

GEODIVERSITY AND ITS IMPORTANCE ON VERTEBRATE DIVERSITY NEAR RAZAZA LAKE, MIDDLE OF IRAQ

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ABSTRACT

*The study area is located near Razazza Lake, southwest Karbala City, middle of Iraq. Data collections depended on field natural surveys. Geodiversity includes: rocks and minerals, land forms, type of soil and water resources. The main rock bed units are: sandstone, siltstone, mudstone, marl, limestone, dolostone, and gypsum. Landforms are: plateaus, dry wadis, hills, caves, sand sediments, lakes, marshes, ephemeral streams, Shithatha Plain, springs and sabkha. Types of soil are sandy on the plateau and near south part of Razaza Lake peach, while muddy and clayey soil near Shithatha and surrounding. Water resources are: Al-Majara canal, Al-Hassainiya canal, Karbala drainage canal, Razaza Lake, Shithatha springs and drilled wells, Ephemeral stream (Wadi Al-Ubaidh). Geodiversity is provides habitats and enhance biodiversity, therefore many habitats has been recognized, such as: Plateaus, Hills, Cliffs and Wadis, Sand sediments, Razaza Lake, marshes, Wadi Al-Ubaidh, Shithatha plain, Springs, sabkha. Vertebrate diversity in Razzaza Lake and adjacent areas belongs to five classes; Pisces, Amphibia, Reptilia, Aves, and mammalian. It comprises 89 species including 78 genera, 57 families and 22 orders. It is found that structural units of habitats of the area have their own vertebrate faunas. Results showed that some species are common to all habitats mentioned here for example *Merops superciliosus*, *Upupa epops*, *Vulpes vulpes* and *Pipistrellus kuhlii*; others seem to be utilize more than one habitat in the area for example *Gambusia affinis*, *Canis aureus*, *Hyaena hyaenam*, *Hystrix indicam*, *Prinia gracilis*, *Phoenicopterus ruber*, and *Uromastyx microlepis*. Few species were recorded from one type of habitat for example *Diplometopon zarudnyim*, *Stenodactylus affinis*, *Bubo bubo*, *Scincus scincus* and *Taphozous nudiventris magnus*. Of the species recorded, some were found of special interest from the conservation point of view for example *Stenodactylus affinis* and *Hypocolius ampelinus*. A comparison between the statuses of present vertebrate biodiversity and three decades ago was provided emphasizing on*

the environmental changes happened to the Razzaza Lake and the adjacent areas with the shortage of water quantity and deterioration of its quality.

Keywords: Iraq; Karbala; Razzaza lake; Geodiversity; Habitats; Vertebrate diversity

INTRODUCTION

Geodiversity includes rocks, minerals, landforms, soils and water resources (Gray, 2004). Involved factors provide the framework for biologic and human life on earth (Stanley, 2002). Naturalists referred to important relationship between geodiversity and biodiversity. Geodiversity and natural processes sustain biosystems (Santucci, 2005). Publications and conferences were increasing at last decades as well as many researchers focus on the interaction between modern “geo-bio systems” (Jackova and Romportl, 2008; Petrisor and Sabro, 2010; Hart, 2012; Gray *et al.*, 2013; Mohammad and Al-Zubaidi, 2014; and Al-Zubaidi *et al.*, 2014).

Vertebrates diversity at Razzaza lake area, in its turn, was poorly studied and the relevant data belonged mainly to scattered notes in some taxonomic references for more than 60 years (for example, Hatt, 1959; Khalaf, 1959; Allouse, 1960 – 1962; and Harrison, 1968). Some recent efforts to survey the fauna of the Iraqi ecosystems including middle desert area were done like Mohammad *et al.* (2010); Mohammad and Ali (2013); Nature Iraq (2013); and Al-Sheikhly *et al.* (2015).

The aim of the present work is to update our knowledge on the current status of the vertebrate diversity and their distribution among the different geological structural units of the Razzaza Lake and its adjacent areas.

METHODS

Data's collection of this study depended on field survey during many field trips to the Razaza Lake and adjacent areas, south west Karbala City, middle of Iraq, to study geodiversity, ecosystems, habitats and vertebrates diversity. Determining the taxa identities depend on collecting whole or a part, their feces, hair, spines, or tracks of the footprints, observing, or photographing the vertebrate animal in the field. Iraq Natural History Museum records were consulted to compare present findings with the data obtained earlier. Interviews with local people and fishermen about animals in the studied area were also done.

- **Location:** Studied area is located southwest of Karbala City, near the southern part of Razaza Lake- middle of Iraq (Fig. 1). Tectonically, it is located on the Abu Jir fault zone which separates a stable platform on the west and an unstable platform on the east.
- **Climate:** It is play important role to form the earth surface and land forms near Razazza Lake. Table (1) showed some climatic data of the studied area.

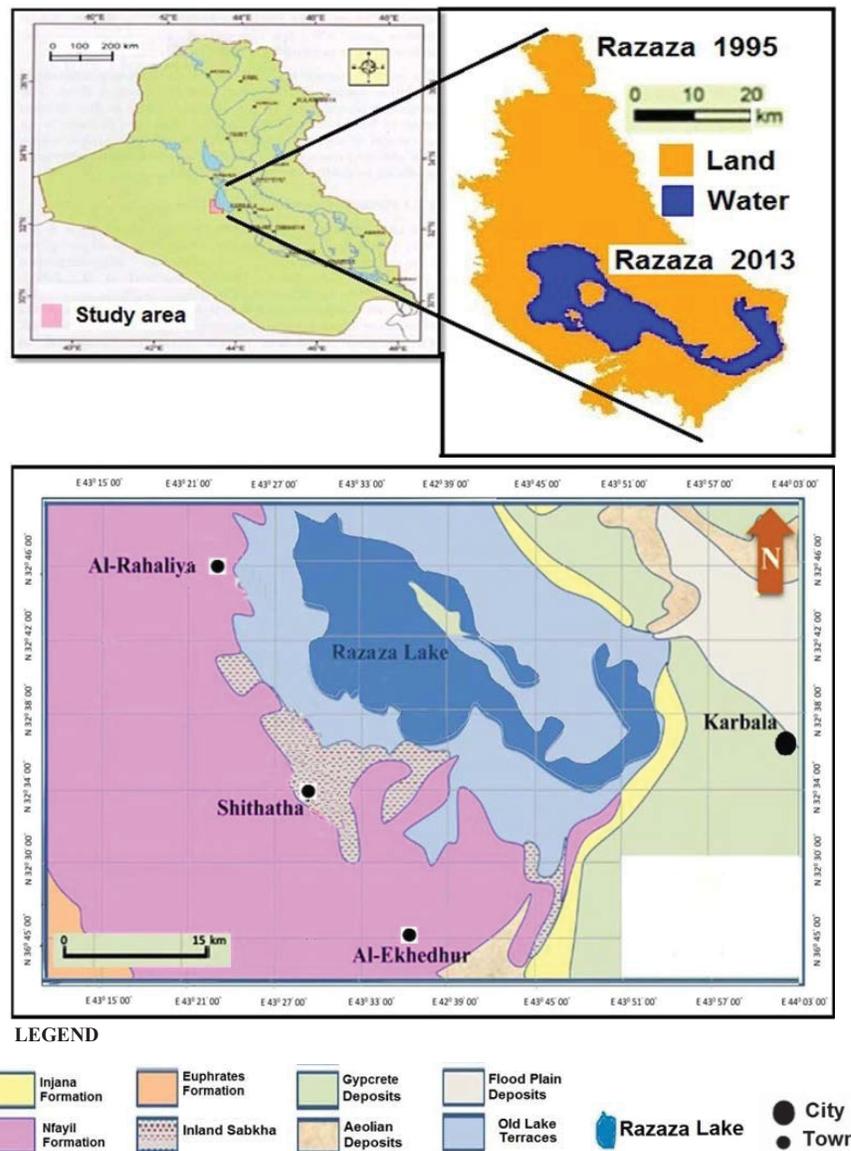


Fig. 1: Location and Geology map of studied area (Al-Dabbas *et al.*, 2015)

Table 1: Climatic data of Karbala and Najaf Stations (IGOMI, 2000)

Station	Temperature Max.	Temperature Min.	Annual rainfall	Annual evaporation
Karbala	43 °C	6.4 °C	109 mm	3332.7 mm
Najaf	44 °C	6.4 °C	122 mm	3194.3 mm

RESULTS AND DISCUSSION

Current study depends on geodiversity, habitats (ecosystems) and vertebrate diversity near Razaza Lake and adjacent areas.

▪ Geodiversity

The main structural units of the studied area are two fault zones Abu Jir fault and Emam Ahmad Bin Hashim fault. Their depths are about 150 m and the directions are Northwest-Southeast (Al-Sakini, 1984; and Brazaniji and Yasi, 1987). Many researchers suggested that the water of Shithatha springs related to involved fault zones, which have about 10 Km in width (Abbas and Al-Khatib, 1982; and Al-Sakini, 1984). The geodiversity of studied area composed of rock bed units, landforms, soils and water resource.

– **The rock bed units:** exposed in the study area belong to Paleogene and Neogene Periods (Dammam, Euphrates, Nfayil, Injana and Dibdiba Formations) and Quaternary sediments (Hassan, 2007; and Sissakian and Mohammed 2007). Dammam Formation (Late Eocene), upper part exposed in the area consists of limestone and marl in addition to few lenses of chert. Euphrates Formation (Early Miocene), about 40 – 57 m thick, consist of fossiliferous limestone. Nfayil Formation (Middle Miocene), about 27 m thick, consists of interbedding of limestone and marl. Injana Formation (Late Miocene), about 31m thick, consists of sandstone, claystone, mudstone and marly limestone in addition to secondary gypsum. Dibdiba Formation (Pliocene – Pleistocene), about 1 – 18 m thick, consists of sandstone contain pebble sometimes. Quaternary sediments include depression fill, Aeolian, flood plain, sabkha and gypcrete.

– **Landforms:** the landforms have been subdivided into 8 units according to their origin (Al-Zubaidi and Jan, 2016).

1. Structural-denudational origin: which include, plateau, mesas, wadis, hills, and cliffs. Karbala plateau or Tar Al-Sayyed (locally name) is part of Karbala – Najaf plateau the only plateau in the studied area. The length of Karbala plateau is more

than 105 Km and its high up to 21 m (Sissakian *et al.*, 2015). Some mesas occurred within Nfayil Formation covered by hard limestone. Some hills developed beside the plateau, range from few to 20 m comprises sandstone, mudstone and claystone. Other hills occurred far away from plateau belong to Nfayil Formation range from few to 10 m consisting of marl and limestone (Sissakian *et al.*, 2015). Cliffs, of steep slope are developed on the west part of the plateau within Injana Formation. Many gentle slope and flat wadis, successive with cliffs, are dissected the plateau and inclined toward Razzaza Lake. Shallow fractures (caves) in rocks in Tar caves were recorded to be used by the eagle owl *Bubo bubo* for nesting while the deep ones were used by two species of bats; the Naked-rumped Tomb Bat *Taphozous nudiventris magnus* and the Kuhl's Pipestrelle *Pipestrellus kuhlii* for hiding during daytime. The large holes inside Tar caves unit (Figs. 2 and 3) are wide and large enough to contain several hundreds of these bats and large quantity of bat feces was accumulated at the base.



Fig. 2: Tar caves



Fig. 3: Tar caves and surrounding areas

- 2. Denudational origin:** include Desert pavement, mushroom rocks. Desert Pavement is covered by sub-rounded to sub-angular pebbles. Length of pebble reaches to 5cm, which may be derived from Dibdibba Formation and/or Karbala plateau. Mushroom rocks developed on the top west side of plateau within Injana Formation (Fig. 4).
- 3. Solution origin:** include lake, salt marsh and piping caves. Razzaza Lake bottom consists of carbonate rock bed units. Involved rock bed units which belong to Nfayil and Euphtates Formations were fractured by three group of lineaments (Al-Kubaisi *et al.*, 2014). low land in study area may be filled by spring salty water to form salt marshes which locally used to raising Buffaloes and fishing. Rock shelters and caves (Fig. 5) of different sizes developed by solution effect on claystone (Hassan and Al-Khateeb, 2005) or by Karstification on marly limestone (Sissakian *et al.*, 2015) within Injana Formation at the upper part of plateau. The water level in the general

are had dropped considerably by the cut off Al-Majara Channel the major resource linking and bringing water from Al-Habbaniya Lake to the Razzaza.



Fig. 4: mushroom rock in west side of plateau



Fig. 5: Rock shelters developed in the upper part of Injana Formation

4. Springs: there are more than twenty water springs controlled by Euphrates fault (Abu jir fault). Water of springs used for irrigation and daily uses in Shithatha town (Ain Al-Tamur). According to the field surveys many spring dried after 2003. Involved spring feed from Euphrates and Dammam aquifers . Large artesian springs within Ain Tamur town witnessed considerable decrease in the water quantity at the nineties of the past century. This was reflected by the dryness of all irrigation channels carrying water to orchards and crop and vegetable fields. After 2003 authorities drilled very deep new wells for irrigation and house daily use using 14" diameter pipes to fulfill the necessary needs of the people. It is of interest to mention here that the freshwater gastropod *Melanopsis buccinoidea* is present in huge numbers in the channels, artesian springs and springs throughout the Ain Al-Tamur (Shithatha) area (Figs. 6 and 7). This is correlated mainly to the high content of sulphur compounds in the drilled water. This snail is known to present in rich sulphur content water (Mohammad, 2014a).



Fig.6: Ain Al-Zarqa spring inside Ain Al-Tamur (Shithatha) town



Fig. 7: one of the newly drilled wells

- 5. Fluvial origin:** include terraces, alluvial fan, and flood plain. Terraces sediments are occurring on the sides of large ephemeral streams such as Al-Ubaidh. Alluvial fans sediments are common at the west of Shithatha plain such as: Al-Ubaidh and Tabbal. Involved sediments composed of poorly cemented and poorly sorted sediments which contain carbonate and chert gravels (Hamza, 2007). Flood plain sediments are developing on two sides of large ephemeral stream and composed of sand, mud and clay. Its thickness range from 1 meter to some meters (Hamza, 2007). Many locations of this unit were heavily utilized to get sand for industrial and construction purposes, accompanied with use of huge quantities of underground water for washing sand. The water was maintained in a large depression beyond each site and collected through deep artesian wells of 4" to 6" pipes drilled in the seventies of the past century and some of them are still pouring water till now.
- 6.** Many ephemeral stream such as Al-Ubaidh (Fig. 8), Ghadaf, Abu Mindhar, Tabbal, Saffawiyat and others, controlled by topography, are drain from the west toward depression of Razzaza Lake (Sissakian, 2007). This structural unit offered suitable places for breeding and nest building of the Ruddy Shelduck *Tadorna ferruginea* which takes place during summer mostly in May and June. This duck disappeared from the area with the road paving at the middle of seventies of the past century and reach more tourists to visit the Al-Ukhaidher fort and the nearby Ain Al-Tamur town. This duck is no more exists in the area by now. Also, this unit contains Green toad *Bufo viridis*, the Eurasian frog *Pelophylax ridibundus* and the Himri fish *Carassobarbus luteus*. Their existence is related directly to the presence of good quantities of fresh water transferred by Al-Ubaidh valley and its branches especially during the rainy season, which allows to these animals to migrate locally from southern edge of the lake southward for more pure fresh water. These small bodies of freshwater contribute to the unusual existence and maintaining of a small population of the freshwater lymnaeid snail *Radix auricularia* in the heart of the desert. Its presence may be by bringing the eggs of the snail by aquatic birds through attaching these eggs with their legs or feathers.
- 7. Evaporational origin:** include two types, secondary gypsum and sabkha. Secondary gypsum exposed on the upper part of plateau cliffs within sandstone of Injana Formation which may be derived from Nfayil Formation (Al-Zubaidi and Jan, 2016).

Sabkhas were developed in the distal part of alluvial fan sediments which consists mainly of fine materials. Involved sediments found near Razzaza Lake (Fig. 9) and west of Shithatha town.



Fig. 8: Al-Ubaidh ephemeral stream after rainy days



Fig. 9: saline and fine materials (sabkha), near Razzaza Lake

8. Aeolian origin: Aeolian landforms resulted in the studied area are trapped dunes, shadow dunes, barchan dune and sand sheets. Trapped dunes form when the sand grains deposited within *Tamarix* tree or deposited behind the tree to form shadow dunes which found on plateau, wadi and Beach of Razzaza Lake. Barchan dune found on the beach close to lower part of wadis particularly near Qatarat Al-Emam Ali (Fig. 10). Sand sheet found in the areas without vegetation on the beach, wadis and on the plateau.



Fig. 10: Barchan dune found on the beach of Razzaza Lake near Qatarat Al-Emam Ali

– **Water Resources:** there are six water resources within the studied area: Al-Majara canal, Al-Hassainiya canal, Karbala drainage canal, Shithatha springs, drilled wells and Ephemeral streams; and Razzaza Lake (the largest water basin).

- **Al-Majara canal:** It is joining between Al-Habbaniya Lake, which feed from Euphrates River, and Razzaza Lake. Its importance as water source was completely diminished since
- **Al-Hassainiya canal:** It is transport water from Euphrates River to Razzaza Lake after passing though farms, gardens, Karbala city and other towns.
- **Karbala drainage canal:** It is founded in 1931 for reclamation the salty soils in farms and gardens, which is located between Euphrates River and Karbala city. Water of involved canal transported to Razzaza Lake by water pumps (Fig. 11).



Fig. 11: water transported from Karbala drainage canal to the Razzaza Lake

- **Shithatha springs:** there are many water springs (> 20), affected by Abu Jir – Alsalman fault. Formerly, mentioned springs have plenty of water, but after 2003 became dry because of deep wells digging which reach to 150 m and more (Al-Zubaidi and Jan, 2016). The most prominent irrigation systems is its springs, Ain Al-Hamra, Ain Al-Zarga, Ain Seeb and a complicated network irrigation channels through the orchards and farms in addition to many small spring and tens of date palm trees around composes one of many scattered small oases around the town (Mohammad, 2014b).
- **Drilled wells:** After 2003, many farmers digged deep wells to use it for drinking, irrigation and other daily uses. Currently, water flows continuously from involved wells to the farms and gardens. The access water already goes to Razzaza Lake basin.
- **Ephemeral streams:** many ephemeral streams flow, during rainy seasons from highland deserts to the east direction toward Razzaza Lake such as: Wadi Al-Ubaidh, Ghadaf, Tabbal and others.
- **Razaza Lake:** It is the second largest water basin in Iraq and the largest basin in studied area. It was founded in 1969 to prevent floods of Euphrates River which might be take place in middle and south Iraq. Formerly the surface area of the lake reach to

1621 Km², water depth reaches to 40 m and the conserved water, during 1995, about 25750 billion m³. But in 2013, the surface area of the lake was decreased to 271 Km, water depth range between 5 – 10 m and the conserved water about 4300 billion m³ (Othman *et al.*, 2013).

– **Types of soil:** The major type of the soil is the sandy soil on the Plateau and the south part of Razaza Lake peach. While muddy and clayey soil is the major type at Shithatha and surrounding areas.

▪ **Habitats (ecosystems)**

According to geodiversity of study area, many habitats were recognized: **a)** Plateau, **b)** Hills, cliffs and wadi, **c)** Sand sediments, **d)** Razaza Lake, **e)** Marshes, **f)** Wadi Al-Ubaidh, **g)** Shithatha plain, **h)** Springs, **i)** sabkha.

a. Plateau: The upper surface of plateau is covered by Dibdiba Formation (Hassan, 2007) or by alluvial fan (Sissakian *et al.*, 2015) which are hardened by gypcrete and sometimes covered by desert pavement, particularly east of Karbala – Shithatha main road. Field surveys show that the uppermost meter of the plateau is composed of white to creamy friable coarse sand with pebbles. Involved upper meter of sediments are easy to dig in by spiny-tailed lizard (Al-Dhab) *Uromastyx microlepis* in which they are lived (Fig. 12). About 40 years ago this area was filled with dens of this lizard but gradually they disappeared from the area with intensification of different human activities and by the beginning of this century they became rare. Examples of vertebrates: Reptilia: *Uromastyx microlepis*; Aves: *Galerida cristata*, *Pterocles alchata*, *P. senegalensis*, *Falco tinnunculus*, *Alaemon alaudipes*, *Prinia gracilis*, *Hirundo rustica*, *Upupa epops*; Mammalia: *Hyaena hyaena*, *Vulpes vulpes*, *Canis lupus*, *Canis aureus*, *Mellivora capensis*, *Lepus arabis*, *Allactaga euphratica*.



Fig. 12: Entrance of the den of spiny-tailed lizard in the Plateau

b. Hills, cliffs and wadi habitat: many hills and cliffs found near and far away from plateau provide resting places and elevated landscape sight for some falconiform birds to enabling them watching some preys such as hares and small mammals during their migration such as steppe eagle, imperial eagle, harriers. On the cliff, sometimes secondary gypsum exposed on the bedding plane of the rock bed units of Injana Formation. Gypsum has low hardness in which can be removed by hayena claw to prepare their caves. Piping cave developed on claystone (Hassan and Al-Khateeb, 2005) or karstification on marly limestone (Sissakian *et al.*, 2015) offered many caves for *Taphozous nudiventris magnus* and *Pipistrellus kuhlii* bats. Plateau dissected by some wadis that are mainly covered by fine sand sediment grew on *Haloxylon salicornicum*. Such microenvironment is preferred by the limbless lizard *Diplometopon zarudnyi* which lives underground beneath the moist sand. At the height of Tar Cave about 30 Km Southwest of Kerbala City in the early years of eighties decade of the last century, the Eagle owl *Bubo bubo* was recorded to utilize the cracks beneath rocks for nesting and one fully covered with feathers juvenile ready to leave the nest was seen. Examples of vertebrates: Reptilia: *Diplometopon zarudnyi*, *Stenodactylus doriae*, *Bunopus tuberculatus*, *Mabuya aurata*, *Mesalina brevirostris*, *Acanthodactylus grandis*, *Trapelus rudiratus*, *Spalerosophis diadema cliffordi*, *Malpolon moilensis*, *Eryx jaculus*, *Cerastes cerastes*; Aves: *Oenanthe oenanthe*, *Galerida cristata*, *Cettia cetti*, *Columba livia*, *Lanius collurio*, *L. nubicus*, *Falco tinnunculus*, *Bubo bubo*, *Merops superciliosus*, *Alaemon alaudipes* *Prinia gracilis*, *Motacilla alba*, *Hirundo rustica*, *Upupa epops*; Mammalia: *Vulpes vulpes*, *Canis aureus*, *C. lupus*, *Hyaena hyaena*, *Mellivora capensis* *Lepus arabicus*, *Hystrix indica*, *Tatera indica*, *Nesokia indica*, *Pipistrellus kuhlii*, *Taphozous nudiventris magnus*.

c. Sand sediments: many types of recent fine- very fine sand sediments has been found southeast side of Razzaza Lake which are deposited by wind. Examples of vertebrates: Reptilia: *Scincus scincus* *Cerastes cerastes* *Spalerosophis diadema cliffordi* *Malpolon moilensis*; Aves: *Oenanthe oenanthe* *Galerida cristata* *Cettia cetti* *Lanius collurio* *Lanius nubicus* *Falco tinnunculus* *Merops superciliosus* *Alaemon alaudipes* *Prinia gracilis* *Motacilla alba* *Hirundo rustica* *Upupa epops*; Mammalia: *Allactaga euphratica* *Vulpes vulpes* *Canis aureus* *Canis lupus*.

d. Razaza Lake: It is the largest basin in the study area (Fig. 13). The shortage of water resources caused decreasing of depth to 5 – 10 m, surface area to 271 Km² and the water conservation to 4300 billion cubic meters (Othman *et al.*, 2013). In the seventies and eighties decades of the last century the water was nearly fresh to brackish and a lot of freshwater economic fishes was recorded from the lake including *Mesopotamichthyes sharpeyi*, *Luciobarbus xanthopterus*, *Barbus grypus*, *Barbus kersin*, *Aspius vorax*, *Carassobrbus luteus*, *Silurus triostegus* and many other non economic species. At the beginning of the nineties decade onwards the quantity of water considerably decreased and its quality became Chloride-sodium family (Al-Dabbas *et al.*, 2015). The fishermen who counted once in the area by several hundred left their job in view of the absence of their targeted fishes. Examples of vertebrates: Pisces: *Gambusia affinis*, *Acanthopagrus perda*; Amphibia: *Pelophylax ridibundus*; Reptilia: *Natrix tessellata*; Aves: *Ardea cinerea*, *A. Purpurea*, *Phoenicopterus ruber*, *Hoplopterus spinosus*, *Charadrius alexandrinus*, *C. hiaticula*, *C. dubius*, *Gallinago gallinago*, *Larus genei*, *L. ridibundus*, *Sterna hirundo*, *Gelochelidon nilotica*, *Sternula albifrons*, *Phalacrocorax carbo*, *Grus grus*, *Gallinula chloropus*, *chloropus*, *Fulica atra*, *Chettusia leucura*, *Ixyobruchus minutes*, *Halcyon smyrnensi*; Mammalia: *Canis lupus*, *Hyaena hyaena*, *Lepus arabicus*, *Hystrix indica*, *Vulpes vulpes*.



Fig. 13: Razzaza Lake

It is of interest to mention here is the crustacean *Sphaeroma a. annandalei*. It seems that it is widely distributed throughout the southern marshy areas with noticeable tolerance to wide range in salt content of water. Ali *et al.* (2007) reported it from Suq Shuyukh and Hammar marshes while Al-Zubaidi *et al.* (2017) reported it from Huwaizah marsh. It is also observed in Dalmaj marsh (personal data) and Razzaza lake (Mohammad *et al.*, 2010; Mohammad and Ali, 2013; and Mohammad, 2014b). This

crustacean seems to accelerate desertification in the area through boring in the sandstone rocks encircling the Razzaza Lake. This is in agreement with Higgins (1956); Talley *et al.* (2001); Davidson (2006); and Mohammad (2014b) who assessed *Sphaeroma* spp. as bioeroding factors and accelerate erosion and damage to maritime structures and in some heavily infested Californian marshes the erosion can exceed 1 m/y.

e. Marshes: It is formed when the low land occurred between Shithatha plain and Razzaza Lake and filled by spring water and later by well water after passing through garden (Fig. 14). Examples of vertebrates: Amphibia: *Bufo viridis*, *Pelophylax ridibundus*; Reptilia: *Natrix tessellate*, *Stenodactylus affinis*; Aves: *Marmaronetta angustirostris*, *Ardea cinerea*, *A. purpurea*, *Phoenicopterus ruber*, *Hoplopterus spinosus*, *Charadrius alexandrinus*, *C. hiaticula*, *C. dubius*, *Sterna hirundo*, *Gelochelidon nilotica*, *Sternula albifrons*, *Phalacrocorax carbo*, *Gallinula chloropus chloropus*, *Fulica atra*, *Chettusia leucura*, *Larus ridibundus*, *Ixyobruchus minutes*, *Botaurus stellaris*, *Halcyon smyrnensis*, *Hippolias pallid*, *Turdoides altirostris*, *T. caudatus*; Mammalia: *Mus musculus*, *Rattus rattus*, *Vulpes vulpes*, *Canis aureus*, *Lepus arabeus*.



Fig. 14: marshes to the east of Razzaza Lake

f. Wadi Al-Ubaidh: It is ephemeral stream that flows from Iraqi- Saudi Arabia border to the east toward Razzaza Lake and have high discharge during rainy days and may be flooded out of the main channel to form flood plain and terraces (Al-Zubaidi and Jan, 2016). In the end of seventies decade of the last century breeding of 5 pairs at least of the Ruddy shelduck *Tadorna ferruginea* was frequently reported from this habitat just beyond the Al-Ukhaidher Fort about 70 Km southwest of Kerbala City, and by the beginning of nineties decade there was

no breeding activities. Example of vertebrates: Pisces: *Carassobarbus luteus*; Amphibia: *Bufo viridis*, *Pelophylax ridibundus*; Reptilia: *Cerastes cerastes*, *Eryx jaculus*, *Acanthodactylus grandis*, Aves: *Tadorna ferruginea*, *Marmaronetta angustirostris*, *Ardea cinerea*, *A. Purpurea*, *Hoplopterus spinosus*, *Charadrius alexandrines*, *C. Hiaticula*, *C. Dubius*, *Gallinago gallinago*, *Larus genei*, *L. ridibundus*, *Sterna hirundo*, *Gelochelidon nilotica*, *Sternula albifrons*, *Phalacrocorax carbo*, *Tadorna ferruginea*, *Gallinula chloropus chloropus*, *Chettusia leucura*, *Ixyobruchus minutes*, *Botaurus stellaris*, *Halcyon smyrnensis*, *Upupa epops*; Mammalia: *Vulpes vulpes*, *Canis aureus*, *C. Lupus*, *Hyaena hyaena*, *Mellivora capensis*, *Lepus arabeus*, *Hystrix indica*, *Tatera indica*, *Nesokia indica*, *Pipistrellus kuhlii*.

g. Shithatha plain: It is developed by the accumulation of distal parts of many alluvial fans, which resulted from many ephemeral streams flow from west, Iraqi- Saudi Arabia border, to the east, toward Razzaza Lake. It is characterized by very low gradient and its sediments consists of clayey silt and silty clay (Fig. 15), which was became suitable for date palm and fruit gardens, in addition to vegetable cultivation.

Examples of vertebrates: Amphibia: *Bufo viridis* *Pelophylax ridibundus*; Reptilia: *Eryx jaculus* *Gymnodactylus scaber* *Acanthodactylus grandis*; Aves: *Cercotrichas galactotes* *Passer domesticus* *Pica pica* *Motacilla alba* *Oriolus oriolus* *Turdoides caudatus* *T. Altirostris* *Hippolias pallida* *Pycnonotus leucotis* *Columba livia* *C. palumbus* *Streptopelia decaocto* *S. Turtur* *Halcyon smyrnensis* *Upupa epops*; Mammalia: *Hemiechinus auritus* *Mus musculus* *Rattus rattus* *Hystrix indica* *Vulpes vulpes* *Canis aureus* *Mellivora capensis* *Lepus arabeus* *Pipistrellus kuhlii*.



Fig. 15: Shithatha plain near Ain Al-Tamur town

h. Springs: many water springs (more than 20) have been occurred at study area which is related to fault zone, but they were dried after 2003 when the locals dig mechanical deep water wells (more than 150 meters) for irrigation. The type of water is chloride and sulphate mainly. Examples of vertebrates: Pisces: *Gambusia affinis*, Amphibia: *Bufo viridis*, *Pelophylax ridibindus*, Reptilia: *Eryx jaculus*, Aves: *Marmaronetta angustirostris*, *Hypocolius ampelinus*, *Pica pica*, *Passer domesticus*, *Turdoides caudatus*, *Galerida cristata*, *Lanius collurio*, *L. Nubicus*, *Prinia gracilis*, *Halcyon smyrnensis*, *Cercotrichas galactotes*; Mammalia: *Hemiechinus auritus*, *Canis aureus*, *C. Lupus*, *Vulpes vulpes*, *Hyaena hyaena*, *Lepus arabicus*, *Herpestes javanicus*.

i. Sabkha: chloride and sulphate sabkha have been occurred as thin layers or among soil particles, west of Shiththa town, which may be resulted from evaporation of underground water.

Examples of vertebrates: Reptilia: *Stenodactylus affinis*; Aves: *Hypocolius ampelinus*, *Lanius collurio*, *L. nubicus*, *Galerida cristata*, *Oenanthe oenanthe*; Mammalia: *Lepus arabicus*, *Canis aureus*, *C. lupus*, *Vulpes vulpes*, *Herpestes javanicus*.

▪ Vertebrate diversity

Table (2) summarizes the results on the vertebrate diversity. It would show that vertebrates of Razzaza Lake and adjacent areas comprise 5 classes, 22 Orders, 57 families, 78 genera, and 89 species. Results showed that some species are common to all habitats mentioned here for example *Merops superciliosus*, *Upupa epops*, *Vulpes vulpes* and *Pipistrellus kuhlii*; others seem to be utilize more than one habitat in the area for example *Gambusia affinis*, *Canis aureus*, *Hyaena hyaenam*, *Hystrix indicam*, *Prinia gracilis*, *Phoenicopterus ruber*, and *Uromastix microlepis*. Few species were recorded from one type of habitat for example *Diplometopon zarudnyim*, *Stenodactylus affinis*, *Bubo bubo*, *Scincus scincus*, and *Taphozous nudiventris magnus*. Of the species recorded, some were found of special interest from the conservation point of view for example the Marsh gecko *Stenodactylus affinis* and the Grey hypocolius *Hypocolius ampelinus*.

**Table 2: Tentative list of the vertebrate species recorded in the Razzaza Lake area:
Vertebrate diversity**

Class Pisces:

Carassobarbus luteus (Cyprinidae: Cypriniformes)
Acanthopagrus perda (Bagridae: Siluriformes)
Gambusia affinis (Poeciliidae: Cyprinodontiformes)

Class Amphibia:

Bufo viridis (Bufonidae: Anura)
Pelophylax ridibundus (Ranidae: Anura)

Class Reptilia:

Acanthodactylus grandis (Lacertidae: Squamata)
Bunopus tuberculatus (Gekkonidae: Squamata)
Cerastes cerastes (Viperidae: Squamata)
Diplometopon zarudnyi (Trogonophidae: Squamata)
Eryx jaculus (Boidae: Squamata)
Cyrtopodion scabrum (Gekkonidae: Squamata)
Mabuya aurata (Scincidae: Squamata)
Malpolon moilensis (Colubridae: Squamata)
Mesalina brevirostris (Lacertidae: Squamata)
Natrix tessellata (Colubridae: Squamata)
Scincus scincus (Scincidae: Squamata)
Spalerosophis diadema cliffordi (Colubridae: Squamata)
Stenodactylus affinis (Gekkonidae: Squamata)
Stenodactylus doriae (Gekkonidae: Squamata)
Trapelus ruderatus (Agamidae: Squamata)
Uromastix microlepis (Agamidae: Squamata)

Class Aves:

Alaemon alaudipes (Alaudidae: Passeriformes)
Ardea cinerea (Ardeidae: Pelecaniformes)
Ardea purpurea (Ardeidae: Pelecaniformes)
Bubo bubo (Strigidae: Strigiformes)
Cercotrichas galactotes (Muscicapidae: Passeriformes)
Cettia cetti (Cettidae: Passeriformes)
Charadrius alexandrinus (Charadriidae: Charadriiformes)

Charadrius dubius (Charadriidae: Charadriiformes)
Charadrius hiaticula (Charadriidae: Charadriiformes)
Chettusia leucura (Charadriidae: Charadriiformes)
Columba livia (Columidae: Columbiformes)
Columba palumbus (Columidae: Columbiformes)
Corvus frugilegus (Corvidae: Passeriformes)
Falco tinnunculus (Falconidae: Falconiformes)
Fulica atra (Rallidae: Gruiformes)
Galerida cristata (Alaudidae: Passeriformes)
Gallinago gallinago (Scolopacidae: Charadriiformes)
Gallinula chloropus chloropus (Rallidae: Gruiformes)
Gelochelidon nilotica (Sternidae: Charadriiformes)
Grus grus (Gruidae: Gruiformes)
Halcyon smyrnensis (Alcedinidae: Coraciiformes)
Hippolias pallida (Acrocephalidae: Passeriformes)
Hirundo rustica (Hirundinidae: Passeriformes)
Hoplopterus spinosus (Charadriidae: Charadriiformes)
Hypocolius ampelinus (Hypocoleidae: Passeriformes)
Ixyobruchus minutes (Ardeidae: Pelecaniformes)
Lanius collurio (Laniidae: Passeriformes)
Lanius nubicus (Laniidae: Passeriformes)
Larus genei (Laridae: Charadriiformes)
Larus ridibundus (Laridae: Charadriiformes)
Marmaronetta angustirostris (Anatidae: Anseriformes)
Merops superciliosus (Meropidae: Coraciiformes)
Motacilla alba (Motacillidae: Passeriformes)
Muscicapa striata (Muscicapidae: Passeriformes)
Oenanthe oenanthe (Muscicapidae: Passeriformes)
Oriolus oriolus (Oriolidae: Passeriformes)
Passer domesticus (ploceidae: Passeriformes)
Phalacrocorax carbo (Phalacrocoracidae: Suliformes)
Phoenicopterus ruber (Phoenicoptera: Phoenicoptera)
Pica pica (Corvidae: Passeriformes)
Prinia gracilis (Cisticolidae: Passeriformes)

Pterocles alchata (Pteroclididae: Pteroclidiformes)
Pterocles senegalensis (Pteroclididae: Pteroclidiformes)
Pycnonotus leucotis (Pycnonotidae: Passeriformes)
Sterna hirundo (Sternidae: Charadriiformes)
Sternula albifrons (Sternidae: Charadriiformes)
Streptopelia decaocto (Columbidae: Columbiformes)
Streptopelia turtur (Columbidae: Columbiformes)
Tadorna ferruginea (Anatidae: Anseriformes)
Turdoides altirostris (Leiothrichidae: Passeriformes)
Turdoides caudatus (Leiothrichidae: Passeriformes)
Upupa epops (Upupidae: Bucerotiformes)

Class Mammalia:

Allactaga euphratica (Dipodidae: Rodentia)
Canis aureus (Canidae: Carnivora)
Canis lupus (Canidae: Carnivora)
Hemiechinus auritus (Erinaceidae: Eulipotyphla)
Herpestes javanicus (Herpestidae: Carnivora)
Hyaena hyaena (Hyaenidae: Carnivora)
Hystrix indica (Hystricidae: Rodentia)
Lepus arabis (Leporidae: Lagomorpha)
Mellivora capensis (Mustelidae: Carnivora)
Mus musculus (Muridae: Rodentia)
Nesokia indica (Muridae: Rodentia)
Pipistrellus kuhlii (Vesertilionidae: Chiroptera)
Rattus rattus (Muridae: Rodentia)
Taphozous nudiventris magnus (Emballonuridae: Chiroptera)
Tatera indica (Muridae: Rodentia)
Vulpes vulpes (Canidae: Carnivora)

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