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Short Communication

STUDY OF AVIAN DIVERSITY AT SELECTED SITES ALONG TARBELA DAM, INDUS RIVER, PAKISTAN

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ABSTRACT

Tarbela Dam is a wetland in Pakistan but most of the natural landscape has been deforested and modified due to deforestation. The present study was planned to know avian diversity of Tarbela Dam, Indus River, Pakistan, which was unexplored till now. This one year research was carried out in the vicinity of the Tarbela reservoir, Indus River, Pakistan, from March 2018 to February 2019. The data were collected early in the morning (4:00 am to 7:00 am) and before sunset (5:00 pm to 6:00 pm). Data were collected from eight sub sites i.e. Kalabat, Galla, Pehure, Sobra, Labadam, Kiara, Balongi and Kabbal. During the study period, the total avian population recorded was 2697 while species were 63. The Shannon-wiener diversity index was as Kalabat (3.666), Galla (3.762), Pehure (3.662), Sobra (3.765), Labadam (3.63), Kiara (3.783), Balongi (3.585) and Kabbal (3.703). The highest Evenness index (E= 0.7993) was noted from Sobra and the lowest Evenness index (E= 0.6182) was documented from Pehure. The highest Richness/Margalef (R=10.03) was recorded from Pehure and Kiara. It may be concluded that Tarbela Dam has high avian diversity to date and should be declared a Ramsar site.

Key words: Wetland, Richness, Margalef, Evenness, Tarbela Dam.
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INTRODUCTION

Anthropogenic impacts have caused major changes in the quality and functioning of numerous wetlands. These changes have resulted from alterations in the chemical, biological and physical components of wetland ecosystems. Extensive land clearing and development have led to increased erosion in uplands areas, leading to enhanced sedimentation in lowland wetlands. This enhanced accumulation of sediment can change the hydrological system and chemical features of the wetlands in a relatively short time. Other anthropogenic impacts may have long-lasting impacts on ecosystems of wetland i.e. municipal sewage, industrial wastes, agriculture waste, dam construction and stream canalization. These impacts contribute to changes in the system of water cycles and nutrient. Wetlands are among the most threatened ecosystem on earth (Altaf, 2016) and this landscape is used by birds and other wildlife for rest, food and shelter (Ali, 2005; Verones *et al.*, 2013). Pakistan has a lot of climatic zones (Roberts, 1997; Salma *et al.*, 2012), resulted in a variety of wetland systems (IUCN, 1989), and has 225 wetlands of which 19 are registered as Ramsar sites. Pakistan wetland area is 780,000 hectares (Altaf *et al.*, 2014).

Across the earth, 9159avian species are identified (Barrowclough *et al.*, 2016), while 2700 birds species have been observed from Asia by Cambridge (2001) and 668 species of bird have been documented from Pakistan by Mirza and Wasiq (2007). Avian diversity is hard to census in large geographical landscape whilst there is need to protect the world's threatened avian species (Kirby *et al.*, 2008). Anthropogenic impacts are increasing day by day, which are negatively impacts on the avian diversity (McKee *et al.*, 2004), need to monitor and management (Cody, 1981; Pidgeon *et al.*, 2001).

Bird species are under threats from habitat loss (Haider *et al.*, 2017), hunting and climate change. Anthropogenic impacts degrade the forest and habitats of avian species (Ali, 2005; Altaf, 2010). Pollution also resulted in reduced oxygen and increased sedimentation; therefore, a negative impact on bird species (McKinney *et al.*, 2010). Basic reason is that the environment of this avian species is almost lost due to transformation of forests into the agricultural land, while threats are also present e.g. over hunting, predation, dames, water extraction and pollution. The present research is planned to study the diversity of Tarbela Dam, Indus River, Pakistan, which has not yet been explored.

MATERIALS AND METHODS

This research was conducted from March 2018 to February 2019. The study was focus on following sites, Kalabat town, Kiara, Labadam, Pehur, Sobera, Balongi, Kabbal and Gala (Table 1 and Figure 1).

The Tarbela Dam is the largest rock filled dam built in the whole world and present on the Indus River (34º7′ 35″North, 72º48′ 37″ East) in Haripur District, Khyber Pakhtunkhwa, about fifty kilometers northwest of Islamabad. The climate in Tarbela Dam is hot in summer (from April to September) with average temperatures ranging from 38ºC to 46ºC. Winters are cold with average temperatures ranging from 3ºC to 14ºC.The annual average rainfall were recorded as 1026mm. The humidity is relatively high throughout the year (GOP, 2016).

The Indus is the largest flow through the Karakorum and Himalayan Mountains and passes from Tarbela Dam. In Monsoon, the flow of water is higher than other seasons. A total 130 genera of plants were documented from the study area. Asteraceae, Lamiaceae, Leguminosae and Euphoriaceae are the most dominant families in Tarbela Dam. A total of 29 mammalian species, 9 species of amphibians and 26 species of reptiles and 89 species of water bird including 68 migratory avian species are documented from Tarbela dam (WAPDA, 2016).

Methodology: Data of avian species were collected using "linear count survey method" and both "direct" (i.e. physical count and voices) as well as "indirect" (i.e. nests and meetings with local people in group or one to one) methods were used. Key books i.e. "Birds of Pakistan"(Mirza and Wasiq, 2007) and "Birds of the Indian subcontinent" (Grimmett, 1998) were utilized.

Statistical Analysis: The data were analyzed through PAST software (version 3) like "Shannon-wiener diversity index" (H'), "Simpson diversity index" (S), "Margalef/Richness" (R) and "Evenness" (E) (Hammert *et al.*, 2001).

Census index/density" was analyzed using the formula;

"Census index" = numbers of birds /area (500 hectare)

Table 1: Habitats and their coordinates at Indus River.

Sr.	Habitats	Coordinates	Elevation (ft)
1	Kalabat town	34º 02 ′13.29″ N 72º54 ′20.22″ E	1556
2	Labadam	34º06 ′25.11″ N 72º42 ′13.55″ E	1496
3	Kiara	34º07 ′07.00″ N 72º43 ′43.00″ E	1411
4	Pehure	34º04 ′14.32″ N 72º40 ′00.96″ E	1131
5	Galla	34º02 ′35.92″ N 72º39 ′01.31″ E	1085
6	Sobra	34º02 ′06.69″ N 72º 40 ′04.64″ E	1117
7	Balongi	34º10 ′09.00″ N 72º48 ′40.00″ E	1456
8	Kabbal	34º09 ′07.00″ N 72º48 ′43.00″ E	1480

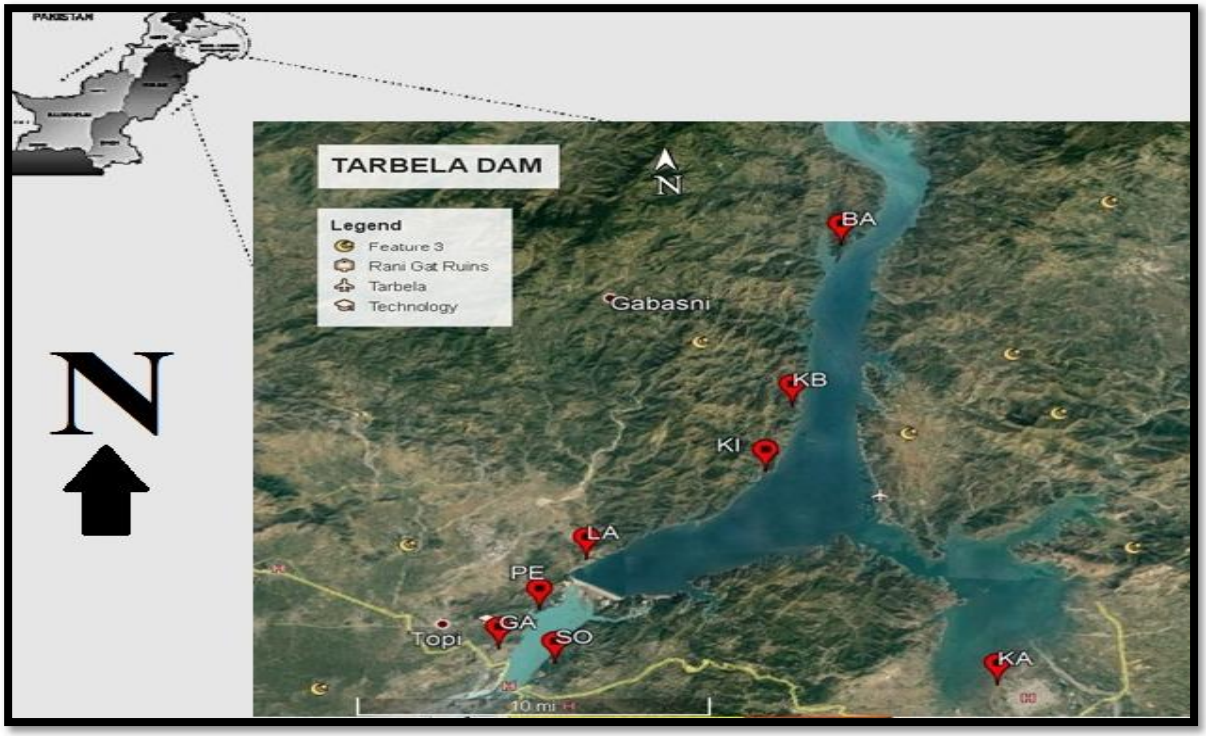

Figure 1: Map Showing Indus River and Study Sites.

RESULTS AND DISCUSSION

Data on ecology and population of waterbirds diversity at Tarbela dam were taken from March 2018 to February 2019. During the study period, a total number of 2697 individuals belonging to 63 avian species were encountered at the Tarbela Dam (Table 2).

A total of 433 birds with 59 species were recorded from Kalabat town, Tarbela Dam during the study period. Simpson Index, Shannon-wiener diversity index, Evenness, Margalef Index and Density of this area were 0.9634, 3.666, 0.6623, 9.554 and 2.416 respectively. During surveys, the highest population (n=515) with 62 species of waterbirds was recorded in Gala, Tarbela Dam. Diversity analysis showed that the Simpson Index was 0.969, Shannon-Wiener diversity index was 3.762, Evenness was 0.6941, Margalef Index was 9.769 and Density or Census Index of area was 3.086. It is noted that highest number of species was recorded from the Pehure, Tarbela Dam, 485 birds population were observed from this site. Simpson Index (0.9584), Shannon-Wiener diversity index (3.662), Evenness (0.6182), Margalef Index (10.03) and Density (2.632) were recorded and showed rich diversity in the area.

Total 273 birds population was recorded and 54 avian species were recorded from Sobera during the study period. Simpson diversity index, Shannon-wiener diversity index, Evenness, Margalef Index and Density were observed as 0.9721, 3.765, 0.7993, 9.448 and 1.792 respectively from study area. A total of 250 birds and 52 species were recorded from Labadam, Tarbela Dam. Simpson diversity index, Shannon-wiener diversity index, Evenness, Margalef Index and Density, were documented as 0.9665, 3.63, 0.7254, 9.237 and 1.42 respectively at Labadam. During survey, 218 birds and 55 species were noted from Kiara, Tarbela Dam. Simpson diversity index, Shannon-wiener diversity index, Evenness, Margalef Index and Density or Census Index were noted as 0.9706, 3.783, 0.7988, 10.03 and 0.976 respectively from study area. During the study period, a total of 234 birds representing 48 species were recorded from Balongi, Tarbela Dam. Simpson diversity index, Shannon-wiener diversity index, Evenness, Margalef Index and Density, were recorded as 0.9613, 3.585, 0.7512, 8.615 and 1.294 respectively at Balongi. During the study period, a total of 289 numbers of birds representing 53 species were recorded from Kabbal, Tarbela Dam. Simpson diversity index, Shannon-wiener diversity index, Evenness, Margalef Index and Density, were recorded as 0.9695, 3.703, 0.7657, 9.177 and 1.486 respectively at Kabbal (Table 3).

Total 32 avian species with 17 families and alongwith6 orders during the research to Ravi river (Iqbal *et al.*, 2011). Further, it is documented that 43 avian species from Rasool barrage, Punjab, Pakistan (Akbar *et al.*, 2010). And ornithologist also observed total 51 avian species along river Chenab (Altaf *et al.*, 2015; Altaf, 2016).

The IUCN (2015) demonstrated that avian diversity of Tarbela Dam has 1 species (i.e. common pochard) vulnerable, 3 species (i.e. ferruginous duck, Eurasian oyster catcher and greater thicknee/stone plover) as near threatened and 59 species as Least Concern.

Top abundant species were recorded name are written as; barn or common swallow (number was, 228), black or Eurasian coot (n=115), little cormorant (n=114), common pochard (n=110), cattle egret (n=103), mallard (n=96), gadwall (n=90) and common black-headed gull (n=90), (Table 2). During present survey, 33 species of waterfowl were observed as winter visitor in the study area. Similarly, 22 bird species were resident in the study area. Out of them, five were summer visitor, 2 species were year round visitors while one species was irregular in the study area (Table 2).

Table 2. Birds' diversity of the study area.

Sr. No.	Common name Scientific name Species Authority	Family Order	Status	OC	KT	GA	PE	SO	LA	KI	BA	KA	Total
1	Gadwall *Anas strepera* Linnaeus, 1758	Anatidae Anseriformes	LC	WV	10	8	20	8	18	4	10	12	90
2	Common Teal *Anas crecca* Linnaeus, 1758	Anatidae Anseriformes	LC	WV	10	16	10	4	8	4	2	8	62
3	Mallard *Anas platyrhynchos* Linnaeus, 1758	Anatidae Anseriformes	LC	WV	16	10	20	10	16	6	10	8	96
4	Northern Pintail *Anas acuta* Linnaeus, 1758	Anatidae Anseriformes	LC	WV	6	4	6	4	4	2	2	2	30
5	Shoveler *Anas clypeata* Linnaeus, 1758	Anatidae Anseriformes	LC	WV	8	10	8	4	4	4	0	0	38
6	Red Crested Pochard *Netta rufina* Pallas, 1773	Anatidae Anseriformes	LC	WV	4	1	5	0	4	2	0	2	18
7	Common Pochard	Anatidae	VU	WV	40	20	10	14	12	4	0	10	110

	Aythya ferina Linnaeus, 1758	Anseriformes											
8	Tufted Duck *Aythya fuligula* Linnaeus, 1758	Anatidae Anseriformes	LC	WV	0	4	1	0	2	0	0	1	8
9	Garganey *Anas querquedula* Linnaeus, 1758	Anatidae Anseriformes	LC	WV	10	14	10	8	10	10	10	4	76
10	Eurasian Wigeon *Mareca penelope* Linnaeus, 1758	Anatidae Anseriformes	LC	WV	10	16	12	8	6	4	8	10	74
11	Common Golden Eye *Bucephala clangula* Linnaeus, 1758	Anatidae Anseriformes	LC	WV	0	6	2	0	2	0	0	0	10
12	Purple Swamphen *Porphyrio porphyrio* Linnaeus, 1758	Rallidae Gruiformes	LC	R	0	2	2	1	0	2	2	2	11
13	Common Shelduck *Tadorna tadorna* Linnaeus, 1758	Anatidae Anseriformes	LC	WV	3	8	2	0	4	0	2	0	19
14	Ruddy Shelduck *Tadorna ferruginea* Pallas, 1764	Anatidae Anseriformes	LC	WV	10	6	4	6	4	2	4	2	38
15	Ferruginous Duck *Aythya nyroca* Güldenstädt, 1770	Anatidae Anseriformes	NT	WV	2	1	2	0	0	2	1	0	8
16	Smew Duck *Mergellus albellus* Linnaeus, 1758	Anatidae Anseriformes	LC	WV	4	2	2	1	2	0	0	0	11
17	Intermediate Egret *Mesophoyx intermedia* Wagler, 1827	Ardeidae Pelecaniformes	LC	Y	5	10	6	8	10	8	4	6	57
18	Little White Egret *Egretta garzetta* Linnaeus, 1766	Ardeidae Pelecaniformes	LC	I	10	16	10	6	9	2	8	8	69
19	Grey Heron *Ardea cinerea* Linnaeus, 1758	Ardeidae Pelecaniformes	LC	WV	1	1	2	2	0	2	0	1	9
20	Black Crowned Night Heron *Nycticorax nycticorax* Linnaeus, 1758	Ardeidae Pelecaniformes	LC	WV	1	2	2	1	1	2	2	1	12
21	Little Cormorant *Microcarbo niger* Vieillot, 1817	Phalacrocoracidae Suliformes	LC	R	10	10	50	10	8	6	10	10	114
22	Great Cormorant *Phalacrocorax carbo* Linnaeus, 1758	Phalacrocoracidae Suliformes	LC	R	2	2	10	6	2	2	4	2	30
23	Great Crested Grebe *Podiceps cristatus* Linnaeus, 1758	Podicipedidae Podicipediformes	LC	WV	2	6	10	2	10	2	2	2	36
24	Little Greb *Tachybaptus ruficollis* Linnaeus, 1758	Podicipedidae Podicipediformes	LC	R	6	8	6	4	0	2	4	4	34
25	Water Rail *Rallus aquaticus* Linnaeus, 1758	Rallidae Gruiformes	LC	R	1	1	2	2	1	2	2	4	15
26	Eurasian Bittern *Botaurus stellaris* Linnaeus, 1758	Ardeidae Pelecaniformes	LC	Y	1	2	2	3	0	1	1	2	12
27	Black or Eurasian Coot *Fulica atra* Linnaeus, 1758	Rallidae Gruiformes	LC	R	15	40	20	10	10	4	6	10	115
28	Greylag Goose	Anatidae	LC	WV	8	16	1	0	2	4	6	8	45

	Anser anser Linnaeus, 1758	Anseriformes											
29	Great White Fronted Goose *Anser albifrons* Scopoli, 1769	Anatidae Anseriformes	LC	WV	2	2	10	8	0	0	0	0	22
30	White or Pied Wagtail *Motacilla alba* Linnaeus, 1758	Motacillidae Passeriformes	LC	S	14	10	4	6	6	2	3	4	49
31	Black Winged Stilt *Himantopus himantopus* Linnaeus, 1758	Recurvirostridae Charadriiformes	LC	R	4	4	1	2	3	6	4	6	30
32	Common Crane *Grus grus* Linnaeus, 1758	Gruidae Gruiformes	LC	WV	8	6	6	2	0	2	6	8	38
33	Great White Pelican *Pelecanus onocrotalus* Linnaeus, 1758	Pelecanidae Pelecaniformes	LC	WV	0	4	2	0	0	0	0	0	6
34	Small Pied Kingfisher *Ceryle rudis* Linnaeus, 1758	Alcedinidae Coraciiformes	LC	R	4	5	3	4	2	2	4	3	27
35	Common kingfisher *Alcedo atthis* Linnaeus, 1758	Alcedinidae Coraciiformes	LC	R	1	2	4	4	2	4	4	3	24
36	Eurasian Oyster Catcher *Haematopus ostralegus* Linnaeus, 1758	Haematopodidae Charadriiformes	NT	WV	1	4	10	2	2	2	2	3	26
37	Grey Plover *Pluvialis squatarola* Linnaeus, 1758	Charadriidae Charadriiformes	LC	WV	3	2	4	6	2	2	0	4	23
38	Kentish or Snowy Plover *Charadrius alexandrinus* Linnaeus, 1758	Charadriidae Charadriiformes	LC	WV	6	2	4	2	2	4	2	3	25
39	Temminck's Stint *Calidris temminckii* Leisler, 1812	Scolopacidae Charadriiformes	LC	WV	8	4	4	2	1	2	4	5	30
40	Common Snipe *Gallinago gallinago* Linnaeus, 1758	Scolopacidae Charadriiformes	LC	WV	3	6	2	2	4	2	2	3	24
41	Marsh Sandpiper *Tringa stagnatilis* Bechstein, 1803	Scolopacidae Charadriiformes	LC	WV	6	6	5	4	2	4	2	2	31
42	Black Stroke *Ciconia nigra* Linnaeus, 1758	Ciconiidae Ciconiiformes	LC	WV	2	8	6	3	1	2	0	2	24
43	White Stroke *Ciconia ciconia* Linnaeus, 1758	Ciconiidae Ciconiiformes	LC	WV	2	6	10	0	0	4	0	10	32
44	Common Black-headed Gull *Larus ridibundus* Linnaeus, 1766	Laridae Charadriiformes	LC	R	30	8	10	6	10	10	6	10	90
45	Great Black-backed Gull *Larus marinus* Linnaeus, 1758	Laridae Charadriiformes	LC	R	6	6	3	0	10	2	2	10	39
46	Red-wattled Lapwing *Vanellus indicus* Boddaert, 1783	Charadriidae Charadriiformes	LC	WV	1	1	3	3	1	2	2	1	14
47	Yellow-wattled Lapwing *Vanellus malabaricus* Boddaert, 1783	Charadriidae Charadriiformes	LC	WV	4	6	3	2	2	2	2	2	23

48	Collard Sand Martin *Riparia riparia* Linnaeus, 1758	Hirundinidae Passeriformes	LC	R	14	20	10	4	6	10	6	12	82
49	Red-rumped Swallow *Cecropis daurica* Laxmann, 1769	Hirundinidae Passeriformes	LC	R	4	9	15	10	4	4	3	6	55
50	Black-bellied Tern *Sterna acuticauda* Gray, 1832	Laridae Charadriiformes	EN	R	40	40	60	20	14	4	30	20	228
51	Common Merganser *Mergus merganser* Linnaeus, 1758	Anatidae Anseriformes	LC	WV	1	20	2	2	4	2	2	0	33
52	Indian Pond Heron *Ardeola grayii* Sykes, 1832	Ardeidae Passeriformes	LC	R	4	14	4	8	0	4	2	2	38
53	Common Moorhen *Gallinula chloropus* Linnaeus, 1758	Rallidae Gruiformes	LC	R	2	9	2	2	1	0	4	2	22
54	Greater Thicknee *Esacus recurvirostris* Cuvier, 1829	Burhinidae Charadriiformes	NT	R	4	0	3	1	0	4	0	5	17
55	Water Cock *Gallicrex cinerea* Gmelin, 1789	Charadriidae Charadriiformes	LC	R	4	2	1	4	1	4	4	4	24
56	Great Egret *Ardea alba* Linnaeus, 1758	Ardeidae Pelecaniformes	LC	R	4	6	8	6	2	0	4	4	34
57	Pale Crag Martin *Ptyonoprogne obsoleta* Cabanis, 1850	Hirundinidae Passeriformes	LC	R	6	4	4	6	2	8	6	0	36
58	Lesser Sand Plover *Charadrius mongolus* Pallas, 1776	Charadriidae Charadriiformes	LC	R	8	6	4	6	2	4	0	4	34
59	Caspian Gull *Larus cachinnans* Pallas, 1811	Laridae Charadriiformes	LC	S	10	3	10	2	2	2	10	2	41
60	Lesser Black-headed Gull *Larus fuscus* Linnaeus, 1758	Laridae Charadriiformes	LC	S	10	2	4	2	2	6	4	0	30
61	Grey Wagtail *Motacilla cinerea* Tunstall, 1771	Motacillidae Passeriformes	LC	S	10	20	7	8	4	7	6	6	68
62	Common Tern *Sterna hirundo* Linnaeus, 1758	Laridae Charadriiformes	LC	S	2	6	5	4	5	2	0	4	28
63	Cattle Egrent *Bubulcus ibis* Linnaeus, 1759	Ardeidae Pelecaniformes	LC	R	10	20	15	8	2	20	8	20	103

Note: Least Count (LC), Vulnerable (VU), and Near Threatened (NT), Resident (R), Summer Visitor (S), Winter Visitors (WV), Isolated (I), Year round visitors (Y) and Occurrence (OC).

Table 3: Diversity indices of waterfowls of study area.

Diversity Indices	Kalabat	Galla	Pehure	Sobra	Labadam	Kiara	Balongi	Kabbal
Species	59	62	63	54	52	55	48	53
Individuals	433	515	485	273	250	218	234	289
Simpson (S)	0.9634	0.969	0.9584	0.9721	0.9665	0.9706	0.9613	0.9695
Shannon (H')	3.666	3.762	3.662	3.765	3.63	3.783	3.585	3.703
Evenness (E)	0.6623	0.6941	0.6182	0.7993	0.7254	0.7988	0.7512	0.7657
Margalef (R)	9.554	9.769	10.03	9.448	9.237	10.03	8.615	9.177
Density (D)	2.416	3.086	2.632	1.792	1.42	0.976	1.294	1.486

Conclusion: A lot of land is modified and deforested but still has rich diversity of birds and it should be declared as protected area.

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