



Full Length Article

Waterfowl Diversity at Chashma Barrage (Wildlife Sanctuary Mianwali) and Marala Headworks (Game Reserve Sialkot), Pakistan during 1996–2005

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ABSTRACT

Waterfowl population was surveyed at Chashma barrage, Wildlife Sanctuary, Mianwali and Marala headworks Game Reserve to know the waterfowl diversity from 1996 through 2005 during mid-winter (January) each year. During study period total 533,965 birds of 46 waterfowl species belonging to 26 genera from 11 families representing 6 orders were recorded from Chashma barrage. The most frequent visitor was *Fulica atra* (33.91%) followed by *Anas platyrhynchos* (9.53%), *Aythya ferina* (9.44%), *A. clypeata* (8.91%) *A. penelope* (7.90%), *A. acuta* (7.54%) and *A. crecca* (6.61%). During study total 77,078 birds of 44 waterfowl species belonging to 25 genera from 11 families representing 6 orders were estimated from Marala Headworks. The most abundant were *A. crecca* (25.79%), *A. platyrhynchos* (22.79%) *A. acuta* (11.99%), *Anser indicus* (6.15%), *Aythya ferina* (6.43%) and *A. penelope* (2.80%). A decreasing trend in waterfowl population at both the wetlands was observed. These results suggest that, as an important biotic component of the ecosystem, waterfowl population needs to be conserved by protecting its habitat.

Key Words: Waterfowls; Population dynamics; Habitat; Ecosystem; Pakistan

INTRODUCTION

Wetlands are a significant factor in the health and existence of other natural resources of the state, such as inland lakes, ground water, fisheries and wildlife. Besides this wetlands also function as (i) flood and storm control by the hydrologic absorption and storage capacity of wetlands (ii) wildlife habitat by providing breeding, nesting and feeding grounds and cover for many forms of wildlife, waterfowl, including migratory waterfowl and rare, threatened or endangered wildlife species (iii) protection of subsurface water resources and provision of valuable watersheds and recharging ground water supplies (iv) pollution treatment by serving as a biological and chemical oxidation basin (v) erosion control by serving as a sedimentation area and filtering basin, absorbing silt and organic matter and (vi) sources of nutrients in water food cycles and nursery grounds and sanctuaries for fish. These benefits often play a vital role in recreation, tourism and the economy of any country (Anonymous, 2007).

Pakistan possesses many of the world's climatic and vegetation zones within a relatively small area. After independence in 1947, extensive water management programs were undertaken to ensure regular supply of

water. In this regard three water storage reservoirs, sixteen barrages, twelve interlink canals, two siphons and forty three main channels were built to prosper the agro-based economy of the country (IUCN, 1989).

Amongst the study areas, Chashma barrage (Fig. 1) was declared a Wildlife Sanctuary on January 31, 1974 for a period of five years under the provisions of the Punjab Wildlife Act, 1974. Since then it continuously existed as a Wildlife Sanctuary till now. It is a wetland of international importance and is also a RAMSAR Site. The sanctuary is located 25 km southwest of Mianwali town on Mianwali – Kundian – Dera Ismail Khan Road and comprises of 0.327 Mha. It is located in the provinces of Punjab and North West Frontier Province. Major part of it lies in the Punjab province, Tehsil and District Mianwali and the remaining part of the sanctuary occurring in N.W.F.P. lies in Tehsil Lakki Marwat of Dera Ismail Khan District. Flora of the area comprise three types of biotic communities i.e., plantation of marginal bunds, bela forest and aquatic plants community. The aquatic vegetation consists of *Hydrilla verticillata*, *Nelumbium speciosum*, *Nymphaea lotus*, *Typha angustata*, *T. elephantina*, *Phragmites australis*, *Potamogeton crispus*, *Myriophyllum* spp. *Nymphoides cristatum*, *P. pectinatus*, *Saccharum spontaneum*,

Vallisneria spiralis and *Zannichellia palustris*. The natural vegetation of the region is a mixture of subtropical semi-evergreen scrub and tropical thorn forest. Species include *Olea ferruginea*, *Acacia modesta*, *A. nilotica*, *Adhatoda vasica*, *Dodonaea viscosa*, *Gymnosporia* sp., *Prosopis cineraria*, *Reptonia buxifolia*, *Salvadora oleoides*, *Tamarix aphylla*, *T. dioica*, *Ziziphus mauritania*, *Z. nummularia*, *Chrysopogon aucheri*, *Lasiurus hirsutus*, *Heteropogon contortus* and *Panicum antidotale*. *P. glandulosa* has been introduced in the area. Most of the natural thorn forest on the plains to the east of the Indus has been cleared for agricultural land and for irrigated plantations of *Dalbergia sissoo* and other species (Savage, 1968). The rich fish fauna includes *Gudusia chapra*, *Notopterus chitala*, *Catla catla*, *Cirrhinus mrigala*, *C. reba*, *Labeo rohita*, *L. microphthalmus*, *Puntius ticto*, *P. stigma*, *Barilius vagra*, *Wallago attu*, *Rita rita*, *Bagarius bagarius*, *Mystus aor*, *M. seenghala*, *Heteropneustes fossilis*, *Utropiichthys vacha*, *Nandus* sp., *Mastacembelus armatus*, *M. pancalus*, *Ambassis nama*, *A. ranga* and *Channa punctatus*. Other aquatic fauna includes *Hirudinaria* sp., *Palaemon* spp., *Rana tigrina*, *Kachuga smithi*, *Trionyx gangeticus* and *Lissemys punctata*. Mammals occurring in the area include *Sus scrofa cristatus*, *Axis porcinus*, *Canis aureus*, *Felis libyca* and *Lutra perspicillata* (Savage, 1968).

Marala headworks was declared a Game Reserve in 1987 for a period of five years under the provisions of the Punjab Wildlife Act, 1974 (Fig. 2). Since then it continuously existed as a Game Reserve till now. It is a wetland of international importance. It is located at 25 km in the north of Sialkot, near the Indian border in the Punjab province and comprises of 1620 ha. Three rivers coming from Jammu and Kashmir combine together in the area of Marala headworks. The names of these rivers are Tawi, Chenab and Munawar Wali Tawi. These rivers jointly fill water storage reservoir of Marala headworks. The water storage reservoir with associated marshes supports extensive reed beds and an abundant growth of submerged and floating aquatic vegetation. The aquatic vegetation consists of *Carex fedia*, *H. verticillata*, *Nelumbo nucifera*, *N. lotus*, *P. karka*, *P. crispus*, *P. pectinatus*, *T. angustata*, *V. spiralis* and *Z. palustris*. The natural vegetation of the adjacent plains is tropical thorn forest with species such as *A. nilotica*, *Capparis decidua*, *Prosopis cineraria*, *T. aphylla*, *Zizyphus mauritiana*, *Z. nummularia*, *Eleusine compressa*, *Erianthus* sp., *P. antidotale* and *Saccharum* spp. *Dalbergia sissoo* and *A. nilotica* have been extensively planted along the nearby roads and around fields. A very important wintering area for waterfowl, particularly Anatidae including *Platalea leucorodia*, *Anas crecca*, *A. platyrhynchos*, *A. acuta* along with small numbers of *Podiceps nigricollis*, *Phalacrocorax niger*, *Nycticorax nycticorax*, *Egretta garzetta*, *E. alba*, *Ardea cinerea*, *A. purpurea*, *Threskiornis melanocephalus*, *Tadorna ferruginea* and *Fulica atra*. *Ciconia ciconia*, *Platalea leucorodia* and *Tadorna ferruginea*, *Anser indicus*.

Fig. 1. Chashma Barrage Wildlife Sanctuary

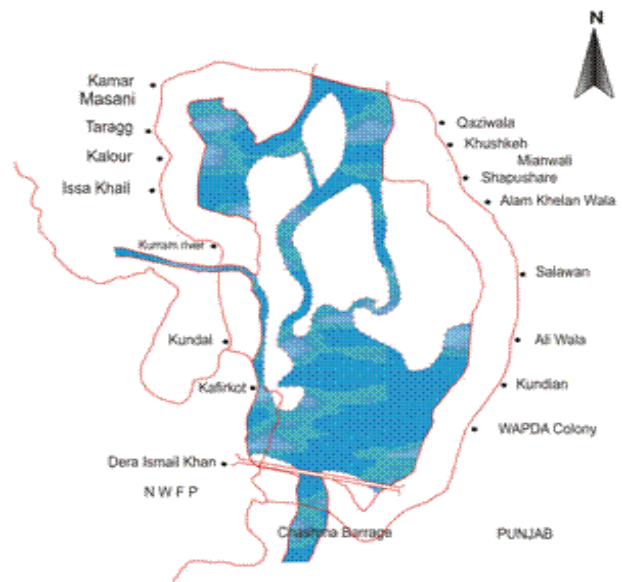
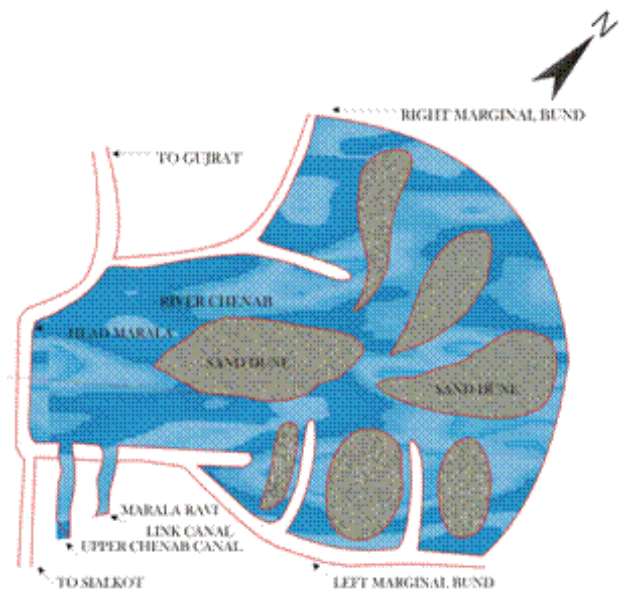


Fig. 2. Head Marala Game Reserve



Mammals known to occur in the area include *S. scrofa cristatus*, *C. aureus* and *F. libyca*. Hog Deer *A. porcinus*, *C. catla*, *C. marulius*, *C. mrigala*. *Cyprinus carpio*, *L. rohita*, *Salmo faria* and *Tilapia mossambica* (Savage, 1968).

The present survey was undertaken to know the effect of habitat loss on the waterfowl species visiting the Chashma barrage and Marala headworks from 1996 through 2005.

MATERIALS AND METHODS

Chashma barrage Wildlife Sanctuary and Marala headworks, Game Reserve were surveyed for waterfowl

population estimation during mid-winter (January) from 1996 through 2005. Visits were conducted on morning and evening. Survey was conducted on foot and by boat. Marginal bunds of the barrages were surveyed by walking on the bunds whereas pond areas were surveyed by using wooden boat. Binocular Standard EZ (10 x 50 mm) Minolta and Swift Telemaster Model 841, Zoom-scope (15 x -60 x 60 mm) were used to observe, spot and identify the bird species following Roberts (1991) and Ali and Ripley (1995 & 2001). Notes and onsite observations were also taken. Informal discussions and dialogues with the locals were also carried out to gather the information about the natural resources of the wetlands and their management. Correlation Coefficient (r) and Univariate Analysis of Variance (Steel *et al.*, 1996) were applied to know the population trends of waterfowls from 1996 through 2005 in both the habitats. Simpson's diversity index (Offwell Woodland & Wildlife Trust, 1989 & 2000/1/2/3/4/5 <http://www.go.to/offwel>) was used to measure the diversity between both the habitats i.e., Chashma barrage Wildlife Sanctuary and Marala headworks Game Reserve.

Simpson's diversity index (D) = $\sum n(n-1)/N(N-1)$

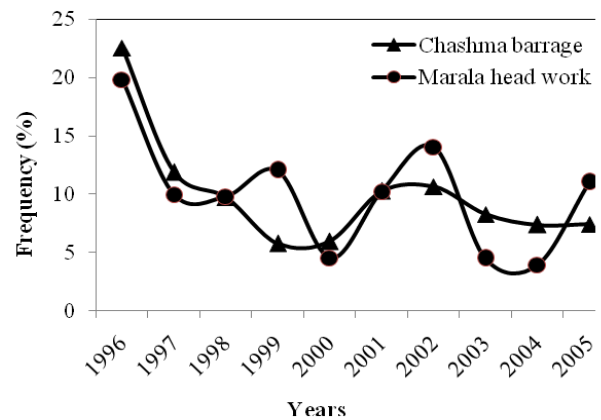
Where n = number of specimens of a species and N = the total number of all the species. The value of D ranges between 0-1. With the index, 0 represents infinite diversity and 1, no diversity i.e., bigger the value of D , the lower the diversity.

RESULTS

Chashma barrage Wildlife Sanctuary is a complex of aquatic and terrestrial habitats; therefore it accommodates a large variety of birds. During study period total 5, 33,965 birds of 46 waterfowl species belonging to 26 genera from 11 families representing 6 orders were recorded from Chashma barrage (Table I). Family Anatidae was recorded to be the most diversified during survey, which was represented by thirteen species comprising 59.29% of the total avian fauna of the study area whereas Rallidea by four species, with relative abundance of 34.08%. Ardeidae had seven waterfowl species with relative abundance of 1.73%. Laridae was represented by five (1.50%) species. Charadriidae and Scolopacidae were represented by four species (each). Podicipedidae were represented by three species. Phalacrocoridae and Recurvirostridae were represented by two species (each) whereas Threskiornithidae and Jacanidae had single species (Table I). The most frequent visitor was *F. atra* (33.91%) followed by *A. platyrhynchos* (9.53%), *A. ferina* (9.44%), *A. clypeata* (8.91%) *A. penelope* (7.90%), *A. acuta* (7.54%) and *A. crecca* (6.61%) (Table I).

Marala headworks Game Reserve is also a complex of aquatic and terrestrial habitat and also accommodates a large variety of birds. During study total 77,078 birds of 44 waterfowl species belonging to 25 genera from 11 families

Fig. 3. Dynamics of waterfowl population at Chashma barrage and Marala headwork during 1996 and 2005. The population counts were taken at mid-winter season



representing 6 orders were estimated from Marala headworks (Table I). Family Anatidae was recorded to be the most diversified during survey, which was represented by fifteen species and comprised 88.67% of the total avian fauna of the study area. Ardeidae was represented by seven species, but followed it, with relative abundance of 4.95%. Laridae was represented by three species. Rallidae, Charadriidae and Scolopacidae were represented by four species each. Phalacrocoridae and Recurvirostridae were represented by two species each whereas Podicipedidae, Ciconidae and Threskiornithidae had single species each. The most abundant were *A. crecca* (25.79%), *A. platyrhynchos* (22.79%), *A. acuta* (11.99%), *A. indicus* (6.15%), *A. ferina* (6.43%) and *A. penelope* (2.81%) (Table I). *F. atra* concentrate mainly on the larger lakes and barrages of the Indus basin therefore its population at Chasma barrage was higher than Marala headworks as the area of Chasma barrage is approximately 20 times larger than that of Marala headworks Game Reserve. The population of *A. crecca* at Marala headworks was higher due to the availability of water weeds like *Carex fedia*, *Scirpus maritimus* and rice fields in the habitat area, the seeds of which are used as food by *A. crecca*.

Diversity of waterfowl species was comparable at both the habitats i.e., Marala Game Reserve had the diversity value 0.150 (Number of species=44) and that the diversity value for Chasma barrage wildlife was 0.162 (Number of species =46). Fig. 3 shows declining trend in waterfowl population at Chashma barrage and Marala Game Reserve, respectively, during the study period. This year-wise declining trend in population of waterfowl was statistically non-significant and poorly negatively correlated at both the habitats i.e., Chashma barrage ($F=0.65$; d.f. =9,285; $p>.05$; $r=-0.60$) and Marala Game Reserve ($F=1.16$; d.f. =9,233; $p>.05$; $r=-0.55$).

DISCUSSION

Declining population at both the habitats in the present

Table I. Waterfowl species (showing number and percent) at Chashma barrage and Marala headworks during 1996 through 2005 (Mid-Winter Counts) (*Waterfowls not recorded)

Order	Family	Common Name	Scientific Name	Chasma barrage		Marala headworks	
				No.	%	No.	%
Podicipediformes	Podicipedidae	Little grebe	<i>Tachybaptus ruficollis</i> (Pallas, 1764)	1008	0.19	177	0.23
		Great crested grebe	<i>Podiceps cristatus</i> (Linnaeus, 1758)	150	0.03	*	*
		Black-necked grebe	<i>Podiceps nigricollis</i> (Brehm, 1831)	25	0.00	*	*
Pelecaniformes	Phalacrocoridae	Little cormorant	<i>Phalacrocorax niger</i> (Vieillot, 1817)	9248	1.73	864	1.12
		Great cormorant	<i>Phalacrocorax carbo</i> (Linnaeus, 1758)	2847	0.53	188	0.24
Ciconiiformes	Ardeidae	Cattle egret	<i>Bubulcus ibis</i> (Linnaeus, 1758)	2127	0.4	653	0.85
		Great egret	<i>Egretta alba</i> (Linnaeus, 1758)	723	0.14	217	0.28
Anseriformes	Anatidae	Intermediate egret	<i>Egretta intermedia</i> (Linnaeus, 1829)	1457	0.27	190	0.24
		Little egret	<i>Egretta garzetta</i> (Linnaeus, 1766)	3308	0.62	1485	1.93
		Purple heron	<i>Ardea purpurea</i> (Linnaeus, 1766)	291	0.05	31	0.04
		Grey heron	<i>Ardea cinerea</i> (Linnaeus, 1758)	839	0.16	225	0.29
		Indian pond heron	<i>Ardea grayii</i> (Sykes, 1832)	516	0.09	1018	1.32
		White stork	<i>Ciconia ciconia</i> (Linnaeus, 1758)	*	*	20	0.03
		Spoonbill	<i>Platalea leucorodia</i> (Temminck & Schlegel, 1849)	32	0.01	281	0.36
		Greylag goose	<i>Anser anser</i> (Swinhoe, 1871)	83	0.02	113	0.15
		Bar-headed goose	<i>Anser indicus</i> (Latham, 1790)	497	0.09	4741	6.15
		Ruddy shelduck	<i>Tadorna ferruginea</i> (Pallas, 1764)	81	0.02	6343	8.23
Gruiformes	Rallidae	Northern pintail	<i>Anas acuta</i> (Linnaeus, 1758)	40283	7.54	9	0.01
		Common shelduck	<i>Tadorna tadorna</i> (Linnaeus, 1758)	*	*	31	0.04
		Spot-billed duck	<i>Anas poecilorhyncha</i> (Forster, 1781)	*	*	9243	11.99
		Common teal	<i>Anas crecca</i> (Linnaeus, 1758)	35279	6.61	19881	25.79
		Mallard	<i>Anas platyrhynchos</i> (Linnaeus, 1758)	50892	9.53	17569	22.79
		Gadwal	<i>Anas strepera</i> (Linnaeus, 1758)	26407	4.95	1077	1.40
		Eurasian wigeon	<i>Anas penelope</i> (Linnaeus, 1758)	42418	7.94	2164	2.81
		Shoveler	<i>Anas chrypeata</i> (Linnaeus, 1758)	47577	8.91	2033	2.64
		Common pochard	<i>Aythya ferina</i>	50408	9.44	4959	6.43
		Ferruginous duck	<i>Aythya nyroca</i> (Gulden Stadt, 1769)	1482	0.28	151	0.20
		Tufted duck	<i>Aythya fuligula</i> (Linnaeus, 1758)	20031	3.75	16	0.02
		Redcrested pochard	<i>Netta rufina</i> (Pallas, 1773)	1138	0.21	20	0.03
		White breasted water hen	<i>Amaurornis phoenicurus</i> (Pennant, 1769)	191	0.04	74	0.10
		Moor hen	<i>Gallinula chloropus</i> (Linnaeus, 1758)	339	0.06	282	0.37
		Common coot	<i>Fulica atra</i> (Linnaeus, 1758)	181052	33.91	210	0.27
		Purple swamp hen	<i>Porphyrio porphyrio</i>	380	0.07	51	0.07
		Charadriiformes	Recurvirostridae	Black winged stilt	<i>Himantopus himantopus</i> (Linnaeus, 1758)	1564	0.29
Avocet	<i>Recurvirostra avosetta</i> (Linnaeus, 1758)			32	0.01	15	0.02
Charadriidae	Northern lapwing		<i>Vanellus vanellus</i> (Linnaeus, 1758)	80	0.02	17	0.02
	Red wattled lapwing		<i>Vanellus indicus</i> (Boddaert, 1783)	277	0.05	283	0.37
	White-tailed plover		<i>Vanellus leucurus</i> (Lichtenstein, 1823)	75	0.01	13	0.02
	Little ringed plover		<i>Charadrius dubius</i> (Scopoli, 1786)	1067	0.2	847	1.10
Jacanidae	Pheasant tail Jacana		<i>Hydrophasianus chirurgus</i> (Scopoli, 1786)	24	0.00	*	*
	Scolopacidae		Green shank	<i>Tringa nebularia</i> (Gunnerus, 1767)	209	0.04	172
Red shank			<i>Tringa tetanus</i> (Linnaeus, 1758)	522	0.10	215	0.03
Little stint			<i>Calidris minuta</i> (Leisler, 1812)	544	0.10	89	0.12
Common sand piper			<i>Actitis hypoleucos</i> (Linnaeus, 1758)	419	0.08	420	0.54
Indian river tern			<i>Sterna aurantia</i> (Gray, 1831)	630	0.12	450	0.58
Great black headed gull			<i>Larus ichthyaeus</i> (Pallas, 1773)	592	0.11	*	*
Laridae	Herring gull		<i>Larus argentatus</i> (Pontoppidan 1763)	240	0.04	5	0.01
	Black headed gull	<i>Larus ridibundus</i> (Linnaeus, 1766)	5301	0.99	95	0.12	
	Brown headed gull	<i>Larus brunnecephalus</i> (Jerdon, 1840)	1280	0.24	*	*	

study areas might be attributed to the threats like (i) illegal hunting of waterfowls mostly by wealthier people who live within the vicinity or high ranked officers who have sufficient influence to escape retribution (ii) land given on lease by the Punjab irrigation and Power Department to the farmers for cultivation of crops at both the study sites seriously degraded the natural habitat of wild birds (iii) livestock grazing was being practiced in the study areas, which continuously disturbed the wild birds who avoid their presence (iv) cutting of trees for fuel wood was also being practiced in both study areas. Removal of *Saccharum spontaneum* and *T. domingensis* on commercial scale was being done for roof-making, fence around the houses, Morra (chair), prayer-mats, floor-mats etc., which seriously

exploited the vegetation and changing the ecosystem (v) unexpected and unpredictable rise and fall in water level due to flood also adversely affected birds' population.

Similar findings for the declining trend in various waterfowls in many regions of the world were observed by Nudds and Cole (1991), Korschgen and Dahlgren (1992), Vaisanen and Solonen (1996), Lebedeva and Markitan (2001), Houdkova (2003), Horn *et al.* (2008), Phillips (2008) and Martarano and Yparraguirre (2008).

Akbar *et al.* (2006), while studying the waterfowl population of Patisar Lake at Bahawalpur from 1996 to 2005 recorded 32 species of waterfowl belonging to 19 genera from 10 families, whereas in the present study 46 waterfowl species belonging to 26 genera from 11 families

representing 6 orders were recorded. Maximum population of *Anas platyrhynchos* recorded by Akbar *et al.* (2006) was 24.09% followed by *A. strepera* (12.18%) and *A. acuta* (11.69%). Waterfowl survey is conducted annually by different agencies involved in research. Scott (1989) reported that over 114, 000 birds were present in January 1975 and more than 100,000 in January 1987 and 1988 at Chasm barrage. He reported that more than 66,000 waterfowl were present in January 1987 at Marala. Punjab Wildlife Research Institute, Gatwala, Faisalabad, is also conducting waterfowl survey annually. The data given in the present study explain that the waterfowl population has decreased too much due to illegal hunting, netting of waterfowl, livestock grazing, fishing and habitat degradation (Fig. 3). If we compare the total annual population estimates with the estimates of Scott (1989) for the year 1987 and 1988, it indicates that there is more than 50% and 88% decline in population of waterfowl at Chasma barrage and Marala headworks, respectively during the last 18 years, which calls for the immediate management planning of the areas.

In crux, this study provided the dynamics of waterfowl population over a decade, which indicated that decline in its population was due to threats such as illegal hunting, loss of plantations in and around the wetlands, drainage of wetlands, pollution of wetlands and unexpected fluctuations in water level due to flood. Thus strict measures should be taken to conserve the waterfowl population in their natural ecosystem.

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