

## Waterbird Populations during Dry and Wet Years in the Hamoun Wetlands Complex, Iran/Afghanistan Border

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**Abstract:** The total extent of the Hamoun wetlands (Pouzak, Hirmand and Sabari) in succulent years (fully wet years) fluctuates from 200,000 to 570,000 ha, but in dry years it reduces to almost zero. The Hirmand River is the only important water resource of the Hamoun wetlands. The wintering population of waterbirds varies from 600,000 individuals to zero. The population of wintering waterbirds in a January waterbird count (Scott 1972) comprised 537,482 individuals (wet year), but in January 2007, it was zero because the wetlands were completely dried out. During wet years, 77 species of waterbirds have been recorded in Hamoun. Under succulent conditions in 1972, 1975, 1981, 1983 and 1994, 43 Iranian protected bird species (both terrestrial and aquatic) and three globally threatened species (*Pelecanus crispus*, *Oxyura leucocephala* and *Aythya nyroca*) were observed at the Hamoun wetlands (Mid-winter Waterbird Census, Scott 1972, 1975, DOE 1981–2004).

**Keywords:** Afghanistan, drought, dry and wet years, Hamoun, Iran, population, species diversity, waterbirds.

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### INTRODUCTION

A hamoun is a freshwater wetland. What is known as the Hamoun Wetland Complex (comprising Lakes Sabari, Hirmand and Puzak) is located in southeast Iran, on the Iran – Afghanistan border (Table 1, Fig. 1). Of the three lakes, Hamoun-e Hirmand lies entirely in Iran, Hamoun Sabari is divided almost equally between Iran and Afghanistan, but only about 22% of Hamoun-e Puzak belongs to Iran. The Hirmand River, after passing *c* 1000 km through Afghanistan, arrives in Iran, bifurcating into two branches, the first of which is Parian Moshtarak. It comprises the Iran – Afghanistan border from Kahak to Milak, but then re-enters Afghanistan as the inflow to Lake Hamoun-e Puzak. The second branch, the Sistan-Rud River, after some 70 km to Afzal-Abad, itself divides into two branches; one enters Lake Hamoun-e Hirmand and other, Lake Hamoun-e Sabari. The river floodwater also supplies the wells at Chah-Nimeh (usually for farming) for use in dry seasons. During wet years, when the Hamouns were full, 181 bird species (migratory and resident) were recorded from these

wetlands (Behrouzi-Rad 1984, Evans 1994, Scott 1995), about 24% of the Iranian avifauna. Furthermore, the Hamoun wetlands are reckoned to support about 23 mammal species (Ziaie 1996), six amphibian species, 37 reptile species (Latifi 1986, Anderson 1999) and 25 fish species, of which 15 are endemic and 10 introduced (Coad 1995, Fishery Office 1997). The Hamoun Wetlands are important economically, ecologically and socially; perhaps it is the only reason that the rural margins remain viable in this otherwise dry region. Hamoun has been a protected area since 1968 and was declared a Ramsar site in 1971 (Ramsar Bureau 1971). Furthermore, it has also been listed as an Important Bird Area in the Middle East since 1994 (Evans 1994).

The fluctuations of waterbird populations, and variations in species diversity and density serve as management tools for wetlands, because these changes depend largely on water flow rates. This paper therefore aims to describe these fluctuations in the Hamoun Wetlands Complex in relation to water levels seasonally and year-on-year.

## MATERIALS AND METHODS

During the study period of December 2006 to December 2007, our recording and analysis of the populations, species diversity, density and fluctuations in numbers of wintering waterbirds of the Hamoun Wetland Complex allow us to explain or at least describe the consequences that resulted from wetlands drying out and how these affect the variety of aquatic and wader species. This study comprises four steps: first, collecting the available data from different sources (*e.g.* libraries, essays, books, internet, local people and experts from the Zabol Office of the Department of the Environment and from the Natural Resources Office and Fisheries Organization); second, use of guidelines for recording the data published by various world institutions (*e.g.* Ramsar Convention on Wetlands, Wetlands International); third, conducting the field study surveys to record the waterbirds during four seasons in the Hamoun Wetlands Complex, from December 2006 to December 2007. (The birds were identified and located with binoculars (10×40) and telescopes (15×60). The Total Count method was used to count birds); fourth; using Excel and Biotoools Microsoft to analyse the field data; Simpson's, Shannon-Wiener, Margalef's indices were calculated to determine the diversity and richness of bird species (Waite 2000). Margalef's index  $R_1=(S-1)/Ln(N)$ , Shannon-Wiener Diversity index  $H'=-\sum_{i=1}^S P_i \times \log_2 P_i$ , Simpson's Diversity index  $D=1-\sum_{i=1}^S [(n_i-1) / N(N-1)]$ , Simpson's Dominance index  $\lambda=[\sum n_i(n_i-1) / N(N-1)]$  and Hill Evenness  $=N_A = \sum P_i^{1/A}$ . Where N= total number of individuals in the sample, S= total species in the samples,  $p_i$ = proportion of species *i* in sample,  $Ln$ =Natural Log= 2.718281828,  $N_A$  is the Diversity number,  $A$ =gives the order of the number ( $A=1,2,3,\dots$ ) and  $n_i$ = number of species *i*.

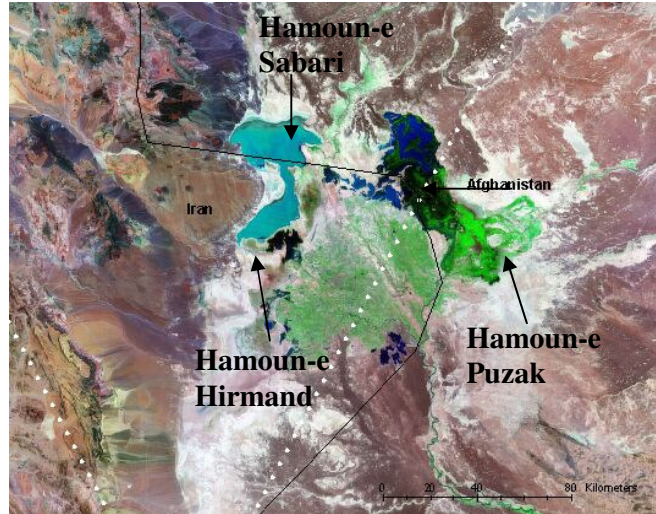


Figure 1. Hamoun Wetlands (when full of Water).

## RESULTS AND DISCUSSION

### Species diversity

In years of good rainfall (1972, 1975, 1981 and 1983) when the Hamoun Wetland Complex was full of water (Mahdavi 1997), there were 15 species of aquatic plants (dominance species being *Potamogeton*, *Seratophyllum* and *Phragmites* that occupied more than 20,000 ha) but when the wetlands dried out (2007), there were only six plant species of which only two were aquatic (*Phragmites* and *Typha*, on small patch less than one hectare), the remaining being desert-adopted species such as *Salsola*, *Tamarix gallica*, *Tamarix aphylla* and *Atriplex* (Table 2). This indicates a sharp ecological change in the plant communities from aquatic to desert species, transforming Hamoun ecosystem from wetland to desert.

During this study when I witnessed a complete drought (except for some flow from the Hirmand river in April 2007), only 49 bird species were present of which 23 were waterbirds (Behrouzi-Rad 2007). In wetter years, Scott (1972, 1995) and Behrouzi-Rad (1985) had reported 181 bird species, 77 of them waterbird and 104 terrestrial. Mansoori (1994) reached a total of 190 bird species during 1973–93 at the Hamoun Wetland Complex. In Table 3, I list 77 waterbird species when water-levels were at their highest, while in Table 4 during drought, this paper lists the waterbird species recorded in the present study. The comparison revealed a decline of 87% in

the number of waterbird species in the Hamoun Wetland Complex during a three-decade period. The decline is directly related to the amount of water in the Complex.

In early 1980s when the Hamoun Wetland Complex was full of water, 18 species were breeding there (Scott 1992, 1995, Behrouzi-Rad 1985). However there are no data available on the breeding activities of waterbirds in there during the 1990s. All waterbird species abandoned the Hamoun Wetland Complex as a breeding ground between 1999 to 2007 due to scarcity of water and overexploitation. Two species (*Himantopus himantopus* and *Vanellus leucurus*) were recorded breeding again in 2007 (Behrouzi-Rad 2007). Table 5 indicates the

breeding waterbirds of the Hamoun Wetland Complex in different decades; a decline of 89% of breeding species on these wetlands during the periods of water shortage and drought year was observed.

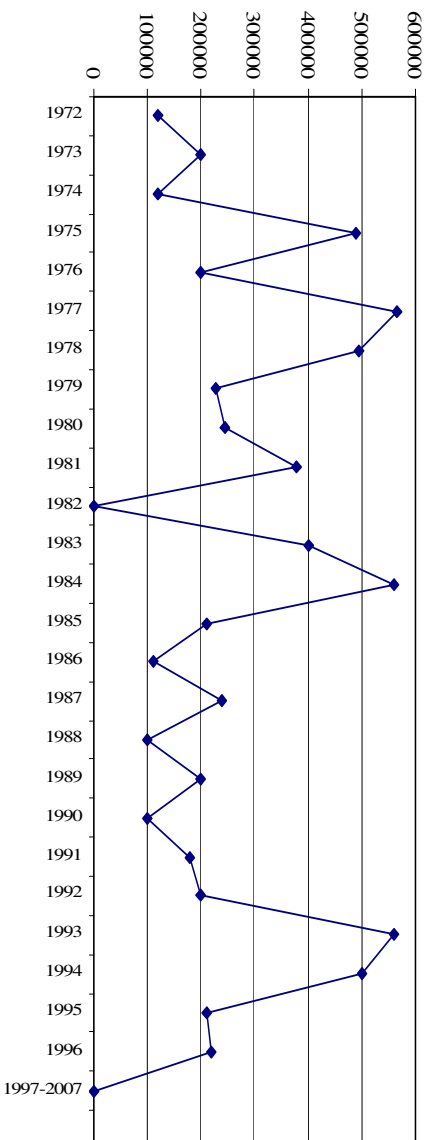
Out of 77 wintering waterbird species, only 18 were seen in 2007. In dry years, the data show an 87% decline. Only 43 of the 181 species listed overall were seen in 2007, representing a 75% decline. Figure 2 shows water level fluctuations and Table 6 and Fig. 3 show the population of wintering waterbirds in the Hamoun Wetlands from 1970 to 2007; Table 7 and Figs. 4–5 show the index of diversity and richness of waterbird species.

**Table 1.** Information about the study area

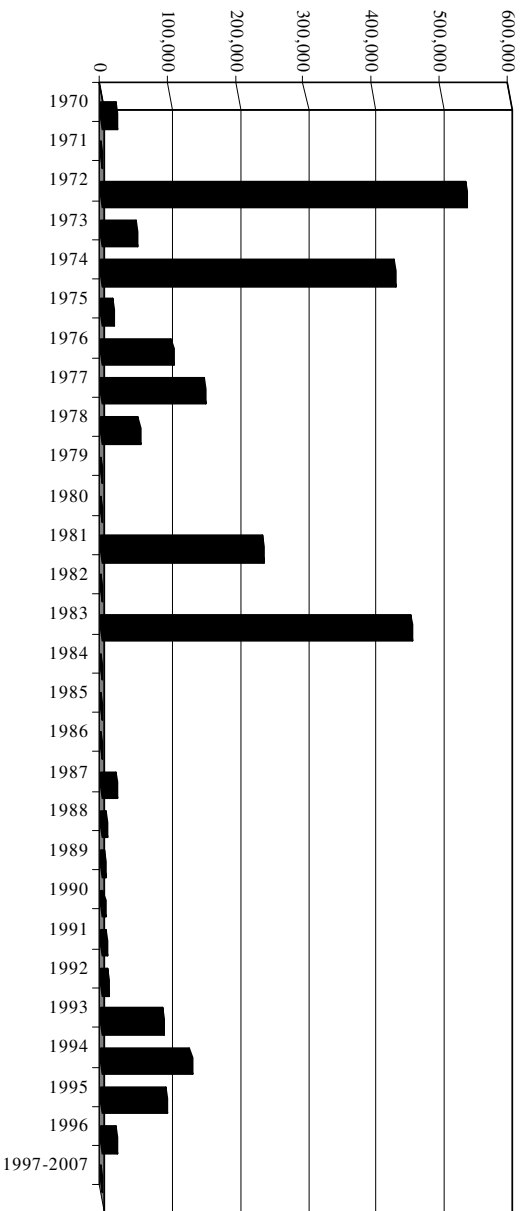
Name	Information
Hamoun Location	Hamoun-e Sabari, Hamoun-e Hirmand and Hamoun-e Puzak
Area	Situated 45 km f northeast of Zabol Hamoun-e Sabari (31° 20'N, 61° 20'E) Hamoun-e Hirmand (30° 50'N, 61° 15'E) and Hamoun-e Pozak( 31° 20'N, 61° 45'E)
Area of Watershed	200,000-570,000 ha. In wet years and zero in dry years. (Mahdavi 1997). Hamoun-e Puzak 35,000, Hamoun-e Sabari 101,300 ha and Hamoun-e Hirmand 65600 ha.
Altitude	370000 Km <sup>2</sup> ( Mahdavi 1997)
Management	470m
Conservation measurement	Environment Office of Zabol
International Importance	Hamoun-e Pozak and Hamoun-e Sabari are protected. Areas.
Owner	It is a Ramsar Site
Use	Government
Water Resource	Agriculture, Fishing, Hunting, Grazing and Handcraft from vegetation of the wetland.
Type of Wetland	Hirmand River, Khash , Frah, Khospas, Harout, Hosein Abad, Nehbandan, and Shour Rivers, (Mahdavi 1997)
Ecological Value	Inland, Palustrine, Semi-Permanent
Fauna	Important habitat for wintering waterfowl and some breeding waterbirds and habitat for <i>Shizothorax</i>
Ecological changes	Waterfowl, (wintering and breeding), mammals, reptiles, amphibians and 25 fish species (endemic and exotic)
	Introduction of exotic fish species; drainage, reduction of plant cover and population of waterbirds. It is on Montreux List.

**Table 2.** Difference between dominance plant species in Hamoun in the 1970s and 2007.

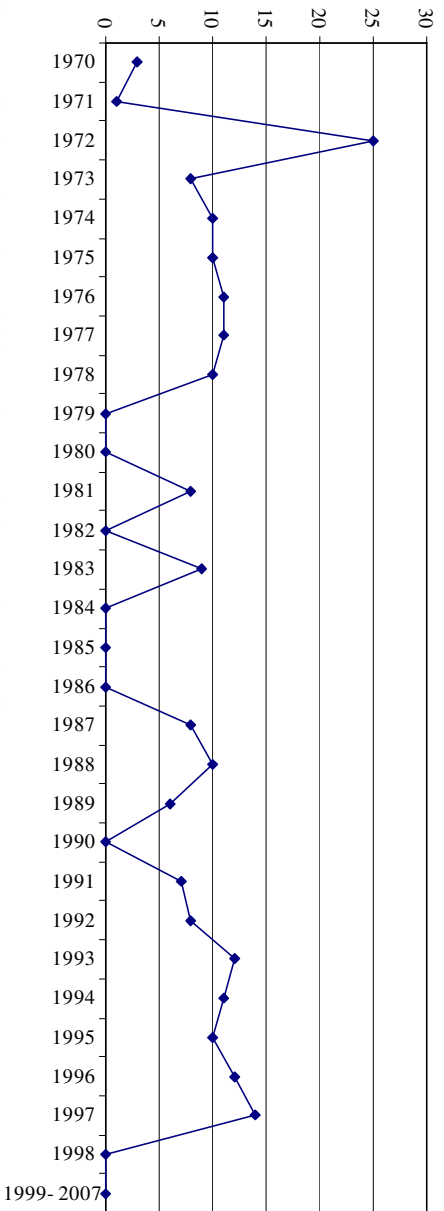
Plant species of Hamoun during 1970s (Wet)	Plant species of Hamoun during 2007 (Completely dried)
<i>Praematism australis</i> (14.000-6.000 ha)	<i>Phraamites australis</i> (2-3ha)
<i>Typha latifolia</i>	<i>Typha</i> very rare
<i>Potamogeton crispus</i>	<i>Tamarix aallica</i>
<i>Potamogeton pectinatus</i>	<i>Tamarix aphylla</i>
<i>Potamogeton lucens</i>	<i>Salsola</i> sp
<i>Potamogeton perfoliatus</i>	<i>Atriplex</i> sp
<i>Valisneria sllustris</i>	-
<i>Zannchelia palustris</i>	-
<i>Cyperus lonaus</i>	-
<i>Bulboschoenusmaritimus</i>	-
<i>Schoenoplectus lacustris</i>	-
<i>Schoenoplectus litoralis</i>	-
<i>Alisma plantaaq aquatica</i>	-
<i>Naias minor</i>	-
<i>Naias marina</i>	-



**Figure 2.** Water area fluctuation in the Hamouns 1972-2007.



**Figure 3.** Wintering population of waterbirds in the Hamouns 1970-2007.



**Figure 4.** Total number of waterbird species recorded annually on the Hamouns 1970-2007.

**Table 3.** No. of Species of Birds Reported from Hamoun Wetland Complex during wet years (1972, 1973, 1975, 1981, 1983, 1994). M.W = Migrant, Wintering, M.W.s.a = Migrant, winter, summer, autumn; M.S = Migrant, summer. (Mid-winter Waterbird Count (DOE 1970–2007)).

Species	Habitat	Hirmand	H. Sabari	H. Puzak
<i>Tachybaptus ruficollis</i> Little Grebe	Aquatic	M.W	M.W	M.W
<i>Podiceps cristatus</i> Great Crested Grebe	Aquatic	M.W	M.W	M.W
<i>Podiceps nigricollis</i> Black-necked Grebe	Aquatic	M.W	M.W	M.W
<i>Pelecanus onocrotalus</i> Great White Pelican	Aquatic	M.W	M.W	M.W
<i>Pelecanus crispus</i> Dalmatian Pelican	Aquatic	M.W	M.W	M.W
<i>Phalacrocorax pygmeus</i> Pygmy Cormorant	Aquatic	M.W	M.W	M.W
<i>Phalacrocorax carbo</i> Great Cormorant	Aquatic	M.W	M.W	M.W
<i>Egretta garzetta</i> Little Egret	Water side	M.W	M.W	M.W
<i>Casmerodius albus</i> Great Egret	Water side	M.W	M.W	M.W
<i>Ardea cinerea</i> Grey Heron	Water side	M.W	M.W	M.W
<i>Ardea purpurea</i> Purple Heron	Water side	M.W	M.W	M.W
<i>Ardea goliath</i> Goliath Heron	Water side (Scott 1972)		Vagrant	One report
<i>Nycticorax nycticorax</i> Black-crowned Night Heron	Water side	M.W	M.W	M.W
<i>Ixobrychus minutus</i> Little Bittern	Water side	M.W	M.W	M.W
<i>Botaurus stellaris</i> Great Bittern	Water side	M.W	M.W	M.W
<i>Ciconia nigra</i> Black Stork	Water side (Scott 1972)		Vagrant	One report
<i>Ciconia ciconia</i> White Stork	Water side		Vagrant	M.W
<i>Plegadis falcinellus</i> Glossy Ibis	Water side	M.W	M.W	M.W
<i>Platalea leucorodia</i> Eurasian Spoonbill	Water side	M.W	M.W	M.W
<i>Phoenicopterus (rubber) roseus</i> Greater Flamingo	Aquatic	M.W	M.W	M.W
<i>Oxyura leucocephala</i> White-headed Duck	Aquatic	M.W	M.W	M.W
<i>Cygnus olor</i> Mute Swan	Aquatic	M.W	M.W	M.W
<i>Cygnus cygnus</i> Whooper Swan	Aquatic (DoE Reports 1985)		Vagrant	One report
<i>Anser anser</i> Greylag Goose	Aquatic	M.W	M.W	M.W
<i>Tadorna ferruginea</i> Ruddy Shelduck	Aquatic	M.W	M.W	M.W
<i>Tadorna tadorna</i> Common Shelduck	Aquatic	M.W	M.W	M.W
<i>Nettapus coromandelianus</i> Pygmy Goose	Cotton Aquatic (Scott 1995)	1970-1971	Vagrant	One report
<i>Anas Penelope</i> Eurasian Wigeon	Aquatic	M.W	M.W	M.W
<i>Anas strepera</i> Gadwall	Aquatic	M.W	M.W	M.W
<i>Anas crecca</i> Eurasian Teal	Aquatic	M.W	M.W	M.W
<i>Anas platyrhynchos</i> Mallard	Aquatic	M.W	M.W	M.W
<i>Anas acuta</i> Northern Pintail	Aquatic	M.W	M.W	M.W
<i>Anas clypeata</i> Northern Shoveler	Aquatic	M.W	M.W	M.W
<i>Marmaronetta angustirostris</i> Marbled Duck	Aquatic	M.W	M.W	M.W
<i>Netta rufina</i> Red-crested Pochard	Aquatic	M.W	M.W	M.W
<i>Aythya farina</i> Common Pochard	Aquatic	M.W	M.W	M.W
<i>Aythya nyroca</i> Ferruginous Duck	Aquatic	M.W	M.W	M.W
<i>Aythya fuligula</i> Tufted Duck	Aquatic	M.W	M.W	M.W
<i>Bucephala clangula</i> Goldeneye	Aquatic		Vagrant	One report
<i>Mergellus albellus</i> Smew	Aquatic (Scott 1995)		M.W	Few report
<i>Mergus merganser</i> Goosander	Aquatic ( Scott 1995)		Vagrant	One report
<i>Grus grus</i> Common Crane	Water Side	M.W	M.W	M.W
<i>Rallus aquaticus</i> Water Rail	Aquatic	M.W	M.W	M.W
<i>Porzana pusilla</i> Baillon's Crane	Aquatic	M.W	M.W	M.W
<i>Porzana porzana</i> Spotted Crane	Aquatic	M.W	M.W	M.W
<i>Porphyrio porphyrio</i> Purple Swamphen	Aquatic	M.W	M.W	M.W
<i>Gallinula chloropus</i> Common Moorhen	Aquatic	M.W	M.W	M.W

Species	Habitat	Hirmand	H. Sabari	H. Puzak
<i>Fulica atra</i> Eurasian Coot	Aquatic	M.W	M.W	M.W
<i>Haematopus ostralegus</i> Eurasian Oystercatcher	Water Side	M.W.s.a	M.W.s.a	M.W.s.a
<i>Himantopus himantopus</i> Black-winged Stilt	Water Side	M.W	M.W	M.W
<i>Recurvirostra avosetta</i> Pied Avocet	Water Side	M.W	M.W	M.W
<i>Glareola pratincola</i> Collared Pratincole	Water Side	M.W.s	M.W.s	M.W.s
<i>Charadrius hiaticula</i> Ringed Plover	Water Side	M.W.s.a	M.W.s.a	M.W.s.a
<i>Charadrius dubius</i> Little Plover	Water Side	M.W.s.a	M.W.s.a	M.W.s.a
<i>Vanellus vanellus</i> Northern Lapwing	Water Side	M.W.s.a	M.W.s.a	M.W.s.a
<i>Vanellus indicus</i> Red-wattled Lapwing	Water Side	M.W.s.a	M.W.s.a	M.W.s.a
<i>Vanellus leucurus</i> White-tailed Lapwing	Water Side	M.W.s.a	M.W.s.a	M.W.s.a
<i>Limosa limosa</i> Black-tailed Godwit	Water Side	M.W.s.a	M.W.s.a	M.W.s.a
<i>Tringa totanus</i> Common Redshank	Water Side	M.W.s.a	M.W.s.a	M.W.s.a
<i>Tringa stagnatilis</i> Marsh Sandpiper	Water Side	M.W.s.a	M.W.s.a	M.W.s.a
<i>Tringa nebularia</i> Greenshank	Water Side	M.W.s.a	M.W.s.a	M.W.s.a
<i>Tringa ochropus</i> Green Sandpiper	Water Side	M.W.s.a	M.W.s.a	M.W.s.a
<i>Tringa glareola</i> Wood Sandpiper	Water Side	M.W.s.a	M.W.s.a	M.W.s.a
<i>Actitis hypoleucos</i> Common Sandpiper	Water Side	M.W.s.a	M.W.s.a	M.W.s.a
<i>Philomachus pugnax</i> Ruff	Water Side	M.W.s.a	M.W.s.a	M.W.s.a
<i>Larus ridibundus</i> Black-headed Gull	Aquatic	M.W.s.a	M.W.s.a	M.W.s.a
<i>Larus genei</i> Slender-billed Gull	Aquatic	M.W.s.a	M.W.s.a	M.W.s.a
<i>Larus cachinnans</i> Yellow-legged Gull	Aquatic	M.W.s.a	M.W.s.a	M.W.s.a
<i>Larus ichthyaetus</i> Great-headed Gull	Aquatic	M.W.s.a	M.W.s.a	M.W.s.a
<i>Larus minutus</i> Little Gull	Aquatic	M.W.s.a	M.W.s.a	M.W.s.a
<i>Sterna nilotica</i> Gull-billed Tern	Aquatic	M.W.s.a	M.W.s.a	M.W.s.a
<i>Sterna caspia</i> Caspian Tern	Aquatic	M.W.s.a	M.W.s.a	M.W.s.a
<i>Sterna hirundo</i> Common Tern	Aquatic	M.W.s.a	M.W.s.a	M.W.s.a
<i>Sterna albifrons</i> Little Tern	Aquatic	M.W.s.a	M.W.s.a	M.W.s.a
<i>Sterna repressa</i> White-cheeked Tern	Aquatic	M.W.s.a	M.W.s.a	M.W.s.a
<i>Chlidonias hybrida</i> Whiskered Tern	Aquatic	M.W.s.a	M.W.s.a	M.W.s.a

**Table 4.** Species and number of Birds observed in Hamoun 2004–2007 (Behrouzi-Rad, Jan 2004, 2005, 2006 and 2007).

Species	Date	H. Sabari	H. Hirmand	H. Puzak
<b>No wintering birds</b>	<b>2004–2006</b>	<b>Completely dry</b>	<b>Completely dry</b>	<b>Completely dry</b>
	<b>20 Dec 2007</b>	<b>Completely dry</b>	<b>Completely dry</b>	<b>Completely dry</b>
	<b>There were no birds</b>			
	<b>20 April 2007</b>	<b>(2 meter depth)</b>	<b>(30cm depth)</b>	<b>(2 meter depth)</b>
<i>Pelecanus onocrotalus</i> Great White Pelican		1		
<i>Himantopus himantopus</i> Black-winged Stilt	"	12	5	26
<i>Vanellus indicus</i> Red-wattled Lapwing	"	0	0	1
<i>Charadrius hiaticula</i> Common Ringed Plover	"	0	0	2
<i>Tringa stagnatilis</i> Marsh Sandpiper	"	0	0	3
<i>Actitis hypoleucos</i> Common Sandpiper	"	0	0	21
<i>Phalaropus lobatus</i> Red-necked Phalarope	"	0	0	197
<i>Larus ridibundus</i> Black-headed Gull	"			198
	<b>21 July 2007</b>	<b>1.5 meter Depth (existed for a short time)</b>	<b>Wet (Short time)</b>	<b>1 meter depth (existed for a short time)</b>
<i>Himantopus himantopus</i> Black-winged Stilt	"	0	0	43
<i>Vanellus leucurus</i> White-tailed Lapwing	"	0	0	13

Species	21 July 2007	H. Sabari	H. Hirmand	H. Puzak
<i>Calidris minutus</i> Little Stint	"	0	0	1
<i>Larus canus</i> Common Gull	"	0	0	25
<i>Sterna albifrons</i> Little Tern	"	0	0	1
	<b>13 Sep 2007</b>	<b>1 meter depth</b>	<b>Completely dry</b>	<b>80 cm depth</b>
<i>Pelecanus onocrotalus</i> Great White Pelican	"	1	0	0
<i>Charadrius dubius</i> Little Ringed Plover	"	8	0	0
<i>Tringa totanus</i> Common Redshank	"	4	0	2
<i>Tringa stagnatilis</i> Marsh Sandpiper	"	9	0	0
<i>Calidris minutus</i> Little Stint	"	0	0	8
<i>Larus canus</i> Common Gull	"	12	0	0
<i>Larus ichthyaetus</i> Pallas's Gull	"	12	0	0
<i>Larus ridibundus</i> Black-headed Gull	"	38	0	0
<i>Larus genei</i> Slender-billed Gull	"	15	0	0
<i>Larus cachinnans</i> Yellow-legged Gull	"	52	0	0
	<b>Dec 2007</b>	<b>25 cm– 1m (small part of wetland)</b>	<b>0"</b>	<b>20 cm</b>

**Table 5.** Population of breeding birds of Hamoun 1970s and 2007.

Species	1970s	2007	H. Puzak	Hamouns	References
<i>Podiceps cristatus</i>	Few Pr	-	Several Pr	H.Hir. H Sab.	Scott 1995
<i>Egretta garzetta</i>	50 Pr	-	-	H.Hir. H Sab.	Scott 1972
<i>Ardea cinerea</i>	40 Pr	-	-	H.Hir. H Sab.	Scott 1995,
<i>Ardea purpurea</i>	10 Pr	-	Several Pr	H.Hir. H Sab.	Scott 1995
<i>Nycticorax nycticorax</i>	20 Pr	-	-	H.Hir. H Sab.	Scott1995
<i>Botaurus stellaris</i>	20–30Pr	-	3 pr	H.Hir. H Sab.	Scott 1995,
<i>Platalea leucorodia</i>	120 Pr	-	-	H.Hir. H Sab.	Scott 1972
<i>Marmaronetta angustirostris</i>	Few Pr	-	-	H.Hir. H Sab.	Scott 1995
<i>Aythya nyroca</i>	5 Pr	-	-	H.Hir. H Sab.	Scott 1972
<i>Himantopus himantopus</i>	100 Pr	130Pr Puzak	H. -	H.Hir. H Sab.	Scott,1995, 2005 Behrouzi-Rad
<i>Glareola pratincola</i>	5–10 Pr	-	-	H.puz. Sab.	H Scott 1995
<i>Vanellus leucurus</i>	5–10 Pr	52 pr	H. Puzak	Several Pr H.puz. Sab.	H Scott1995, Behrouzi-Rad 2005
<i>Larus genei</i>	150–200 Pr	-	-	H.Hir. H Sab.	Scott1995
<i>Sterna nilotica</i>	5–10 Pr	-	-	H.Hir. H Sab	Scott1995
<i>Sterna caspia</i>	Several Pr	-	-	H.Hir. H Sab	Scott1995
<i>Sterna hirundo</i>	10 Pr	-	-	H.Hir. H Sab	Scott1995
<i>Sterna albifrons</i>	40–60 Pr	<b>2 species</b>	2 Pr	H.Hir. H Sab	Scott1995
<i>Chlidonias hybrida</i>	300–400 Pr	-	50 Pr	H.Hir. H Sab.	Scott1995
<b>Total</b>			<b>6 species</b>	<b>18 species</b>	

**Table 6.** Water levels and wintering population of Waterbirds of Hamouns 1970-2007 (Scott 1995, Behrouzi-Rad 1998-2007).

Year	H. Puzak	H. Sabari	H. Hirmand	TOTAL Hamouns
1970 Fairly dry	14,517	13,201	5,876	21,713
1971 Dry	165	3	0	167
1972 (High from March) Fairly dry	0	537,482	0	537,482
1973 Fairly dry	44,100	9	7,200	51,309
1974 Fairly High	28,520	68,385	334,239	431,144
1975 Fairly High	32,931	82,020	49,008	16,959
1976 High	6,942	89,687	7,521	104,150
1977 High	117,503	23,832	10,471	151,806
1978 Fairly dry	0	5,609	48,919	54,528
1979 Fairly dry	0	0	0	0
1980 High	0	0	0	0
1981 High	143,432	74,292	20,080	237,804
1982 High	0	0	0	0
1983 High	60,462	9,923	348,955	455,340
1984 Fairly High	0	0	0	0
1985 Fairly dry	0	0	0	0
1986 Fairly dry	0	0	0	0
1987 Fairly dry	8,851	12,181	0	21,032
1988 High	6,364	0	0	6,364
1989 Fairly dry	2,893	2,050	0	4,943
1990 High	0	0	3,550	3,550
1991 Fairly High	5,443	319	1,923	7,685
1992 High	3,104	814	5,109	9,027
1993 Fairly dry	29,307	37,735	23,049	90,091
1994 Fairly High	60,440	45,635	24,581	130,656
1995 Fairly High	31,024	34,356	30,026	95,406
1996 High	18,177	2,213	630	21,020
1997 Fairly dry	87,429	39,328	42,315	165,869
1998-2007 Dry	0	0	0	0

**Table 7.** Species diversity indices of waterbirds on Hamoun wetland complex 1970–2007.

Years	Margalef's Richness	Shannon-Wiener Diversity	Simpson's Diversity (1 - Dominance)	Simpson Dominance	Hill Evenness
1970	0.651	0.967	0.526	0.174	0.505
1971	0	0	0	0	0
1972	0.983	2.171	0.878	0.566	0.871
1973	0.454	1.451	0.643	0.357	0.698
1974	0.600	1.971	0.870	0.130	0.943
1975	0.600	1.89	0.823	0.177	0.821
1976	0.784	1.385	0.625	0.375	0.577
1977	0.594	1.039	0.603	0.397	0.433
1978	0.578	0.854	0.401	0.599	0.371
1979	0	0	0	0	0
1980	0	.0	0	0	0
1981	0.409	1.191	0.569	0.431	0.573
1982	0	0	0	0	0
1983	0.504	1.224	0.652	0.348	0.557
1984	0	0	0	0	0
1985	0	0	0	0	0
1986	0	0	0	0	0
1987	0.534	1.526	0.749	0.251	0.734
1988	0.712	1.774	0.794	0.206	0.770
1989	0.435	0.940	0.504	0.496	0.525
1990	0	0	0	0	0
1991	0.483	1.382	0.674	0.326	0.710
1992	0.603	0.753	0.338	0.662	0.362
1993	0.741	1.598	0.687	0.313	0.643
1994	0.693	1.805	0.756	0.244	0.726
1995	1.273	1.987	0.807	0.193	0.663
1996	1.696	2.368	0.857	0.143	0.736
1997	1.888	2.383	0.883	0.116	0.688
1998–2007	0	0	0	0	0

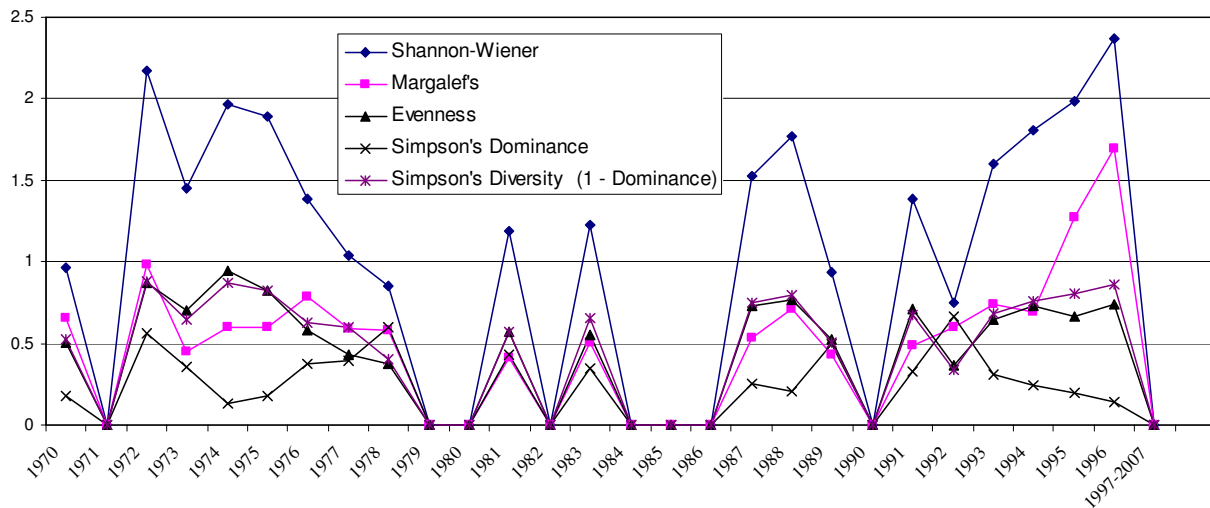


**Table 8.** Threatened species of birds reported from Hamoun 1970-2007 (R.M.E=Restricted to the Middle East, R.T= Regionally Threatened).

Species	Hamouns	Cites	IUCN	D.O.E Law
<i>Phalacrocorax pygmeus</i> Pygmy Cormorant	+	-	Lower Risk	-
<i>Pelecanus onocrotalus</i> Great White Pelican	+	I	-	Protected
<i>Pelecanus crispus</i> Dalmatian Pelican	+	I	Lower Risk	Protected
<i>Botaurus stellaris</i> Great Bittern	+	-	R.T	-
<i>Ciconia ciconia</i> White Stork	+	I	-	Protected
<i>Platalea leucorodia</i> Eurasian Spoonbill	+	II	-	-
<i>Phoenicopterus roseus</i>	+	II	-	Protected
<i>Cygnus olor</i> Mute Swan	+	-	-	Protected
<i>Aythya nyroca</i> Ferruginous Duck	+	-	VU	Protected
<i>Oxyura leucocephala</i> White-headed Duck	+	II	VU	Protected
<i>Marmaronetta angustirostris</i> Marbled Duck	+	II	VU	Protected
<i>Pandion haliaetus</i> Western Osprey	+	II	-	Protected
<i>Milvus migrans</i> Western Black Kite	+	II	-	Protected
<i>Haliaetus albicilla</i> White-tailed Eagle	+	I	-	Protected
<i>Gypaetus barbatus</i> Lammergeier	+	II	-	Protected
<i>Neophron percnopterus</i> Egyptian Vulture	+	II	-	Protected
<i>Gyps fulvus</i> Eurasian Griffon Vulture	+	II	-	Protected
<i>Aegypius monachus</i> Cinereous Vulture	+	II	-	Protected
<i>Circus aeruginosus</i> Western Marsh Harrier	+	II	-	Protected
<i>Circus cyaneus</i> Hen Harrier	+	II	-	Protected
<i>Circus macrourus</i> Pallid Harrier	+	II	-	Protected
<i>Buteo buteo</i> Common Buzzard	+	II	-	Protected
<i>Buteo rufinus</i> Long-legged Buzzard	+	II	-	Protected
<i>Buteo lagopus</i> Rough-legged Buzzard	+	II	-	Protected
<i>Aquila clanga</i> Greater Spotted Eagle	+	II	-	Protected
<i>Aquila rapax</i> Tawny Eagle	+	II	-	Protected
<i>Aquila heliaca</i> Eastern Imperial Eagle	+	II	-	Protected
<i>Aquila chrysaetos</i> Golden Eagle	+	II	-	Protected
<i>Hieraaetus fasciatus</i> Bonelli's Eagle	+	II	-	Protected
<i>Hieraaetus pennatus</i> Booted Eagle	+	II	-	Protected
<i>Falco tinnunculus</i> Common Kestrel	+	II	-	Protected
<i>Falco cherrug</i> Saker Falcon	+	I	-	Protected
<i>Falco peregrinus</i> Peregrine Falcon	+	I	-	Protected
<i>Falco pelegrinoides</i> Barbary Falcon	+	I	-	Protected
<i>Grus grus</i> Common Crane	+	-	-	Protected
<i>Chlamydotis undulata</i> Macqueen's Bustard	+	I	-	Protected
<i>Oenanthe alboniger</i> Hume's Wheatear	+	-	R.M.E.	-
<i>Oenanthe finschii</i> Finsch's Wheatear	+	-	R.M.E.	-
<i>Oenanthe picata</i> Variable Wheatear	+	-	R.M.E.	-
<i>Oenanthe xanthopyrna</i> Rufous-tailed Wheatear	+	-	R.M.E.	-
<i>Sylvia minula</i> Desert Whitethroat	+	-	R.M.E.	-
<i>Sylvia mystacea</i> Ménétries's Warbler	+	-	R.M.E.	-
<i>Passer moabiticus</i> Dead Sea Sparrow	+	-	R.M.E.	-
<b>Total</b>	<b>43</b>	<b>30</b>	<b>13</b>	<b>32</b>

**Table 9.** Number of Hunting Licenses issued to the hunter in different years around Hamouns during the 1992–99 period (DOE, Zabol).

Type of license	1992	1993	1994	1995	1996	1997	1998	1999	2000-2007
<b>Common license</b>	776	790	1100	697	1112	1815	2100	1140	0
<b>Special license</b>	30	88	822	1212	442	310	211	134	0



**Figure 5.** Species diversity indices of waterbirds on the Hamouns 1970–2007.

### Relationship between waterbirds and water levels in Hamouns

The relationship between waterbirds and water-levels in the Hamoun Wetland Complex is one of extremes – teeming life or apparent annihilation. Birds use some areas for nesting and breeding and others for shelter or feeding. Large assemblages of wintering waterbirds form in the Complex when water is abundant, usually in the following areas:

- A. The area ranging from around Lotfollah village to Kouh-e Khajeh and northern parts of Kouh-e Khajeh, to the northwest of Chah-Khorma wetland (Hamoun-e Hirmand to Hamoun-e Sabari).
- B. The central parts of the wetland, from Adimi and regions around the villages of Dake-Gaz, Posht Hmounak, Rig-Alisofi, Rig-Ozra, Tishekany, Otagh-kalan, Darddel, Miankong, Kong-Heidar, Besh-Delbar and Bring in the west (Hamoun-e Sabari).
- C. The northwestern area of the Hamoun Complex, namely Takht-e Edalat, starings from Gorgori village and approaching the reedbeds close to Takht-e Edalat (Hamoun-e Puzak).

The reed-bed mosaic interspersed with different depths of open water in these three different areas provides favourable habitats for the birds. Another factor influencing or forcing the bird assemblages to form high densities in parts of the Complex is the extent of floating plant coverage that constitutes much of the food of

waterbirds. Furthermore, the distribution of waterbirds across the Hamouns depends largely the presence of undisturbed secure food resources and safe refuges, which in turn are closely related to the water-levels that exist at the time in the Complex (Fig. 1).

There is also a close relationship between the associated species of these wetlands and their usage of various other water bodies. In wet years, fish-eating birds are present in numbers, but when the fish disappear in dry years, the fish-eating birds naturally disappear also. Diving fish-eating birds (*e.g. Phalacrocorax carbo*) need a water depth of at least one metre, a circumstance characteristic of the Hamouns at times when water levels are high for lengthy periods. The depth of water required by non-diving fish-eating bird species (such as Ardeidae) is less, but there is an inverse relationship between the numbers of birds and the amount of prey species in the shallows – large numbers of birds deplete the prey stocks. The overall bird populations (Figs. 4–5) depend on whether the Hamoun Complex is full of water, and for how long the water remains deep enough. The consequence for ducks, for example, is that both seasonal and year-on-year variations in water levels affect not only the wintering numbers but also the range of species present. The populations of diving and surface-feeding ducks decreased as water level drops, and to zero in dry years.

### Globally threatened species of birds in Hamoun

Table 8 shows the protected species of birds as advocated by the National Environmental Laws adopted by the Department of the Environment; Some of them are threatened species as designated by the IUCN (2004) report and as listed in appendices of CITES (2000) relating to their regular reported presence in the Hamoun Wetlands Complex. During the dry years at Hamoun (1999–2007) no globally threatened species of waterbirds was recorded at all. However, three protected species (*Pelecanus onocrotalus*: one on 20 April and one on 13 September 2007. *Circus macrourus*: one on 20 April 2007. *Falco tinnunculus* one on 20 April 2007) were present in Hamoun wetland against 43 species in wet years.

As the water diminishes long-term, the declines of waterbird species' population and diversity accelerate, and especially such threatened species as *Pelecanus crispus*, *Oxyura leucocephala* and *Aythya nyroca* (IUCN).

### CONCLUSION

The water level in the Hamoun Wetlands Complex is directly related to the overall water flow from the Hirmand River (Mahdavi 1997), although the seasonal rivers of Harout, Farah-Rud, Khoospas and Khash from Afghanistan and the rivers Hosein-Abad and Rud-e Shour from Iran do contribute water to these wetlands (Mahdavi 1997), but their contribution has only a marginal stabilizing effect on the wetland. Aquatic plant cover also depends on the levels of water in the wetlands (Table 2); when they are full, 15 plant species were recorded in the Hamoun, but these reduced to only six at low water-levels. The Hamoun is characterized by aquatic plants such as *Phragmites australis* and *Typha* that cover more than 20,000 ha of its area when it is full of water, but in dry years, reed does not grow in the wetlands (Behrouzi-Rad 1985, 2007).

Hamoun supports about 500,000–600,000 waterbirds in wet years (Behrouzi-Rad 1984, Scott 1995), 2–3 times above the Ramsar criteria (the Ramsar Convention on Wetlands states that any wetland protecting 20,000 waterbirds at any time of year should be registered as Ramsar site). However, in years

when the wetlands dry out, these numbers reduce to zero, as in 2007. Table 7 shows the relationship between the level of water and number of wintering waterbirds in the Hamoun Wetland Complex. Although other factors such as security and food availability affect bird populations, distribution and diversity, the fundamental factor here is water. Table 8 and Figs. 4–5 also highlights this relationship of water levels and species richness (Simpson and Shannon-Wiener indices). The wetland water-levels affect not only species' population and diversity but also the make-up of the species community that depends on the wetland.

In years of low water levels or overall desiccation, the number of fish-eating bird species reaches to its minimum. The typical fish-eating birds in the area are *Phalacrocorax carbo*, *Ardea cinerea*, *Egretta garzetta*, *Pelecanus onocrotalus* and *Sterna* sp. Figure 5 shows the population growth process of fish-eating birds in Hamoun wetland (Behrouzi-Rad 2004, Scott 1992, 1995).

The data collected indicate that more than 1500 families of wetland margin settlers depend on hunting birds to make a living. Table 9 shows the number of hunting licenses issued to professional hunters of the area. However, the wetland has been dry since 1999 and no license has been issued to hunters by the Department of the Environment Office of Zabol. The variations in water-levels over time are a measure of how the social activities of the local people relate to or change in step with the diversity and number of birds in the Hamoun Complex. The beds of the Hamouns often change, for the area is a centre for sand storms, and the fine siliceous particulates of the dust from the dry and light clay can cause respiratory and other illnesses among the local people (Fig. 6).

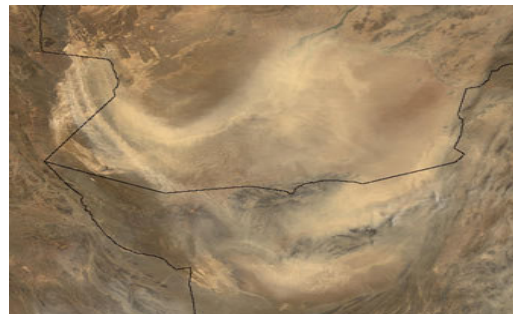


Figure 6. Storm over the Hamouns (internet 1990s).

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