conserve / restore its natural vegetation, a number of studies and management activities have been conducted. These include: measures to conserve the endangered Otter *Lutra lutra*; establishment of a grazing exclosure to promote the restoration of *Typha* vegetation; creation of artificial pond by local community to safeguard endemic turtles and fish from drought.

14- Different studies/surveys conducted: Within the framework of CIWP, several studies and survey works were conducted which are listed as below:

- Collection of baseline information and identification of deficiencies;
- Sources of contamination of the Lake's water resources;
- Climatology of Lake Parishan area;
- Hydrology and water resources of LP;
- Impacts of groundwater wells on the Lake's water resources.

13.3 Impacts of the current drought

Since early 2000s, the Lake Parishan area (and indeed much of Iran) has been subject to an intense and persistent drought. As a result, throughout 2009 and 2010 the lake bed has been dry (Map11), with severe consequences for biodiversity and for the local communities who depend on the lake. These conditions have stimulated a number of actions, particularly the investigation of the impacts of groundwater use for agriculture on the lake's condition.

The ongoing drought has placed a very significant constraint on the achievement of several of the planned outcomes from the CIWP, in particular the recovery of biodiversity and the implementation of sustainable use of the Lake's resources (fisheries and ecotourism). Importantly, however, the management plans and institutional mechanisms are now in place for these outcomes to be achieved as soon as the drought conditions ease.

13.4 Looking forward

There can be no doubt that the CIWP has brought about a significant change in the attitudes and approaches to the management of Lake Parishan. Before the project, management was solely in the hands of the DOE, and there were significant tensions between stakeholders and particularly with the local communities. Today, there is a common agreed goal for the management of the Lake, and all stakeholders are working together to achieve this. The CIWP will end in 2012, and the challenge is to ensure that

these changed approaches are now sustained in the long-term for the benefit of both the people and biodiversity of Lake Parishan.

Lake Parishan, Sat image of 11 June 2011

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Annex 1

Soil data

Table 1 Soil data from the bed of Lake Parishan

Points	Depth	Wet soil color		Texture	Moisture	Structure	Plasticity	Stickiness	Gypsum	Lime	Root residues	Shell
		Value	Description									
1	0-5	5/2Y2/5	Grayish Yellow	Silty Caly Loam	Saturated	2	2	1	-	H	H	H
	5-25	4/1Y2/5	Dark Gray	Silty Clay Loam	"	2	2	1	-	H	L	L
	25-64	5/1Y2/5	Gray	Silty Clay Loam	"	2	2	1	+	H	L	H
2	0-10	5/3Y2/5	Brownish Olive	Silty Clay Loam	"	2	1	1	+	H	H	+
	10-33	5/2Y2/5	Grayish Yellow	Silty Loam	"	2	1	1	-	H	L	L
	33-39	4/1Y 10	Dark Gray	Silty Clay Loam	"	2	1	1	-	H	L	+
	39-60	6/1Y5	Gray	Silty Clay Loam	"	2	2	1	+	H	L	L
3	0-10	4/1Y2/5	Dark Gray	Clay Loam	"	2	0	1	-	H	M	M
	10-31	5/2Y2/5	Grayish Yellow	Clay	"	2	0	1	-	H	M	H
	31-56	5/1 Y5	Gray	Loam	"	2	0	1	-	H	M	L
4	0-5	6/2 Y5	Grayish Olive	Silty Clay Loam	"	2	0	1	-	M	H	L
	5-65	7/2Y2/5	Light Gray	Loam	"	2	2	1	-	H	-	L
5	0-5	5/2Y5	Grayish Yellow	Silty Loam	"	2	1	1	-	H	L	_
	5-20	7/2Y2/5	Light Gray	Silty Loam	"	2	1	1	-	H	+	L
	20-59	6/2 Y2/5	Grayish Brown	Clay Loam	"	2	1	1	-	H	L	L
6	0-10	4/2 Y5	Grayish Brown	Silty Clay Loam	"	2	0	1	-	H	+	L
	10-63	7/2Y2/5	Light Gray	Clay Loam	"	2	1	1	-	H	-	L
7	0-14	6/3 Y2/5	Yellowish Brown	Silty Loam	"	2	1	1	+	H	H	-
	14-48	7/3Y10	Light Brown	Loamy Sand	"	1	2	0	-	H	H	-
8	0-4	7/2	Light Gray	Loamy Sand	"	2	0	1	-	H	L	-
	4-14	8/1YR5	White	Sandy Loam	"	2	1	1	+	H	H	-
	14-60	8/1YR5	White	Loam	"	1	1	0	+	H	M	-
9	0-8	4/1 Y2/5	Dark Gray	Silty Loam	"	1	0	0	-	H	H	-
	8-24	5/1Y2/5	Gray	Silty Loam	"	3	2	2	-	H	L	L
	24-56	5/1Y2/5	Gray	Silty Loam	"	3	2	2	-	H	L	L
10	0-10	6/2Y2/5	Grayish Brown	Silty Loam	"	1	0	0	-	H	H	-
	10-63	7/2Y2/5	Light Gray	Silty Loam	"	2	0	1	+	H	L	L

(+) = Exists (-) = Not exists H= High M= Moderate L= Low, see also next page.

Table 2 Physical and Chemical Analysis of the Soils of the Bed of Lake Parishan

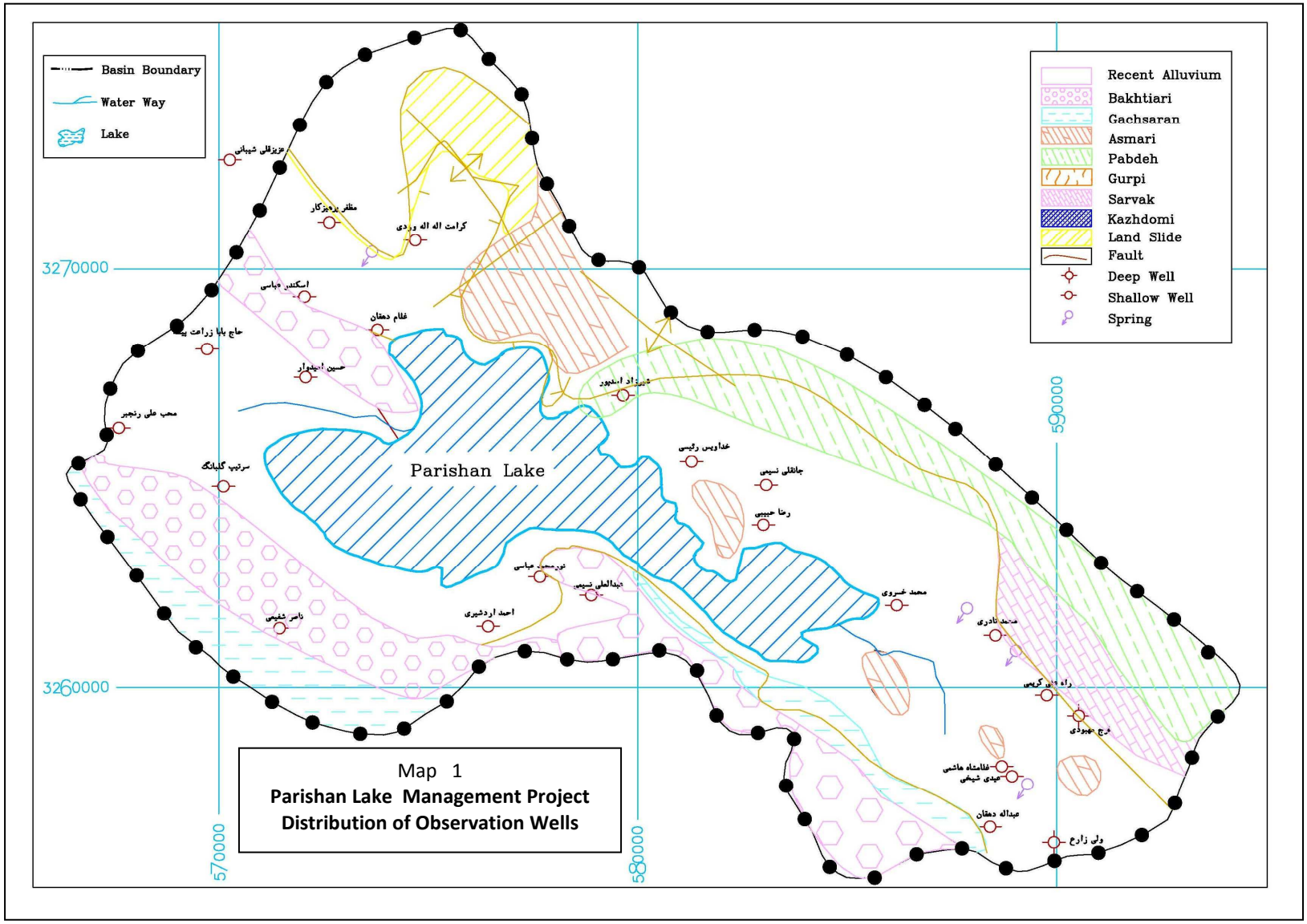
Station	Depth	Size Classes (%)				EC	pH	TOM	Salinity	Texture	Soluble Cation (mg/L)			Soluble Anion (mg/L)			
	(cm)	Clay	Silt	Sand	Gravel	(dS/m)		%	(PPT)		Ca^{++}& Mg^{++}	Na^{+}	K^{+}	Co_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{---}
1	0-5	38/3	55/6	5/0	1/1	4/61	8/7	21	4	SiCL	5/73	615	46/2	32	19/6	1670	334/3
	5-25	36/6	44/2	18/4	0/8	-	8/6	19	-	SiCL	-	-	-	-	-	-	-
	25-64	41/2	49/4	8/1	1/5	5/70	9	17	4/5	SiCL	689	769	57/1	0	95/5	1790	608
2	0-10	35/0	49/3	14/1	1/6	6/18	8/8	19	5	SiCL	663	878	65/6	0	198	2085	781/2
	10-33	33/3	45/3	21/1	0/3	-	8/6	15	-	SiL	-	-	-	-	-	-	-
	33-39	36/9	46/0	15/8	1/3	-	8/4	17	-	SiCL	614/4	706	57	0	186	-	1031/4
	39-60	47/3	43/1	8/8	0/8	5/58	8/4	12	5	SiCL	518	506	65/6	21	129	1710	1121
3	0-10	31/3	38/9	28/0	1/8	5/60	8/9	21	5	CL	724/4	-	66/2	8	115/2	1690	324/6
	10-31	66/1	17/0	14/8	2/1	-	8/1	17	-	C	-	-	-	-	-	-	-
	31-56	29/5	41/2	27/9	1/3	3/45	8/5	15	3	L	630/8	456	46/2	0	154	1420	470/2
4	0-5	29/5	49/1	20/0	1/4	6/49	7/9	24	5/5	SiCL	379/5	815	63/6	0	104	1709	437
	5-65	25/8	45/0	27/3	1/9	7/42	8/1	14	6	L	1031	890	80/2	11	71	2890	496
5	0-5	11/2	61/7	45/8	1/3	4/82	8/8	18	4	SiL	730/7	685	51/6	18	140/5	1620	371
	5-20	20/0	53/2	26/0	0/8	-	8/7	13	-	SiL	-	-	-	-	-	-	-
	20-59	32/9	43/1	23/1	0/9	4/74	8/9	11	4	CL	687/4	690	70/4	11	144/3	1675	423
6	0-10	31/4	53/1	14/2	1/3	6/49	8/5	22	5/5	SiCL	1222	831	64/4	-	167/4	1914	448
	10-63	28/3	36/9	32/1	2/7	5/32	8/3	11	5	CL	1055	705	64/4	9	138/8	1617	497/4
7	0-14	12/0	69/1	17/9	1/0	5/96	8/9	17	5	SiL	1027	767	64/2	0	272/4	1954	623
	14-48	7/2	17/2	75/0	0/6	6/01	8/5	12	5	LS	923	839	60/4	16	130/8	2010	397
8	0-4	8/5	16/6	74/6	0/3	5/5	8/8	13	5/2	LS	682	799	58	4	219	1630	436/1
	4-14	11/5	46/3	41/3	0/9	-	-	11	-	SL	-	-	-	-	-	-	-
	14-60	11/2	35/4	53/1	0/3	7/2	8/4	11	7	L	912	872	67/6	13	114/8	2568	1170
9	0-8	15/9	64/2	19/1	0/8	5/45	8/6	22	4/5	SiL	584	829	91/6	0	109	1681	321
	8-24	19/3	56/0	23/0	1/7	-	-	19	-	SiL	-	-	-	0	98	-	497/4
	24-56	16/8	66/1	16/2	0/9	5/57	8/7	10	5	SiL	591	785	88/6	18	37	-	489
10	0-10	8/0	48/1	41/8	2/1	5/30	8/6	19	5	SiL	672	705	69/6	17	38/8	1612	388
	10-63	-	13/1	51/5	34/4	0/63	8	16	6	SiL	770	-	81/6	6	166/3	2105	1107

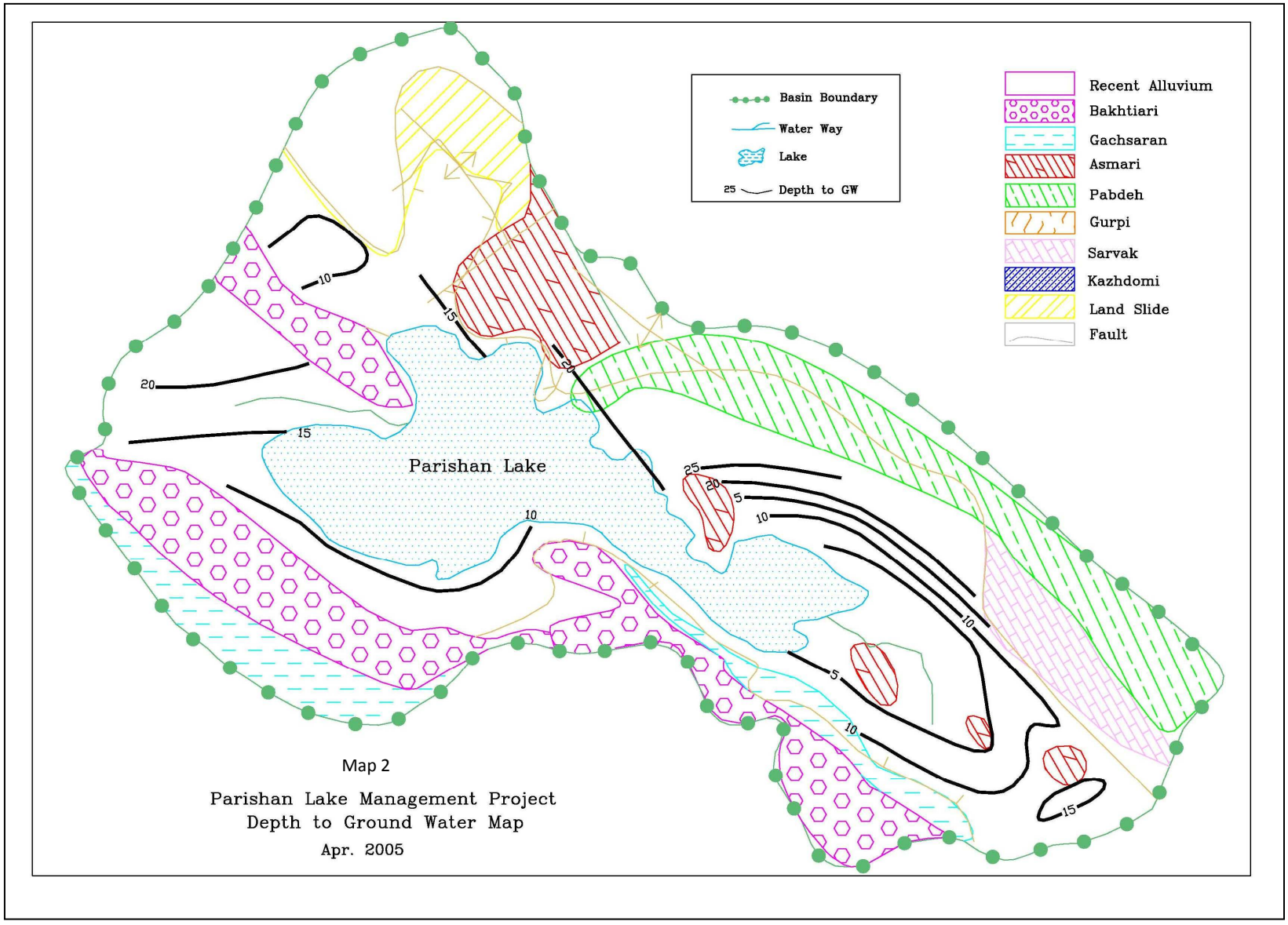
Legend for Table 1: Structure (1= weak 2=Meidum 3=Strong), Plasticity (0= Low 1=medium 2=high), Stickiness (0= Very low 1=Medium 2= High)

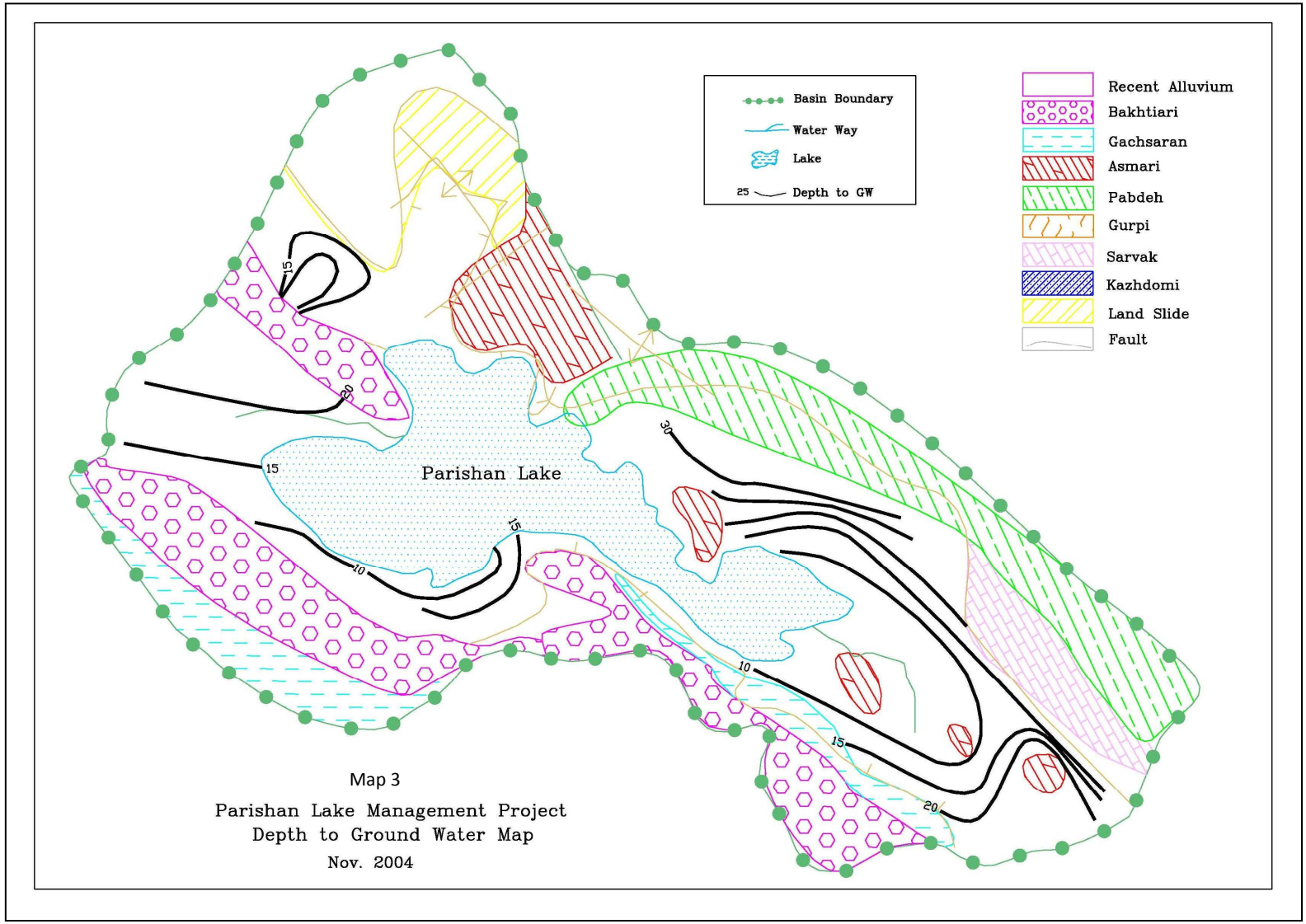
PPT= Part per thousands

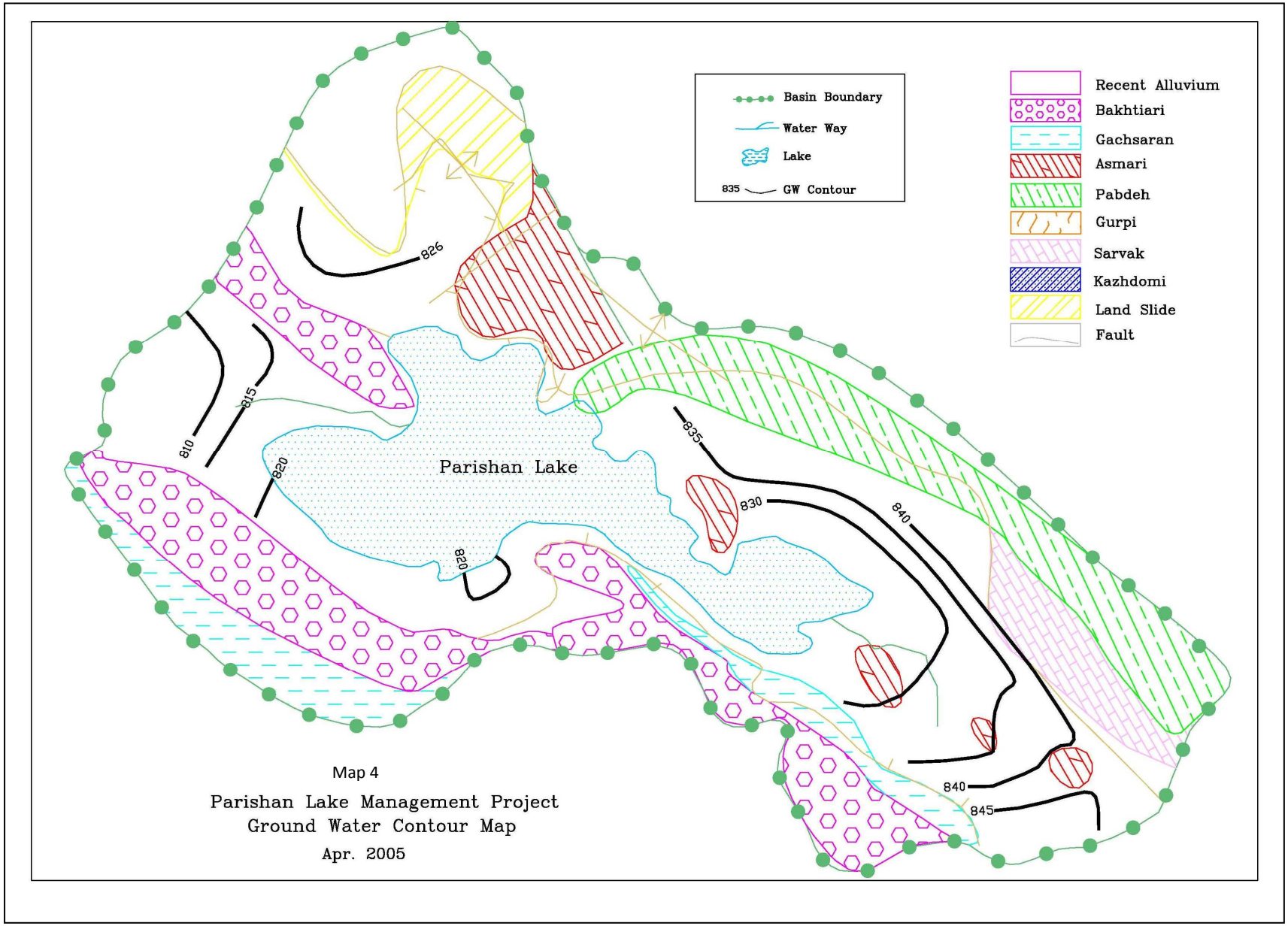
Appendix 2

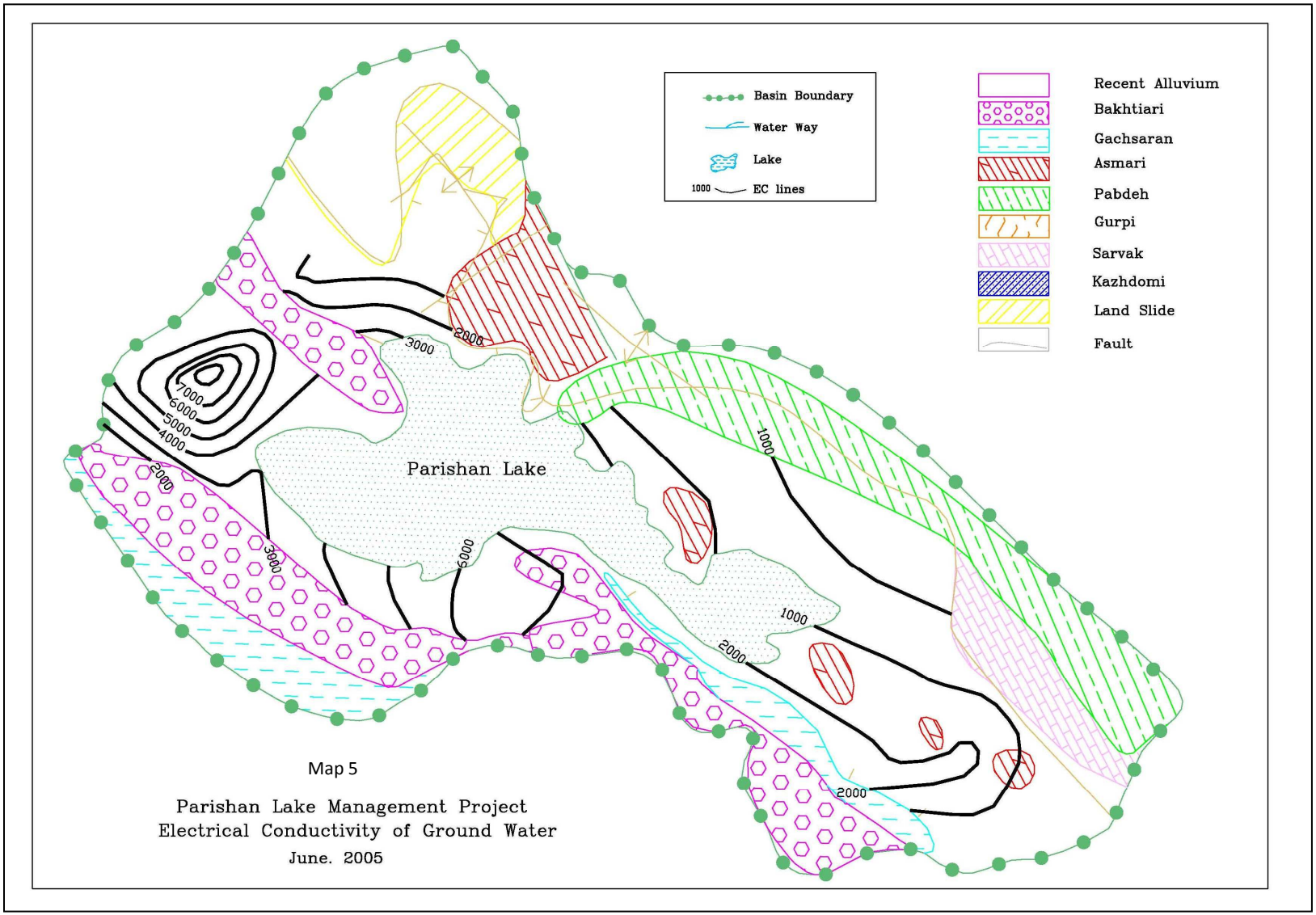
Water resources

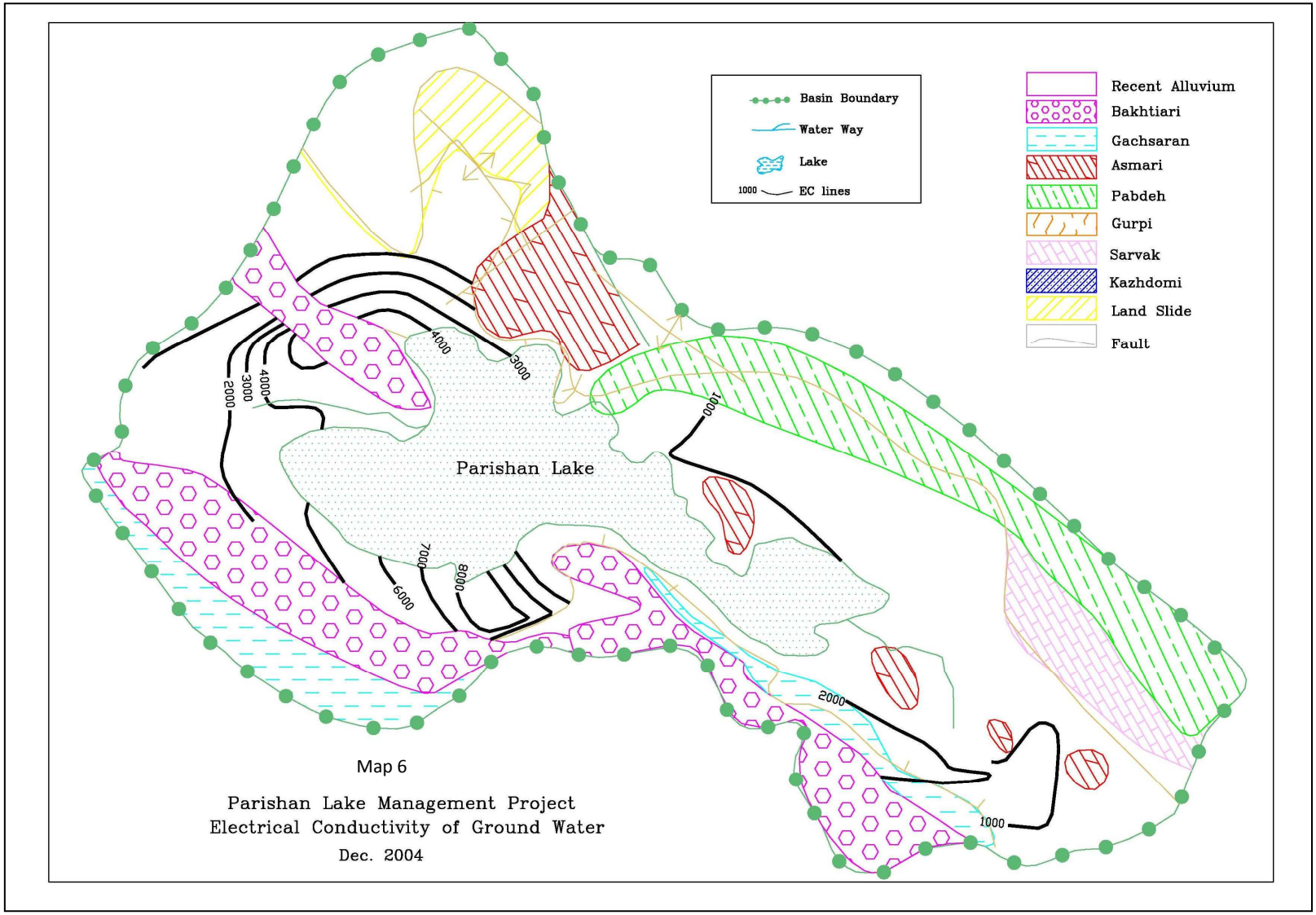

Basin Boundary
Water Way
Lake
Recent Alluvium
Bakhtiari
Gachsaran
Asmari
Pabdeh
Gurpi
Sarvak
Kazhdomi
Land Slide
Fault
Deep Well
Shallow Well
Spring
Parishan Lake
3270000
3260000
570000
580000
590000
Map 1
Parishan Lake Management Project
Distribution of Observation Wells


Basin Boundary
Water Way
Lake
25 Depth to GW
Recent Alluvium
Bakhtiari
Gachsaran
Asmari
Pabdeh
Gurpi
Sarvak
Kazhdomi
Land Slide
Fault
Parishan Lake
10
15
20
25
5
Map 2
Parishan Lake Management Project
Depth to Ground Water Map
Apr. 2005


Basin Boundary
Water Way
Lake
25 Depth to GW
Recent Alluvium
Bakhtiari
Gachsaran
Asmari
Pabdeh
Gurpi
Sarvak
Kazhdomi
Land Slide
Fault
Parishan Lake
15
20
30
15
10
10
15
20
Map 3
Parishan Lake Management Project
Depth to Ground Water Map
Nov. 2004


Basin Boundary
Water Way
Lake
835 GW Contour
Recent Alluvium
Bakhtiari
Gachsaran
Asmari
Pabdeh
Gurpi
Sarvak
Kazhdomi
Land Slide
Fault
Parishan Lake
826
815
810
820
820
835
830
840
840
845
Map 4
Parishan Lake Management Project
Ground Water Contour Map
Apr. 2005


Basin Boundary
Water Way
Lake
1000 EC lines
Recent Alluvium
Bakhtiari
Gachsaran
Asmari
Pabdeh
Gurpi
Sarvak
Kazhdomi
Land Slide
Fault
Parishan Lake
7000
6000
5000
4000
3000
2000
1000
Map 5
Parishan Lake Management Project
Electrical Conductivity of Ground Water
June. 2005


Basin Boundary
Water Way
Lake
1000 EC lines
Recent Alluvium
Bakhtiari
Gachsaran
Asmari
Pabdeh
Gurpi
Sarvak
Kazhdomi
Land Slide
Fault
Parishan Lake
2000
3000
4000
4000
3000
6000
7000
8000
1000
2000
1000
Map 6
Parishan Lake Management Project
Electrical Conductivity of Ground Water
Dec. 2004

1-1- Water balance of Lake Parishan

As already mentioned, because of several components interacting with water resources of the Lake, interpretation of the hydrological attributes of the Lake is somehow complicated. In this regard two main questions could be raised. 1) What is the contribution of external resources (karst formation and Arjan wetland) to water supply of the LP, and 2) Is there any seepage inflow into the lake other than visual flows of springs? To answer such questions, two water balance analyses have been exercised which are discussed hereunder.

Water balance in the catchment: This very generalized water balance is exercised to examine the order of magnitude of contribution from external resources. The components in the water balance equation (1) include the annual inflows (precipitation as a known and external ground waters as an unknown parameter) in the catchment versus the annual water losses (Different sources of evaporations, uses and losses).

$$I_p + I_{gw} = O_{ed} + O_{el} + O_{cnv} + O_{du} + O_{cc} + O_{gw} \quad (1)$$

Different nomenclatures in the above equation are defined below:

I_p = Inflow to the catchment through precipitation (known);
I_{gw} = Inflow to the catchment through ground water (unknown)
O_{ed} = Outflow due to direct evaporation after each precipitation (estimated)
O_{el} = Outflow due to direct evaporation from the lake (estimated)
O_{cnv} = Outflow due to consumptive use by natural vegetation (estimated)
O_{du} = Outflow due to domestic uses (ignored)
O_{cc} = Outflow due to consumptive use by cultivated crops (estimate)
O_{gw} = Outflow due to outward ground water flows (assumed 0).

Table 1 Water Balance Calculation in the LP basin

	Description	Area, Km2	Flow Quantity, mm	Volume, mcm/yr	
				In	Out
I_p	Precipitation over the catchment	275	450	124	
I_{gw}	GW flow from outside basin		?	55	
O_{ed}	Evaporation from ground surface	230	55		13
O_{el}	Evaporation from the Lake	45	1680		76
O_{cnv}	CU by natural vegetation (range and pasture lands)	190	350		67
O_{du}	Domestic uses				0
O_{cc}	CU by cultivated crops	38	650		25
O_{gw}	GW outflow from the basin				0
	Balance			179	179

The components of the water balance equations are estimated in Table 1. As shown, the ground water inflow from outside the basin in a hydrologically normal year is estimated around 60-70 mcm. Comparing this figure with the total annual spring flow may lead to the conclusion that almost the entire flows from karstic springs around the Lake are transported from outside the basin, i.e. Arjan wetland.

Water balance of Lake Parishan: This exercise of water balance will examine whether or not there is significant inflow into the lake from unmeasured sources such as seepage from foothills. The components in the water balance equation (2) include the annual

inflows (precipitation, runoff and measured ground waters as a known and unmeasured ground water flow as an unknown parameter) versus the annual water losses (Evaporation from the lake, water uptake/uses by wells and ground water outflows). The crucial assumption in this equation is that with all these inflows and outflows used in the equation, and regardless of the seasonal changes, the water level in the lake remains unchanged. On the basis of current conditions, this seems to be a generally acceptable assumption.

$$I_p + I_{ro} + I_s + I_{gw} = O_{ed} + O_{el} + O_{du} + O_{gw} \quad (2)$$

Different nomenclatures in the above equation are defined below:

I_p = Inflow to the Lake through direct precipitation (known);
I_{ro} = Inflow to the Lake through surface runoff flows (estimated);
I_s = Inflow to the Lake through spring flows (estimated)
I_{gw} = Inflow to the Lake through seeping ground water (unknown)
O_{el} = Outflow due to direct evaporation from the lake (estimated)
O_{wu} = Outflow due to well uptakes (estimated)
O_{su} = Outflow due to direct off-take from the lake (ignored)
O_{gw} = Outflow due to outward ground water flows (assumed 0).

Table 2 displays the calculation made for estimating the water balance components.

Table 2 Water balance calculations for Lake Parishan

	Description	Area	Prec.	Flow	Coef.	Volume, mcm/yr	
		km^2	mm	mcm		In	Out
I_p	Precipitation over the Lake	45	450		1.0	20	
I_{ro}	Surface runoff inflow from the catchment area	230	450		0.15	16	
I_{gr}	GW recharge from precipitation	230	450		0.2	21	
I_s	Inflow from spring flows			35	0.7	25	
I_{gw}	Inflow from seeping foothills			?		15	
O_{el}	Direct evaporation from the Lake	45	1680		1.0		76
O_{wu}	Water uses due to uptakes by wells			35	0.6		21
O_{su}	Water uses due to direct uptake from the Lake						0
O_{gw}	GW outflow from the basin						0
	Balance					97	97

Table 3 Monthly average of Water Level Fluctuation- Lake Parishan

Water year		Meh	Aba	Aza	Dey	Bah	Esf	Far	Ord	Kho	Tir	Mor	Sha
Iranian	Greg.	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
51-52	1972/73				104	114	119	118	108	86	64	41	17
52-53	73/74	2	-6	-7	7	48	69	76	74	58	36	12	-13
53-54	74/75	-28	-28	-18		69				88	80	61	40
54-55	75/76	28	24	36	61	86	128	155	167		157	142	129
55-56	76/77	124	123	128	149	172	181	186	185	171	156	138	115
56-57	77/78		113	122	145		197	205	213	204	190	174	162
57-58	78/79	153	149	162	176	200		215	211	196	180	162	145
58-59	79/80	132	127	133	158	195	230	148	151				202
59-60	80/81	190	182	176	192	215	232	245					
60-61	81/82	79	62	58	67	88	110	131	136	127	111		
61-62	82/83	167	175	190	200	111	121	132	133	121	103	84	66
62-63	83/84	54	49	49	53	59	60	67	60	44	22	5	
63-64	84/85				2	13	21	21	10	1	121	105	84
64-65	85/86	70	62	66	88	95	104	109	110	94			
65-66	86/87												
66-67	87/88							249	255	246	230	213	200
67-68	88/89	191	188	192	210	219	224	229	224	205	182	157	137
68-69	89/90	122	117	134	160	197	228	237	235	221	202	183	165
69-70	90/91	151	149	154	164	206	225	243	240	225	207	190	173
70-71	91/92	162	157	167	190	217	234	247	249	243	227	208	192
71-72	92/93	180	176	184	227	269	296	316	336	330	317	303	292
72-73	93/94	282	284	278	292	294	300	305	300	283	261	244	222
73-74	94/95	201	196						167	157	140	122	104
74-75	95/96	92	90	104	138	178	208	239	254	251	240	224	213
75-76	96/97	205	205	209	213	222	227	238	237	222	202	181	160
76-77	97/98	143	140	157	187	217	248	270	272	260	243	225	209
77-78	98/99	199	196	197	204	234	269	279	271	255	238	223	209
78-79	99-00	199	196	199	210	235	240	235	222	199	175	151	131
79-80	2000/01	116	110	120	130	136	138	130	114	92	66	42	17
80-81	01/02	2	0	6	42	91	100	120	117	99	78	56	37
81-82	02/03	23	16	22	33	53	69	77	74	55	33	11	0
82-83	03/04	0	0	0	11	47	58	61	60	43	22	3	0
83-84	04/05	0		37	59	101	128	148	147	138	122	103	87

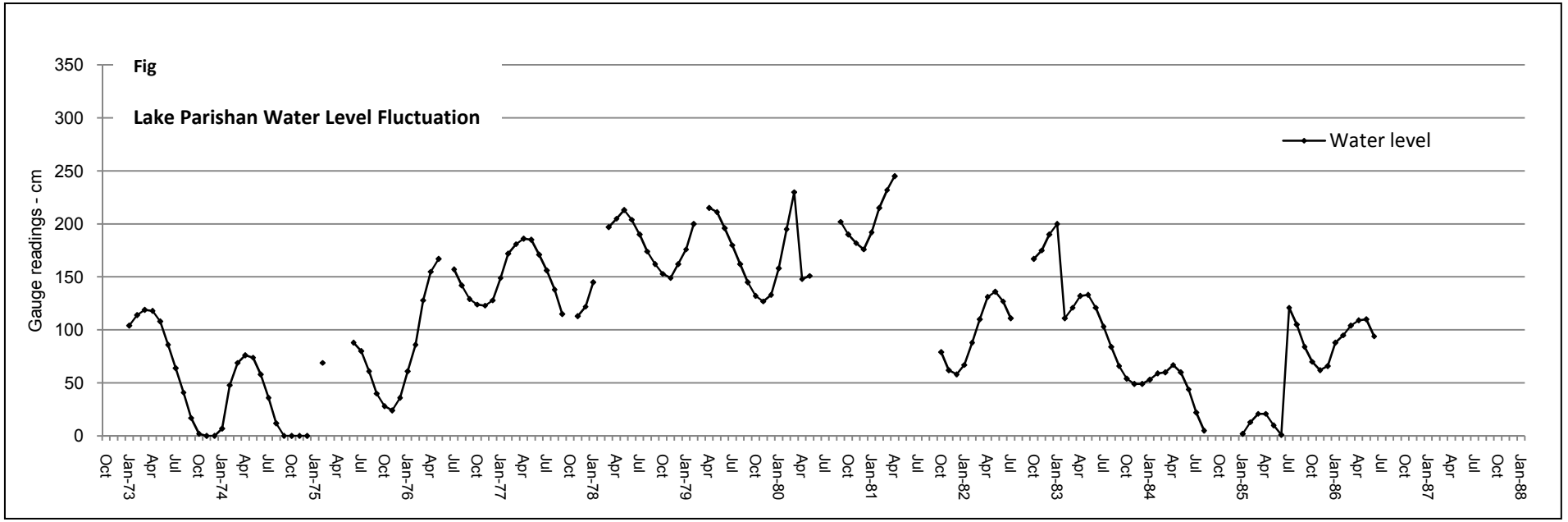
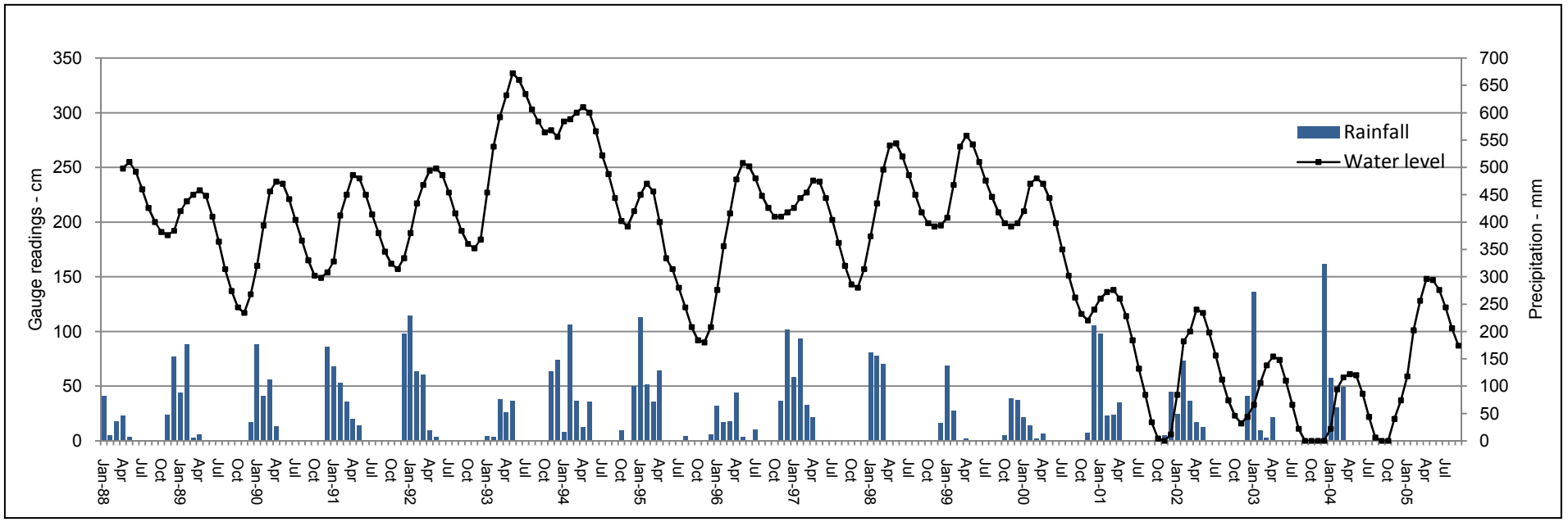


Fig
Lake Parishan Water Level Fluctuation
Water level
Gauge readings - cm
350
300
250
200
150
100
50
0
Oct
Jan-73
Apr
Jul
Oct
Jan-74
Apr
Jul
Oct
Jan-75
Apr
Jul
Oct
Jan-76
Apr
Jul
Oct
Jan-77
Apr
Jul
Oct
Jan-78
Apr
Jul
Oct
Jan-79
Apr
Jul
Oct
Jan-80
Apr
Jul
Oct
Jan-81
Apr
Jul
Oct
Jan-82
Apr
Jul
Oct
Jan-83
Apr
Jul
Oct
Jan-84
Apr
Jul
Oct
Jan-85
Apr
Jul
Oct
Jan-86
Apr
Jul
Oct
Jan-87
Apr
Jul
Oct
Jan-88


Rainfall
Water level
Gauge readings - cm
Precipitation - mm
350
300
250
200
150
100
50
0
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
Jan-88
Apr
Jul
Oct
Jan-89
Apr
Jul
Oct
Jan-90
Apr
Jul
Oct
Jan-91
Apr
Jul
Oct
Jan-92
Apr
Jul
Oct
Jan-93
Apr
Jul
Oct
Jan-94
Apr
Jul
Oct
Jan-95
Apr
Jul
Oct
Jan-96
Apr
Jul
Oct
Jan-97
Apr
Jul
Oct
Jan-98
Apr
Jul
Oct
Jan-99
Apr
Jul
Oct
Jan-00
Apr
Jul
Oct
Jan-01
Apr
Jul
Oct
Jan-02
Apr
Jul
Oct
Jan-03
Apr
Jul
Oct
Jan-04
Apr
Jul
Oct
Jan-05
Apr
Jul

Appendix 3

Midwinter Waterbird Counts

Table 1/ 5 WINTER COUNTS OF WATER BIRDS IN LAKE PARISHAN

	%1 Ramsar	IUCN criterion	1368	1369	1370	1371	1372	1373	1374	1375	1376	1377	1378	1379	1380	1381	1382	1383	1384	1385	Peak records
			1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	
DIVERS & GREBES			570	170	620	505	627	1125	298	127	?	191	312	314	135	191	370	53	196	352	1125
Tachybaptus ruficollis Little Grebe	600		250	170	330	250	320	330	148	69		143	119	160	93	113	190	30	7	79	330
Podiceps cristatus Great Crested Grebe	100		320		**280**	95	**172**	**620**	**103**	58		33	**108**	38	42	36	68	11	**185**	**192**	**620**
Podiceps nigricollis Black-necked Grebe					10	160	135	175	47			15	85	116		42	112	12	4	81	175
PELICANS			70	258	136	58	47	71	70	78	?	30	79	93	33	122	148	50	95	343	343
Pelecanus onocrotalus White Pelican			15	73	90	19	8	18	26	13						34	93		23	21	93
Pelecanus crispus Dalmatian Pelican			55	185	46	39	39	53	44	65		30	79	93	33	88	55	50	72	322	322
CORMORANTS & DARTERS			760	160	760	84	178	275	312	233	?	403	292	831	330	922	1105	459	345	6015	6015
Phalacrocorax carbo Great Cormorant			760	160	760	84	178	275	312	233		403	292	831	330	922	1105	436	197	537	1105
Phalacrocorax pygmaeus Pygmy Cormorant	1000	NT																23	148	**5478**	**5478**
HERONS & EGRETS			288	79	153	289	272	1111	567	413	?	422	412	597	176	366	879	169	125	354	1111
Ardea cinerea Grey Heron			90	21	38	42	67	93	69	36		48	73	27	32	78	54	83	48	126	126
Ardea purpurea Purple Heron	250		78		5	12	2	52	28	32			32	35		46	162	9	8	12	162
Casmerodius albus Great White Egret				8	56	75	11	173	135			203	43	113		35	75	38	13	152	203
Egretta garzetta Little Egret	1000			34	11	25	115	215	112	124		9	105	215		73	117	22	19	52	215
Bubulcus ibis Cattle Egret	1000			16	42	85	55	431	168	175		50	39	93	137	112	160	16	37	8	431
Ardeola ralloides Squacco Heron	1000							31					19	14			5				31
Nycticorax nycticorax Black-crowned Night	1000		120			15		53	16	16			62	52			280	1		4	280
Ixobrychus minutus Little Bittern							15	44	26	13			26	36		13	15				44
Botaurus stellaris Eurasian Bittern					1	35	7	19	13	17		15	13	12	7	9	11				35
Ardeidae spp. unidentified herons												19									19
Egretta/Bubulcus spp unidentified.egrets												78									78
STORKS, IBISES & SPOONBILLS			88	122	216	102	104	184	160	55	?	59	154	155	43	23	87	1	56	24	216
Ciconia ciconia White Stork	250			11	6			2									2				11
Plegadis falcinellus Glossy Ibis	1000		60	79	190	85	77	130	122	23		51	119	133	24		31	1	1	1	190

Table 2/ 5 WINTER COUNTS OF WATER BIRDS IN LAKE PARISHAN

	%1 Ramsar	IUCN Criterion	1368	1369	1370	1371	1372	1373	1374	1375	1376	1377	1378	1379	1380	1381	1382	1383	13846 586	1385	Peak records
			1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	
Platalea leucorodia Spoonbill			28	32	20	17	27	52	38	32	9	8	35	22	19	23	54		55	23	55
FLAMINGO			25	7	0	0	0	85	12	16	?	0	0	0	0	11	23	0	51	225	225
Phoenicopterus ruber roseus Greater Flamingo	2900		25	7				85	12	16						11	23		51	225	225
GEESE, SWANS & DUCKS			26200	9875	9784	2856	8041	10844	11879	3860	?	3032	3280	3020	990	2857	6118	1208	2203	1705	26200
Anser albifrons White-fronted Goose				180				44													180
Anser anser Greylag Goose	2500		**3450**	**2861**	1380	1950	**2810**	**2830**	**4866**	676	308	993	1730	815	380	745	230			102	**4866**
Cygnus cygnus Whooper Swan	---																	3			3
Tadorna ferruginea Ruddy Shelduck	500		850	677	400		175	312	7				132	35			4				850
Tadorna tadorna Shelduck	800				638		15	5	2				122				55		4	52	638
Anas penelope Eurasian Wigeon	2500		2200	750	600	212	379	830	530	375	301	70	230	219			820		6	33	2200
Anas strepera Gadwall	1300		500	43	85	30	80	912	365	205		105	117	130	105	19	300	2	1	30	912
Anas crecca Common Teal	15000		5000	3800	450	160	2875	1320	122	1715	276	965	320	915	280	210	1210	224	500	128	5000
Anas platyrhynchos Mallard	8000		6500	150	30	252	487	3700	5537	464	682	475	430	372	88	673	520	357	224	696	6500
Anas acuta Northern Pintail	7000				2	23	270	212	87	360		98	56	212		42	130	3		1	360
Anas querquedula Garganey								60										2			60
Anas clypeata Northern Shoveler	4000			36	70	59	215	135	73	15				130			115				215
Marmaronetta angustirostris Marbled Teal		Vu	4000		5500				33	20				60	23	14	17		15		5500
Netta rufina Red-crested Pochard	2500				12		35	20	64	13			27	11			15	5			64
Aythya ferina Pochard	3500		2500	650	160	55	520	390	168	17		92	116	105	114	1130	2680	320	1450	386	2680
Aythya nyroca Ferruginous Duck	1000	Vu			250	25	18	72	25					3		24	2		3	2	250
Aythya fuligula Tufted Duck	2000		1200		190	38	162		64			34		9			20	165		6	1200
Bucephala clangula Goldeneye				16																	16
Oxyura leucocephala White-headed Duck	75	En		12	17	52		2		2				4				**127**			127
Anatinae spp. unidentified ducks				700								200								269	700

Table 3/ 5 WINTER COUNTS OF WATER BIRDS IN LAKE PARISHAN

	Ramsar %1	IUCN criterion	1368	1369	1370	1371	1372	1373	1374	1375	1376	1377	1378	1379	1380	1381	1382	1383	1384	1385	Peak records
			1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	
CRANES			425	2023	153	17	13	17	2	0	?	0	14	0	0	0	0	0	2	0	2023
Grus grus Common Crane	20000		425	2023	153	17	13	17	2				14						2		2023
RAILS, GULLINULES & COOT			6400	13518	4949	1476	5257	3973	6367	7462	?	1353	3613	1872	724	12360	5368	1736	2812	15156	15156
Rallus aquaticus Water Rail					2												5			2	5
Gallinula chloropus Moorhen					7			233	320			48	115	112	58	110	32	3	5	16	320
Porphyrio porphyrio Purple Swamphen				18	140	212	520	510	376	146		37	538	400	116	?	11		4		538
Fulica atra Common Coot	20000		6400	13500	4800	1264	4737	3230	5671	7316	4548	1268	2960	1360	550	12250	5320	1733	2803	15138	15138
WADERS			780	914	4409	4184	535	4173	2823	1511	?	315	2691	1829	421	3682	904	51	165	418	4409
Himantopus himantopus Black-winged Stilt	350			16	78			91	16	77			130			119	151	15	5	38	151
Recurvirostra avosetta Avocet	250			28																	28
Vanellus vanellus Northern Lapwing	20000		580	193	2700	3875	290	2930	2470	772	1731	315	2370	1170	290	3230	205		71	298	3875
Vanellus spinosus Spur-winged Plover																		17			17
Vanellus leucurus White-tailed Plover					160	45		61	82	92			104	27	17	23	124	11	59		160
Vanellus indicus Red-wattled Lapwing			200	295	45	35		92	83	42			46	16	13	11	36		15	52	295
Charadrius hiaticula Ringed Plover														60							60
Charadrius dubius Little Ringed Plover								29		31				130					3		130
Charadrius alexandrinus Kentish Plover					140			130		131											140
Limosa limosa Black-tailed Godwit	1000				650	30		130		8				115		173	120			11	650
Limosa lapponica Bar-tailed Godwit																					0
Numenius phaeopus Whimbrel				25																	25
Numenius tenuirostris Slender-billed Curlew				10																	10
Numenius arquata Eurasian Curlew					1																1
Tringa erythropus Spotted Redshank	1000				6																6
Tringa totanus Redshank	2700			20	350	55	110	112	47	295	67	31	30	59	35	110	68	4	12	18	350

Table 4/ 5 WINTER COUNTS OF WATER BIRDS IN LAKE PARISHAN

	%1 Ramsar	IUCN criterion	1368	1369	1370	1371	1372	1373	1374	1375	1376	1377	1378	1379	1380	1381	1382	1383	1384	1385	Peak records
			1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	
Tringa stagnatilis Marsh Sandpiper	750			130				21					11	12	9		12	1			130
Tringa nebularia Greenshank	10000			75			37	43	36								15				75
Tringa ochropus Green Sandpiper				32	5			11		7								1			32
Tringa glareola Wood Sandpiper				30																	30
Tringa cinereus Terek Sandpiper				60																	60
Actitis hypoleucos Common Sandpiper														65			60	1		1	65
Gallinago gallinago Common Snipe					110	20	67	60	27	11				18	13	11	52				110
Lymnocryptes minimus Jack Snipe					11	29	31	93	22	19				103	17		32				103
Calidris minuta Little Stint					2	95		130	13	19				35	27	5	29				130
Calidris temminckii Temminck's Stint					25			22	16	7				19							25
Calidris alpina Dunlin					120																120
Limicola falcinellus Broad-billed Sandpiper									11												11
Philomachus pugnax Ruff					6			218										1			218
GULLS & TERNS			4200	0	4320	600	380	1964	3503	2792	?	6	1350	474	3500	1179	1847	156	102	506	4320
Larus cachinnans Caspian Gull																				18	18
Larus argentatus Herring Gull										2											2
Larus ichthyaetus Great Black-headed Gull								2	3							14	5	6	5		14
Larus ridibundus Black-headed Gull	2500		4200		4300	600	380	1950	3500	2770		6	1350	460	3500	1130	1540	96	86	437	4300
Larus genei Slender-billed Gull	1500				10													20		14	20
Larus minutus Little Gull														14							14
Yellow Legged Gull																			10		10
Larus spp. unidentified gulls																				23	23
Chlidonias hybridus Whiskered Tern	1000				10													34	1	14	34
Sterna albifrons Little Tern								12		20						35	302				302

Table 5/ 5 WINTER COUNTS OF WATER BIRDS IN LAKE PARISHAN

	%1 Ramsar	IUCN criterion	1368	1369	1370	1371	1372	1373	1374	1375	1376	1377	1378	1379	1380	1381	1382	1383	1384	1385	Peak records
			1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	
ADDITIONAL SPECIES			0	68	0	0	0	320	0	0	?	39	0	15	15	8	51	62	15	111	320
Golden Eagle				2																	2
Aquila clanga Great Spotted Eagle												4		4				1	1	13	13
Haliaeetus albicilla White- tailed Sea Eagle																		2	1		2
Circus cyaneus Hen Harrier								12												4	12
Circus aeruginosus Marsh Harrier				5				17				5		11	13	7	11	19	1	38	38
Circus pygargus Montagu's Harrier				2																	2
Pandion haliaetus Osprey				3				1							2			3			3
Alcedo atthis Kingfisher				22														7		1	22
Halycon smyrnensis White-breasted kingfisher																	5	1	1	2	5
Ceryle rudis Lesser pied kingfisher				34								30					27	28	7	48	48
Luscinia svecica Bluethroat																				3	3
Black Francolin																	5				5
B. b. Sandgrus								270													270
Hobby								1													1
Kestrel								9											1		9
Sparrow Hawk								4													4
Gos Hawk								2													2
PeregrineFalcon								2													2
Houbara								2													2
Long legged Bustard																1		1			1
Long leg Buzzard																	3		3		3
Acrocephalus stentoreus Calmarous Reed Warbler																				2	2
Total	20000		**39806**	**27194**	**25500**	10171	15454	**24142**	**25993**	16547	??	5850	12197	9200	6367	**21721**	16900	3945	6167	**25209**	39806