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MAPPING HISTORIC AND CURRENT DISTRIBUTION OF MARBLED TEAL (*Marmaronetta angustirostris*) IN PAKISTAN

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ABSTRACT

There are deficiencies regarding status, distribution, seasonal movements and habitat use by birds, and this is particularly evident in case of wetland species. In order for developing action plans necessary to safeguard species threatened by human pressure, availability of data on distribution, breeding and population trends is imperative. Population of Marbled Teal has drastically reduced as a result of degradation, destruction and fragmentation of its habitat, worldwide. Marbled Teal population, therefore, qualifies vulnerable status in IUCN Red List. There is a dire need to develop a national conservation and management plan to protect Marbled Teal and its wetland habitat in Pakistan. In order for the conservation plans to be effective the spatial distribution of species in question needs to be accurately estimated. Only in this way the conservationists can assess the species distribution in response to climate change and anthropogenic alterations. The present study provides historic records and current distribution status of Marbled Teal in Pakistan. GIS mapping of distribution data gives added advantage and information necessary for planning conservation strategies for Marbled Teal. A careful scrutiny of the results revealed that Marbled Teal is a species of special concern as its habitat has undergone major devastations due to destruction and fragmentation. Comparisons made on the historic, fairly recent and recent distributions of Marbled Teal unfolded the fact that the species has a restricted geographical distribution which has become even more restricted in the recent times in Pakistan.

Key words: Marbled Teal, GIS, conservation, wetlands, historic and current distribution data.

INTRODUCTION

Marbled Teal (*Marmaronetta angustirostris)*. belongs to class Aves, order Anseriformes and family Anatidae. Five duck species are resident in Pakistan and Marbled Teal (*Marmaronetta angustirostris*) is one of those. It is vulnerable specie (Bird Life International, 2017) and lacks information on its population status, migration pattern and other requisite information which is necessary to formulate a national recovery plan for this species in order to protect its wetland habitat in Pakistan. Marbled Teal is considered as rare, vulnerable and biome-restricted species (BirdLife International, 2017).

Wetlands of Pakistan are found in close vicinity of Indus River basin and its adjacent flood plains. Pakistan has around six hundred and seventy species of birds, among which one third are water birds such as teals, swans and geese which flourish in these wetlands and lakes (Li and Mundkar, 2004). Biological resources of wetlands in Pakistan are at risk of habitat loss, fragmentation, contamination and climate change. It is, therefore, imperative to map distribution of threatened species in these wetlands in order to assess their distribution, by employing the breakthrough technique of GIS modelling. For the present study Marbled Teal (*Marmaronetta angustirostris*) was selected for mapping its historic and current distribution in Pakistan. Species occurrence data was collected from the field and other repositories of records can be extrapolated to the entire potential range of the species with the help of distribution maps. There are number of applications of these maps such as identification of previously unknown populations, determination of sites for reintroductions, guidance on additional surveys and selection and management of protected areas (Graham *et al.,* 2004). A comprehensive knowledge of the current distribution of a species is a precondition for rehabilitation of species in an ecosystem (Franklin, 2009; Barik and Adhikari, 2011).

MATERIALS AND METHODS

Species sighting data with longitude and latitude were gathered by field surveys carried out under wetland project expanded over three years duration, funded by WWF- Pakistan as well as from the literature. Collection of historic distribution records of Marbled Teal was achieved by extensive review of literature and collection of available data regarding the confirmed sightings of Marbled Teal in Pakistan. In order to map historic and current distribution of Marbled Teal, extensive literature

review was carried out (Marshall, 1903; Baker, 1908; Aitken, 1914; Waite, 1922; Wright and Dewar, 1925; Hickie, 1935; Christison, 1942; Ali, 1943; Waite, 1948; Savage, 1965; Koning and Walmsley, 1972; Koning and Konning-Raat, 1975; Ahmad, 1983;Ahmad, 1987;Scott, 1989; Roberts, 1991; Green, 1993a b; Khan, 1998; BirdLife International, 2001; Gabol *et al.,* 2005 and Chaudhry *et al.,* 2012). In addition to this, field survey reports of Pakistan Wetlands Programme were explored to collect the recent sighting data of Marbled Teal. The collected data was processed in MS Excel whereby the geographical coordinates along with the localities were added in the data. Moreover, the habitat information of Marbled Teal was synced for further processing. These geographic points helped in delimiting the areas of Marbled Teal presence in Pakistan.

Most of the sighting locations were in the geographical coordinates of Degrees Minutes Seconds (DMS) format which were converted into Degrees Decimals (DD) using MS Excel. Sighting data table was further modified to make it compatible for GIS analysis by adding the latitude and longitude of the localities mentioned in the table, as very few coordinates of the sighting records were available in the literature. Further, the data was categorized into historic, fairly recent and recent categories on the basis of their sighting years. All the sighting records up to year 1960 were given the 'historic' status while the sightings between the years 1961 to 1990 were given the 'fairly recent' and all the records after the year 1991 were classified as recent sightings (Table 2). The geocoded sighting point datasets were retrieved in the ArcGIS 9.3 as event theme for displaying Marbled Teal existence in order to map its distribution. Relevant attributed information of Marbled Teal was added in the attribute tables. The spatial data layers were created using ArcGIS 9.3 software.

RESULTS AND DISCUSSION

Roberts (1991) described the Marbeld Teal as breeding resident at some parts of Balochistan and Sindh Province which include Zangi Nawar Lake, Bund Khushdil Khan, Sonmiani and Drigh Lake while the areas adjacent to these localities like wetlands of DehAkro, Hammal Lake, Nara Canal, Chutiari Reservoir, Lungh Lake and other wetlands along the Indus River stretch in Sindh Province provide the wintering grounds of this species (Fig. 1). After going through an extensive literature a list having all the sightings of Marbled Teal in Pakistan was compiled (Table 1). Fig. 2, 3 and 4 show the spatial distribution according to historic, fairly recent and recent records of Marbled Teal in Pakistan.

Over the period of time, there has been a trend of shrinking of the preferred habitat for Marbled Teal. Historic sightings of Marbled Teal (Fig. 2) were recorded at Dost Ali, GhaibiDero, Hamal Lake, Larkana, Rohri, Sehwan, Karachi, MorPati, Khushdil Khan Lake, Qambar, Manchar Lake, Peshawar, Pithoro Eastern Narra, Siranda Lake, Kallar Kahar, Near Jhelum, Near Bahawalpur, Sheikhupura, Jajjah-Abbasian and Zangi Nawar Lake (Table 1). Marbled Teal was found in all four provinces prior to 1960. While between 1961 to 1990 its sightings (Fig. 3) were more restricted to Sindh, Southern Balochistan and Southern Punjab in localities like TandoMasti Khan, Khushdil Khan Lake, Khairpur, Ghauspur Lake, Kandhkot, Lang (Lungh) Lake, Sunari Lake, Siranda Lake, Seer Chandialakes, Mirpur Sakro, Taunsa barrage, Akri lake (Akridhand), Mangla reservoir, ZangiNawar Lake, Taunsa barrage, Akara dam, Hamal Lake, Pugri, Bridge lake and Chashma Barrage (Table 2).

Recently, Marbled Teal has been sighted at Bolahi, Drigh Lake, Hamal Lake, KharRoo Lake, Loonkhann, Morakho, Allahno Wari, Hab dam, Hamal Lake, Karud Wah, Mahboub Shah Lake, Seer Chandia lakes, Lulukdan, Rangala Wetland Complex, Bridge lake, Lung Lake, Saji Dam, and Dangewari Lake (Fig. 4). Declines in water bird population can therefore be attributed to loss of habitat and also this rate of decline was exacerbated due to uncontrolled hunting and disturbance experienced throughout Indus watershed. This duck is heavily exploited at the breeding places and its eggs are collected. This practice of egg collection and hunting has been a major threat at Lulukdan in Balochistan as well. Egg collection practices have been seen at Zangi Nawar lake and Siranda jheel too. Intensive hunting at Khushdil Khan lake has not been controlled by authorities. During winters extensive netting operation can be seen in different lakes in Sind. Marbled Teals are caught and then supplied in the market of various towns. There is huge subsistence on duck meat by the local residents.

Table 1. Records of Marbled Teal in Pakistan.

Sr No.	Site name	Year	No. of Marbled Teal	Source
		Historic (pre1960)		
1	Rohri district	January 1872	+	BMNH
2	Dost Ali near Sukkur	January 1872	+	BMNH
3	Ghaibi Dero, Larkhana	January 1872	+	BMNH
4	Hamal, Mehur	January 1872	+	BMNH

5	Larkana	January 1872	+	BMNH
6	Sehwan	January 1872	+	BMNH
7	Karachi	September 1877	+	BMNH
8	MorPati, a saltmarsh North of Ormara	June 1878	8	(Baker, 1908; 1921)
9	Khushdil Khan lake Pishin district	February 1903	2	(Marshall, 1903)
10	Qambar	December 1909	+	FMNH
11	Khushdil Khan lake Pishin district	August 1913	+	(Aitken, 1914)
12	Nowshera, Peshawar, on a small jheel near the Kabul river	October 1914	+	(Home 1915; Briggs and Osmaston 1928)
13	Khushdil Khan lake Pishin district	June–July 1914	12	(Meinertzhagen, 1920)
14	Larkana	1914–1917	+	(Ticehurst 1922–1924)
15	Manchar lake, Dadu district	1914–1917	+	(Ticehurst 1922–1924)
16	Pithoro, Eastern Narra	1914–1917	+	(Ticehurst 1922–1924)
17	Siranda lake and Sonmiani lagoon, Lasbela	June 1915	+	(Ludlow 1916, Baker 1921)
18	Siranda lake and Sonmiani lagoon, Lasbela	1916	+	BMNH
19	Karachi	August 1918	+	BMNH
20	Larkana	January 1918	+	BMNH
21	Manchar lake, Dadu district	March 1919	+	BMNH
22	KallarKahar	November 1918, 1921 and 1922	+	(Waite 1922; 1948)
23	Jhelum district	1918 and 1921	+	(Wright and Dewar, 1925)
24	Manchar lake, Dadu district	January 1921	+	BMNH
25	Bahawalpur region	1921–1925	+	(Wright and Dewar, 1925)
26	Sheikopura, near Lahore	March 1923	+	(Wright and Dewar, 1925)
27	KallarKahar	1925	+	(Waite 1922; 1948)
28	Jajjah-Abbasian, Bahawalpur	January 1939	2	(Ali, 1941)
29	ZangiNawar lake, chiefly a winter visitor	1940	+	(Christison, 1942)
30	Jajjah-Abbasian, Bahawalpur	1960s	+	(Green, 1993a)
	Fairly recent (1961-1990)			
31	TandoMasti Khan, near Khairpur	March 1965	+	(Holmes and Wright 1968)
32	Khairpur district	pre-1969, April 1980	+	(Roberts, 1991)
33	Ghauspurjheel	1973	50	(Green, 1993b)
34	Kandhkot	February 1973	50	(Koning and Walmsley, 1973)
35	Lang lake, Larkana district	February 1973	2	(Koning and Walmsley, 1973)
36	Sunari lake, Sanghar district	winter 1974	+	(Koning and Koning-Raat, 1975)
37	Sunari lake, Sanghar district	January 1975	20	(Scott, 1989)
38	Lang lake, Larkana district	midwinter 1977	40	(Green, 1993a)
39	Siranda lake and Sonmiani lagoon, Lasbela	March 1978	+	(Roberts, 1991)
40	Ghauspurjheel	November 1979	6	(Roberts, 1991)
41	GhauspurJheel	30 November 1979	6	(Roberts, 1991)
42	Khairpur	April 1980	+	(Roberts, 1991)
43	Seer Chandia lakes	April 1980	+	(Green, 1993b)
44	Mirpur SakroThatta District	11 October 1981	2	(Roberts, 1991)
45	Mirpur Sakro, Thatta district	October 1981	2	(Roberts, 1991)
46	Taunsa barrage	1981	20	(Scott, 1989)
47	Mangla reservoir	February 1982	60	(Green, 1993b)
48	Akri lake, Nawab Shah district	February 1982	12	(Ahmed, 1983)
49	ZangiNawar lake	February and May 1983	30	(Ahmed, 1983)
50	ZangiNawar lake	January 1984	300	(Roberts, 1991)
51	ZangiNawar lake	May 1984	+	(Roberts, 1991)
52	Taunsa barrage	September 1985	30	(Scott, 1989)
53	Taunsa barrage	January 1987	5	(Scott, 1989)
54	Akara dam	January 1987	50	(Scott, 1989)
55	Hamal, Katchri	January 1987	29	(Scott, 1989)

56	ZangiNawar lake	July 1987	130	(Scott, 1989)
57	Pugri	January 1988	41	(Scott, 1989)
58	Hamal, Katchri	1988	7	(Scott, 1989)
59	Pugri	midwinter 1988	10	(Green, 1993a)
	Bridge lake	11 February–12	+	(Kylänpää, 2000)
60		April, 1989–1998		
	TandoMasti Khan, near Khairpur	October 1989	20	(Oriental Bird Club Bull. 11
61				[1990]: 40–48)
62	Dera Ismail Khan district	January 1990	12	(Green, 1993a)
		Recent (1991-present)		
63	KharRoo lake	January 1991	20	(Green, 1993b)
64	Bolahi (untraced)	January 1991	32	(Green, 1993b)
65	Morakho (untraced)	January 1991	35	(Green, 1993b)
	Loonkhann, near Khipro	midwinter 1991	23	(Green, 1993b)
66				
67	Drigh Lake Wildlife Sanctuary	midwinter 1991	59	(Green, 1993b)
68	Hamal, Katchri	midwinter 1991	1,625	(Green, 1993b)
69	Seer Chandia lakes	January 1992	20	(Green, 1993b)
70	Allahno Wari (untraced)	January 1992	33	(Green, 1993b)
71	KarudWah (untraced)	January 1992	13	(Green, 1993b)
72	Loonkhann, near Khipro	midwinter 1992	13	(Green, 1993b)
73	Hamal, Katchri	midwinter 1992	1006	(Green, 1993b)
74	Loonkhann, near Khipro	Midwinter 1992	13	(Green, 1993b)
75	Mahboub Shah lake, Nawabshah district	May 1992	30	(Green, 1993b)
	Rangala, Muzaffargarh	May and July 1993	27	(BirdLife International,
76				2001)
77	Lulukdan	August 1993,	50	(Khan, 1998)
78	Hub Dam	October 1992	2	(Green, 1993b)
79	Khushdil Khan lake, Pishin	Undated	2	(Marshall, 1903)
80	Khushdil Khan lake, Pishin	Undated	+	(Hickie, 1935)
81	Khushdil Khan lake, Pishin	Undated	4	(Savage, 1968)
82	Khushdil Khan lake, Pishin	Undated	+	Ahmed, 1989)
83	Nal (The Nall)	Undated	+	(Baker, 1921)
84	Ghauspurjheel	Undated	6	(Roberts, 1991)
	southern Dera	Undated	+	(Hume and Marshall 1879–
85	Ghazi Khan district			1881)
	In the Bahawalpur region	Undated	+	(Hume and Marshall 1879–
86				1881)
87	Firoza, Bahawalpur	Undated	+	(McLeod, 1881)
88	Khushdil Khan Lake	Undated	+	(Meinertzhagen, 1920)
89	Drigh Lake, Sind	Mid-winter 1998	2	(Gabol*et al.,* 2005)
90	Drigh Lake, Sind	Mid-winter 1999	380	(Gabol*et al.,* 2005)
91	Drigh Lake, Sind	Mid-winter 2002	24	(Gabol*et al.,* 2005)
92	Lung Lake, Sindh	July-Aug, 2005	60	(Mughal, 2007)
93	Lung Lake, Sindh	31st January 2006	+	(Mughal, 2007)
94	Zero point, SahahdadKot	January 15th, 2010	11	(Chaudhry *et al.,* 2012)
95	Saji Dam in Balochistan	January 22nd, 2010	31	(Chaudhry *et al.,* 2012)
	Rangla Wetlands Complex	April 13-16, 2010	19	(Chaudhry *et al.,* 2012)
	(RWC) in district Muzaffargarh of Punjab			
96	province			
97	RWC	June 2-4, 2010	32	(Chaudhry *et al.,* 2012)
98	RWC	January 18th, 2011	2	(Chaudhry *et al.,* 2012)
99	RWC	January 15th, 2012	4	(Chaudhry *et al.,* 2012)
100	Dangewari Lake in district Khairpur	January 21st, 2012	2	(Chaudhry *et al.,* 2012)
101	Saji Dam in Balochistan	January 24th, 2012	12	(Chaudhry *et al.,* 2012)

KEY:
+ = Present, exact number not known
BMNH= Bombay Museum of Natural History

Table 2. Modified table of the sighting records of Marbled Teal for GIS Analysis.

Sr. No.	Latitude	Longitude	Province	Locality	Year	Status
1	27.68634	68.84279	Sind	Dost Ali	1872	H
2	27.59888	67.64756	Sind	GhaibiDero	1872	H
3	27.43659	67.62678	Sind	Hamal Lake	1872	H
4	27.69236	67.56430	Sind	Larkana,	1872	H
5	27.67928	68.89903	Sind	Rohri	1872	H
6	26.42354	67.86044	Sind	Sehwan	1872	H
7	24.89090	67.02697	Sind	Karachi	1877	H
8	25.23683	64.63248	Balochistan	MorPati	1878	H
9	30.67129	67.06495	Balochistan	Khushdil Khan Lake	1903	H
10	27.60419	68.00490	Sind	Qambar	1909	H
11	30.67129	67.06495	Balochistan	Khushdil Khan Lake	1913	H
12	30.67129	67.06495	Balochistan	Khushdil Khan Lake	1914	H
13	27.69236	67.56430	Sind	Larkana,	1914	H
14	26.44896	67.64238	Sind	Manchar Lake	1914	H
15	34.18311	71.49811	KPK	Peshawar	1914	H
16	25.51053	69.37569	Sind	PithoroEasternNarra	1914	H
17	25.54417	66.61108	Balochistan	Siranda Lake	1915	H
18	25.54417	66.61108	Balochistan	Siranda Lake	1915	H
19	25.54417	66.61108	Balochistan	Siranda Lake	1916	H
20	32.77548	72.70817	Punjab	KallarKahar	1918	H
21	24.89090	67.02697	Sind	Karachi	1918	H
22	27.69236	67.56430	Sind	Larkana,	1918	H
23	32.93469	73.74609	Punjab	Near Jhelum	1,918	H
24	26.44896	67.64238	Sind	Manchar Lake	1919	H
25	26.44896	67.64238	Sind	Manchar Lake	1921	H
26	29.46490	71.67955	Punjab	Near Bahawalpur	1921	H
27	32.77548	72.70817	Punjab	KallarKahar	1922	H
28	31.71328	73.98353	Punjab	Sheikopura	1923	H
29	32.77548	72.70817	Punjab	KallarKahar	1925	H
30	31.68084	74.10384	Punjab	Jajjah-Abbasian	1939	H
31	29.43319	65.75634	Balochistan	ZangiNawar Lake	1940	H
32	31.68084	74.10384	Punjab	Jajjah-Abbasian	1960	H
33	26.47846	68.87842	Sind	TandoMasti Khan	1965	F
34	30.67129	67.06495	Balochistan	Khushdil Khan Lake	1968	F
35	26.88202	69.09702	Sind	Khairpur	1969	F
36	28.13330	69.10000	Sind	Ghauspur Lake	1973	F
37	28.24006	69.18523	Sind	Kandhkot	1973	F
38	28.21869	69.15076	Sind	Kandhkot,	1973	F
39	27.49252	68.02415	Sind	Lang (Lungh) Lake	1973	F
40	26.13580	69.04331	Sind	Sunari Lake	1974	F
41	26.13580	69.04331	Sind	Sunari Lake	1975	F
42	27.49252	68.02415	Sind	Lang (Lungh) Lake	1977	F
43	25.42486	66.59462	Balochistan	Siranda Lake	1978	F
44	28.13330	69.10000	Sind	Ghauspur Lake	1979	F
45	26.88202	69.09702	Sind	Khairpur	1980	F
46	27.86205	67.58178	Sind	Seer Chandia lakes	1980	F
47	24.54570	67.95236	Sind	Mirpur Sakro	1981	F
48	24.52903	67.59601	Sind	Mirpur Sakro,	1981	F
49	30.53846	70.82724	Punjab	Taunsa barrage,	1981	F
50	26.36655	68.73655	Sind	Akri lake (Akridhand)	1982	F
51	33.16676	73.66670	AJK	Mangla reservoir	1982	F
52	33.16676	73.66670	Punjab	Mangla reservoir,	1982	F
53	29.43319	65.75634	Balochistan	ZangiNawar Lake	1983	F
54	29.43319	65.75634	Balochistan	ZangiNawar Lake	1984	F
55	29.43319	65.75634	Balochistan	ZangiNawar Lake	1984	F
56	30.53846	70.82724	Punjab	Taunsa barrage,	1985	F

57	25.38074	62.29330	Balochistan	Akara dam	1987	F
58	25.26660	62.28063	Balochistan	Akara dam	1987	F
59	27.44648	67.62485	Sind	Hamal Lake	1987	F
60	30.53846	70.82724	Punjab	Taunsa barrage,	1987	F
61	29.43319	65.75634	Balochistan	ZangiNawar Lake	1987	F
62	27.44648	67.62485	Sind	Hamal Lake	1988	F
63	27.30413	68.05365	Sind	Pugri	1988	F
64	27.30288	68.05561	Sind	Pugri	1988	F
65	31.77347	70.92473	KPK	Bridge lake	1989	F
66	26.47846	68.87842	Sind	TandoMasti Khan	1989	F
67	31.77347	70.92473	KPK	Chashma Barrage	1990	F
68	27.58172	67.88970	Sind	Drigh Lake WS	1991	R
69	27.44648	67.62485	Sind	Hamal Lake	1991	R
70	26.40088	68.78932	Sind	KharRoo Lake	1991	R
71	25.67531	69.56004	Sind	Loonkhann	1991	R
72	25.28025	67.13047	Sind	Hub dam	1992	R
73	27.44648	67.62485	Sind	Hamal Lake	1992	R
74	25.66670	69.53330	Sind	Loonkhann	1992	R
75	25.67531	69.56004	Sind	Loonkhann	1992	R
76	26.33152	68.71561	Sind	Mahboub Shah Lake	1992	R
77	27.86205	67.58178	Sind	Seer Chandia lakes	1992	R
78	28.54083	62.00389	Balochistan	Lulukdan	1993	R
79	30.22850	71.11130	Punjab	Rangala Wetland Complex	1993	R
80	31.77347	70.92473	KPK	Bridge lake	1998	R
81	27.58172	67.88970	Sind	Drigh Lake WS	1998	R
82	27.58172	67.88970	Sind	Drigh Lake WS	1999	R
83	27.58172	67.88970	Sind	Drigh Lake WS	2002	R
84	27.49252	68.02415	Sind	Lung Lake	2006	R
85	30.22850	71.11130	Punjab	Rangala Wetland Complex	2010	R
86	25.49193	61.98824	Balochistan	Saji Dam	2010	R
87	30.22850	71.11130	Punjab	Rangala Wetland Complex	2011	R
88	26.51110	68.88770	Sind	Dangewari Lake	2012	R
89	30.22850	71.11130	Punjab	Rangala Wetland Complex	2012	R
90	25.49193	61.98824	Balochistan	Saji Dam	2012	R

KEY:
H= Historic (pre1960)
F= Fairly recent (1961-1990)
R= Recent (1991-present)

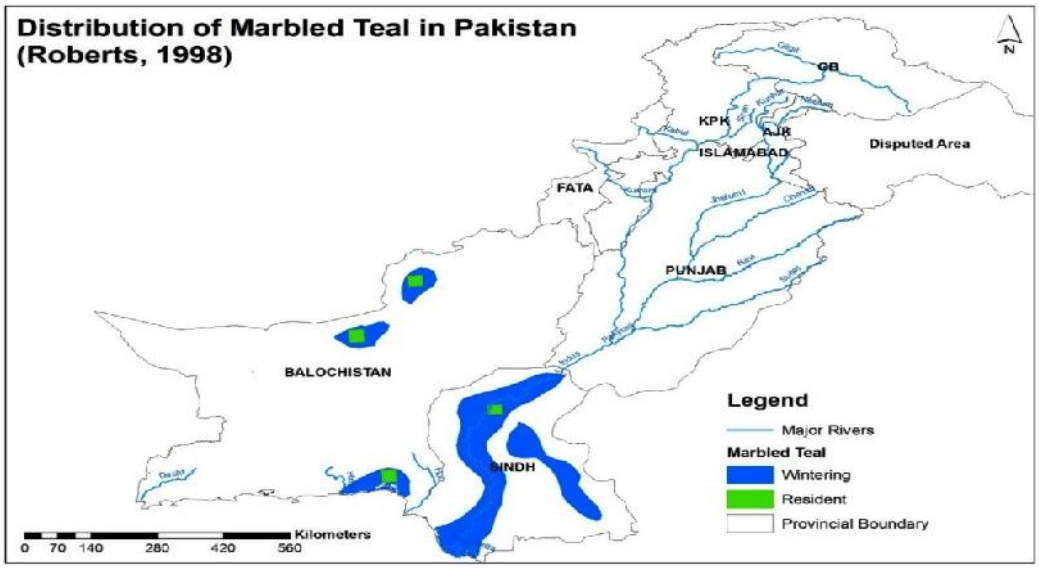

Figure 1. Distribution of Marbled Teal in Pakistan as described by Roberts (1991)

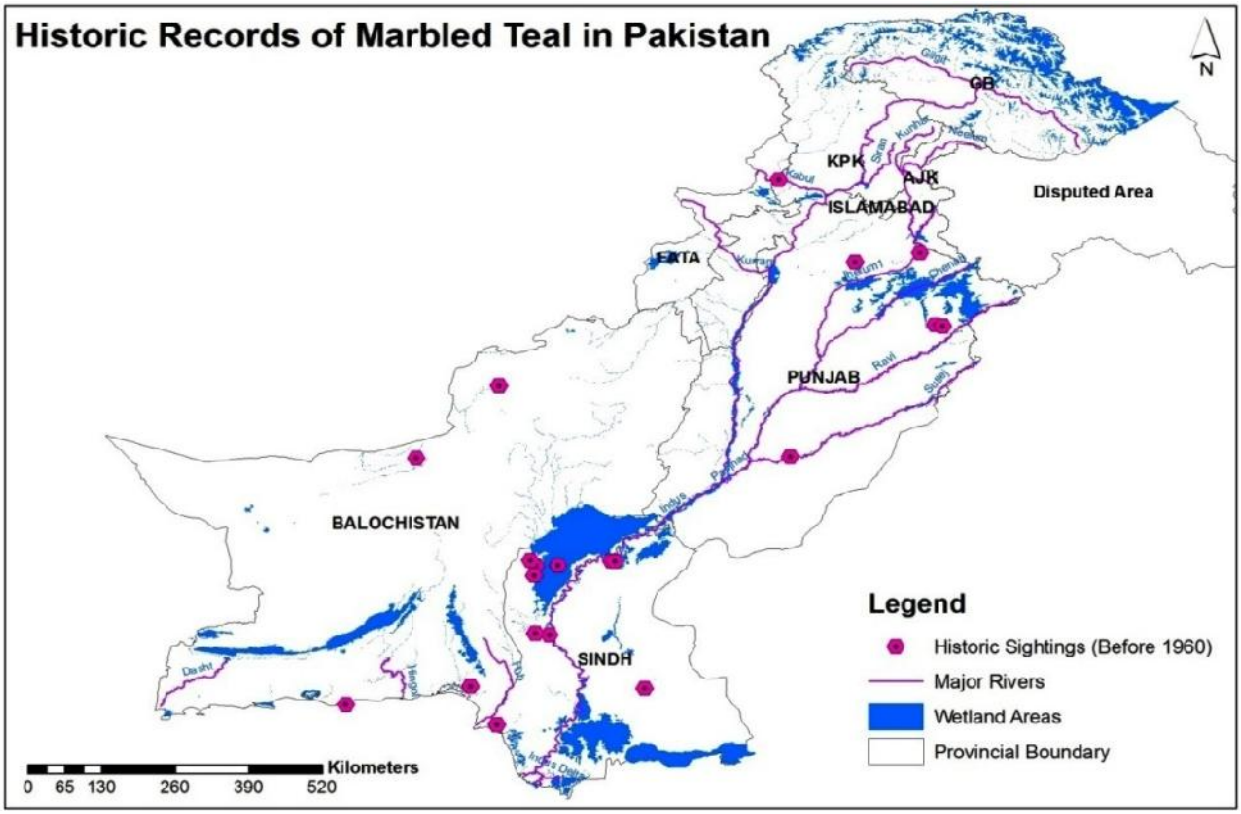

Figure 2. Map showing the distribution of Marbled Teal based on historic records (Before 1960)

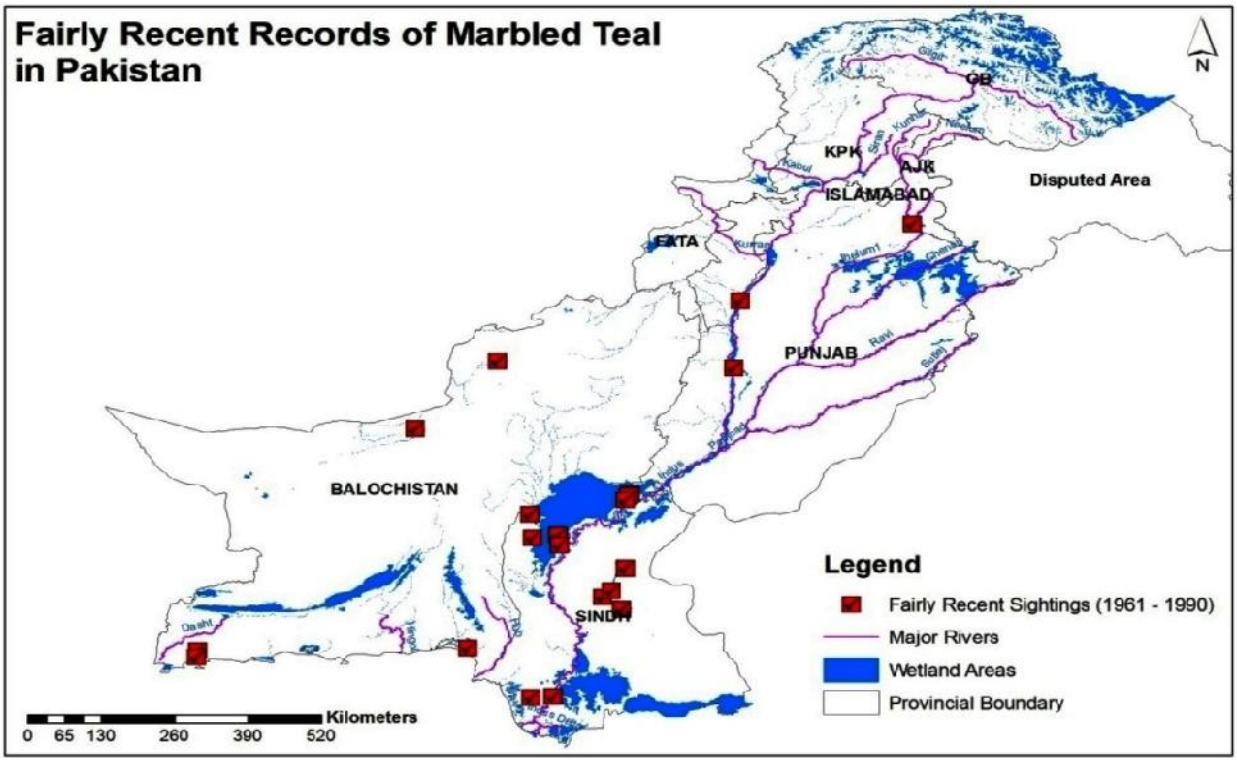

Figure 3. Map showing the distribution of Marbled Teal based on fairly recent records (1961 - 1990)

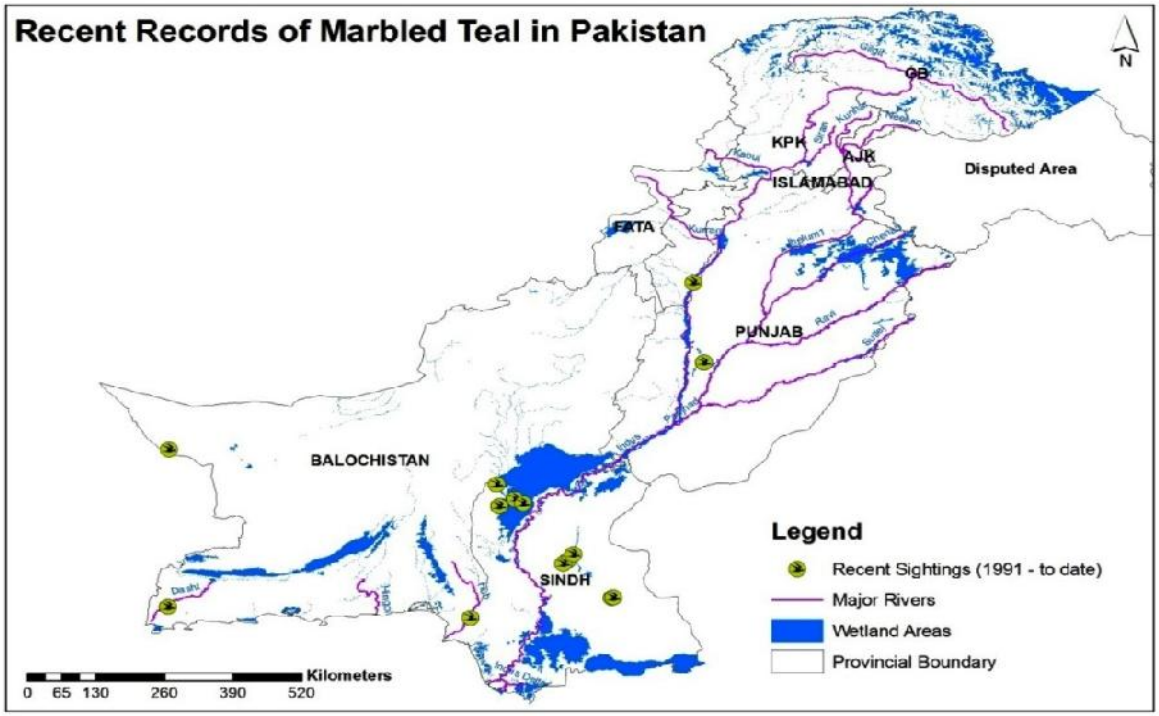

Figure 4. Map showing the distribution of Marbled Teal based on recent records (1991 – to date)

Conclusions: This pioneer study provides historic and current distribution data regarding Marbled Teal, a vulnerable duck species of Pakistan. According to the findings of this study, the duck has suffered a restricted distribution in the current times in comparison to its widespread historic distributions in the same locations. A careful scrutiny of the results revealed that its habitat has undergone major devastations due to destruction and fragmentation. The data is further processed to generate GIS maps which will help in formulating effective conservation plans for Marbled Teal and will better equip in managing its wetland habitat in Pakistan.

Recommendations/ Future Studies: There is lack of data regarding threatened birds. Surveys need to be carried out in order to fill the gaps in the knowledge. This will help identify the techniques required for protection. Bird counts and surveillance of the wintering sites of Marbled Teal are required to be carried out on regular basis. These ducks also change their habitats from one place to the other every season. Therefore, regular monitoring should be carried out in order to fully understand habitat requirements of these species.

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