

Man-made waterbodies in Kurdistan province, western Iran, as refugia for waterbirds

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Wetland ecosystems play a key role in biodiversity conservation. Though artificial waterbodies do not have the functionality of natural wetlands, they can constitute new habitats for bird species and act as their refugia. Over three years, we carried out avifaunal surveys at three major man-made waterbodies (Vahdat, Shahid Kazemi and Gavoshan dams) in Kurdistan province, western Iran, to provide their first checklist of bird species and to see if they can act as refugia for bird species during the drought conditions of the region. A total of 78 bird species were recorded during these surveys. Two species are listed in Appendix I and eight species in Appendix II of the Convention on International Trade in Endangered Species (CITES). Seventy-four species (93.7%) are listed as Least Concern, two Vulnerable and two Near Threatened in the IUCN Red List of Threatened Species. This study suggests that these man-made structures can act as alternatives to natural wetlands and can provide suitable habitats for many bird species. Effective protection in these areas requires the prevention of human disturbance including illegal hunting, overfishing and human disturbance.

INTRODUCTION

Though man-made structures are often associated with habitat destruction, creation of new ones can be advantageous for some bird species (Bird *et al* 1996, Terman 1997, Murgui 2009). Due to the degradation or loss of natural habitats, artificial waterbodies including rice fields, gravel pits, reservoirs, marshes, small ponds or large dams become alternative habitats for some terrestrial and waterbird species (Fasola & Ruiz 1996, Tourenq *et al* 2001, Ma *et al* 2004, Santoul *et al* 2004). Therefore, from the viewpoint of conservation biology, these artificial habitats may gain significant importance for various globally-threatened bird populations (Geslin *et al* 2002, Nijman *et al* 2008, Colding & Folke 2009). It has already been shown that man-made artificial waterbodies may act as refugia and can play a key ecological role for the persistence of biodiversity in areas subject to natural or human disturbance (Hermoso *et al* 2013).

Kurdistan province is located in western Iran and has recently been subject to ornithological survey (eg Zarei *et al* 2017, Zarei *et al* 2018), however, field ornithology still has a lot to accomplish in this province (Khaleghizadeh 2007a, Roselaar & Aliabadian 2007). Its great habitat diversity and numerous aquatic habitats, both natural (eg Zarivar wetland) and man-made (eg Gheslugh dam and Golbolagh dam), seem to provide critical feeding, staging and wintering grounds for many migratory birds such as waders and ducks in the African–Eurasian flyway.

This paper summarizes avifaunal information collected during three years of field observations at the three largest dams (Shahid Kazemi, Vahdat, Gavoshan) across Kurdistan province to provide the first checklist of avifauna of these dams and to highlight the potential effect of artificial waterbodies on wild birds as alternative habitats to natural wetlands.

MATERIALS AND METHODS

Study area

Kurdistan province (total area 28 203 km²) is located on the western edge of the Iranian plateau between 34° 44'–36° 30' N and 45° 31'–48° 16' E, sharing its northern border with West Azerbaijan province, the southern border with Kermanshah province, the

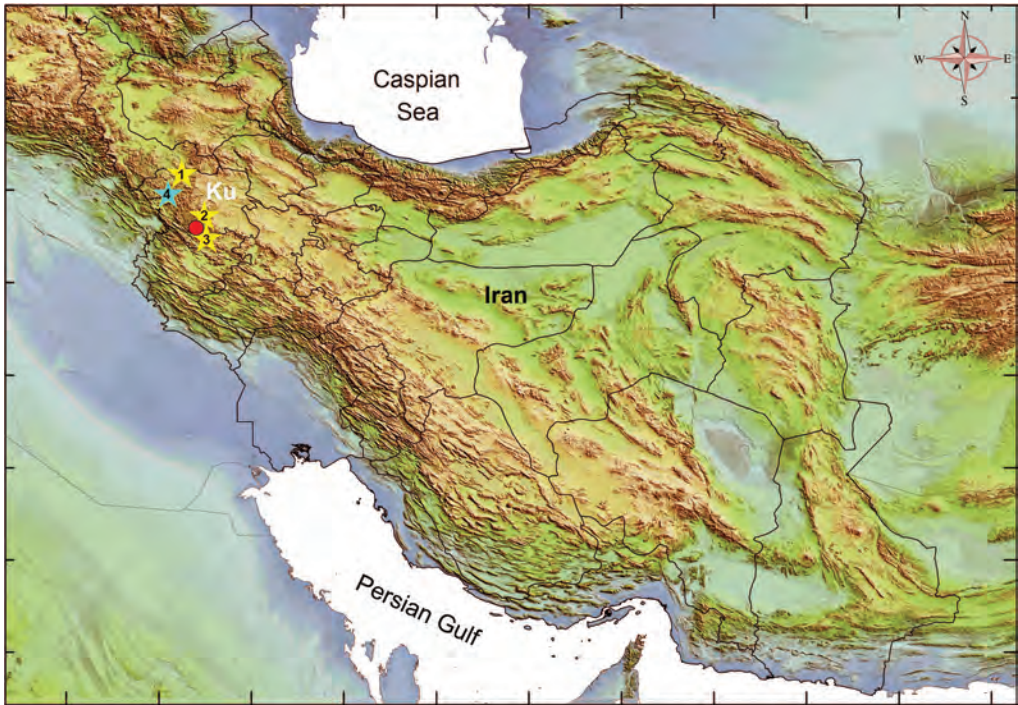


Figure 1. Map of Iran, showing the geographic location of the studied dams in Kurdistan province (Ku), Iran. 1 Shahid Kazemi dam, 2 Vahdat dam, 3 Gavoshan dam and of the Zarivar wildlife refuge/wetland (4). The red dot shows the location of the city of Sanandaj, capital of Kurdistan province. Map prepared using Global Mapper 18 (Global Mapper Software LLC, Olathe, Kansas) and Surfer 11 (Golden Software, LLC).

western border with Iraq, and the eastern border with Zanjan and Hamedan provinces. Elevation ranges from 900–3390 m asl. Annual precipitation ranges from 400 mm in the central highlands to more than 800 mm in the western mountainous areas (Ghasriani 1998). Kurdistan has a rich flora including 2110 species; c25% of plant species recorded throughout Iran (Maroufi 2012). Associated with society’s water demands, many artificial waterbodies of different sizes and purposes have been built in the province. Of these, the three largest dams in the province were selected (Figure 1): Vahdat dam: 35° 26’ N, 46° 59’ E, 1526 m asl, area 934 ha, Plate 1, 13 km north of Sanandaj (capital of Kurdistan province); Shahid Kazemi dam: 36° 21’ N, 46° 30’ E, 1402 m asl, area 3897 ha, Plate 2, 16 km east of Saqqez and lastly Gavoshan dam: 34° 57’ N, 47° 2’ E, 1486 m asl, area c1250 ha, Plate 3, 39.7 km south of Sanandaj.

Data collection

Bird surveys were carried out at the three dams between April 2015 and November 2017, the survey effort not being constant each month. Birds were identified in the field using various ornithological field guides (eg Porter *et al* 2004, Svensson *et al* 2009, Mansoori 2013). To identify threats, we gathered the views of local experts, birdwatchers and rangers, on probable threats to birds at the studied waterbodies. Also, the conservation status for each recorded species was provided using the Convention on International Trade in Endangered Species (CITES; www.cites.org) and the International Union for Conservation of Nature (IUCN; www.iucn.org) Red List of Threatened Species.



Plate 1. A view of Vahdat dam. © Loghman Maleki



Plate 2. A view of Shahid Kazemi dam. © Fatah Zarei



Plate 3. A view of Gavoshan dam. © Loghman Maleki



Plate 4. Eastern Zarivar wetland. © Fatah Zarei

RESULTS

During the fieldwork, a total of 78 bird species were recorded (Table 1). 45 species (57.7%) were waterbirds/waders. The most common threat at all three dams was drought, followed by human intrusion and disturbance including hunting, noise, motor vehicle traffic and overfishing. Recorded species at each site, their status for Kurdistan province (resident, migrant *etc*) and preferred habitats are presented in Table 1.

Vahdat dam

Seventy-five avian species were recorded at Vahdat dam. One species (Peregrine Falcon) is listed in Appendix I of CITES and six species (Eurasian Spoonbill, Eurasian Sparrowhawk, Common Buzzard, Little Owl, Lesser Kestrel and Common Kestrel) in Appendix II of CITES. In the IUCN Red List, seventy-one species (94.6%) are LC, two VU (Common Pochard, European Turtle Dove) and two NT (Ferruginous Duck, Northern Lapwing).

Shahid Kazemi dam

Sixty-four species were recorded. Two species are listed in Appendix I (Peregrine Falcon, Barbary Falcon) and four species in Appendix II of CITES (Eurasian Spoonbill, Eurasian Sparrowhawk, Common Buzzard, Little Owl). Sixty species (93.7%) are LC, two VU (Common Pochard, European Turtle Dove) and two NT (Ferruginous Duck, Northern Lapwing) in the IUCN Red List. Presence of numerous small islands behind this dam protect birds from the threats of natural predators. In addition, these small isolated areas provide a safe staging and breeding ground for many birds including gulls, ducks,

Table 1. Checklist and conservation status of birds at three dams in Kurdistan province. Status is based on Kaboli *et al* (2016), Khaleghizadeh *et al* (2017), our observations and personal communications: R = resident; S = summer visitor and breeding; s = summer visitor but not breeding; W = winter visitor; P = passage migrant. Nomenclature and sequence follow Khaleghizadeh *et al* (2017) and the Iran Bird Records Committee (<http://iranbirdrecords.ir/page/Iran%20Bird%20List>).

	Status (Kurdistan)	Dams			Preferred habitat	
		Vahdat dam	Shahid Kazemi dam	Gavoshan dam	Dam and river	Marginal wood land, farmland and hillsides
Greylag Goose <i>Anser anser</i>	W, P, S	*	*	*	*	
Whooper Swan <i>Cygnus cygnus</i>	W	*			*	
Common Shelduck <i>Tadorna tadorna</i>	W	*	*		*	
Ruddy Shelduck <i>Tadorna ferruginea</i>	W, P	*	*		*	
Gadwall <i>Anas strepera</i>	W	*	*	*	*	
Eurasian Wigeon <i>Anas penelope</i>	W	*			*	
Mallard <i>Anas platyrhynchos</i>	R, W, S	*	*	*	*	
Northern Shoveler <i>Anas clypeata</i>	W, P	*	*	*	*	
Garganey <i>Anas querquedula</i>	P	*	*	*	*	
Eurasian Teal <i>Anas crecca</i>	W, P	*	*	*	*	
Common Pochard <i>Aythya ferina</i>	W, P	*	*		*	
Ferruginous Duck <i>Aythya nyroca</i>	R	*	*		*	
Tufted Duck <i>Aythya fuligula</i>	W	*	*		*	
Smew <i>Mergellus albellus</i>	W	*	*		*	
Chukar Partridge <i>Alectoris chukar</i>	R	*	*	*		*
Little Grebe <i>Tachybaptus ruficollis</i>	R, W	*	*	*	*	
Great Crested Grebe <i>Podiceps cristatus</i>	S	*	*	*	*	
Greater Flamingo <i>Phoenicopterus roseus</i>	W, P	*	*		*	
White Stork <i>Ciconia ciconia</i>	S, s, P	*	*	*		*
Eurasian Spoonbill <i>Platalea leucorodia</i>	P	*	*		*	
Squacco Heron <i>Ardeola ralloides</i>	P	*	*		*	
Western Cattle Egret <i>Bubulcus ibis</i>	P	*	*	*	*	
Grey Heron <i>Ardea cinerea</i>	W, P	*	*	*	*	
Purple Heron <i>Ardea purpurea</i>	S, P	*	*	*	*	
Great Egret <i>Ardea alba</i>	W	*	*	*	*	
Little Egret <i>Egretta garzetta</i>	P, W, S	*	*	*	*	
Great White Pelican <i>Pelecanus onocrotalus</i>	W	*			*	
Great Cormorant <i>Phalacrocorax carbo</i>	W	*	*	*	*	
Western Osprey <i>Pandion haliaetus</i>	P			*		*
Eurasian Sparrowhawk <i>Accipiter nisus</i>	W	*	*	*		*
Western Marsh Harrier <i>Circus aeruginosus</i>	R, S			*		*
Common Buzzard <i>Buteo buteo</i>	W, P	*	*	*		*
Water Rail <i>Rallus aquaticus</i>	R, W, P	*	*	*	*	
Common Moorhen <i>Gallinula chloropus</i>	W, S, P	*	*	*	*	
Eurasian Coot <i>Fulica atra</i>	R, W, S, P	*	*	*	*	
Eurasian Stone-curlew <i>Burhinus oedicnemus</i>	S	*			*	
Black-winged Stilt <i>Himantopus himantopus</i>	S	*	*	*	*	

	Status (Kurdistan)	Dams			Preferred habitat	
		Vahdat dam	Shahid Kazemi dam	Gavoshan dam	Dam and river	Marginal wood land, farmland and hillsides
Pied Avocet <i>Recurvirostra avosetta</i>	S, P	*	*	*	*	
Northern Lapwing <i>Vanellus vanellus</i>	S, W, P	*	*	*		*
Little Ringed Plover <i>Charadrius dubius</i>	S	*	*	*	*	
Common Ringed Plover <i>Charadrius hiaticula</i>	P	*	*	*	*	
Common Snipe <i>Gallinago gallinago</i>	W, P	*	*	*	*	
Common Redshank <i>Tringa totanus</i>	W, S, P	*	*	*	*	
Common Greenshank <i>Tringa nebularia</i>	P, W	*	*	*	*	
Wood Sandpiper <i>Tringa glareola</i>	P	*	*	*	*	
Slender-billed Gull <i>Chroicocephalus genei</i>	W, P	*	*	*	*	
Black-headed Gull <i>Chroicocephalus ridibundus</i>	W, P	*	*	*	*	
Pallas's Gull <i>Ichthyaetus ichthyaetus</i>	W	*	*	*	*	
Caspian Gull <i>Larus cachinnans</i>	W	*	*		*	
Common Tern <i>Sterna hirundo</i>	P, S	*	*	*	*	
Black-bellied Sandgrouse <i>Pterocles orientalis</i>	R	*	*	*		*
Rock Dove <i>Columba livia</i>	R	*	*	*		*
Common Wood Pigeon <i>Columba palumbus</i>	S	*	*	*		*
European Turtle Dove <i>Streptopelia turtur</i>	S, P	*	*	*		*
Little Owl <i>Athene noctua</i>	R	*	*			*
Common Swift <i>Apus apus</i>	S	*	*			*
European Roller <i>Coracias garrulus</i>	S	*	*			*
European Bee-eater <i>Merops apiaster</i>	S, P	*	*			*
Eurasian Hoopoe <i>Upupa epops</i>	S, P	*	*			*
Middle Spotted Woodpecker <i>Dendrocopos medius</i>	R	*	*			*
Syrian Woodpecker <i>Dendrocopos syriacus</i>	R	*	*			*
Lesser Kestrel <i>Falco naumanni</i>	S	*				*
Common Kestrel <i>Falco tinnunculus</i>	R	*		*		*
Peregrine Falcon <i>Falco peregrinus</i>	P	*	*	*		*
Barbary Falcon <i>Falco pelegrinoides</i>	P		*	*		*
Eurasian Magpie <i>Pica pica</i>	R	*		*		*
Hooded Crow <i>Corvus cornix</i>	R	*		*		*
Crested Lark <i>Galerida cristata</i>	R	*	*	*		*
Sand Martin <i>Riparia riparia</i>	P, S	*	*	*	*	
Barn Swallow <i>Hirundo rustica</i>	S, P	*	*	*		*
Rosy Starling <i>Pastor roseus</i>	S, P	*		*		
Common Starling <i>Sturnus vulgaris</i>	R	*		*		*
House Sparrow <i>Passer domesticus</i>	R	*	*	*		*
Western Yellow Wagtail <i>Motacilla flava</i>	S	*	*	*		*
Grey Wagtail <i>Motacilla cinerea</i>	S, W	*	*	*		*
White Wagtail <i>Motacilla alba</i>	R, W	*	*	*		*
European Goldfinch <i>Carduelis carduelis</i>	S, W	*		*		*
Black-headed Bunting <i>Emberiza melanocephala</i>	S	*		*		*

cormorants and grebes. The high level of water entering this dam, and the presence of a considerable fish population (native and exotic) in this area (Esmaeili *et al* 2010) have created a suitable habitat for waterbirds.

Gavoshan dam

Fifty-six species were recorded. Two species are listed in Appendix I (Peregrine Falcon, Barbary Falcon) and five species in Appendix II of CITES (Western Osprey, Eurasian Sparrowhawk, Western Marsh Harrier, Common Buzzard, Common Kestrel). Fifty-four species (96.4%) are LC, one VU (European Turtle Dove) and one NT (Northern Lapwing) in the IUCN Red List. The fish fauna of Gavoshan dam is rich and taxonomically diverse (Ramin & Chehrzad 2008). This rich ichthyofauna and the riparian plant community provide food and shelter for many waterbirds.

DISCUSSION

Man-made waterbodies can act as new habitats for bird species and they are apparently good alternatives to natural wetlands and thus important for waterbird conservation (see Bellio *et al* 2009, Joolaei *et al* 2011, Zakaria & Rajpar 2013, Hamdi & Ismail-Hamdi 2014, Karakaş 2017). Numerous studies have provided checklists of waterbirds in Iran (eg Khaleghizadeh 2007b, Khalilipour *et al* 2007, Behrouzi-Rad 2009, Mansoori 2009, Tohidifar *et al* 2009, Tayefeh *et al* 2011, Tohidifar & Kaboli 2012, Tohidifar & Scott 2014) However, relatively few studies have been conducted on the avifauna of artificial waterbodies (eg Khaleghizadehi & Sehhatiasabet 2007, Nezami 2007, Scott 2007, Barati *et al* 2009, Joolaei *et al* 2011, Behrouzi-Rad & Maktabi 2015, Khani *et al* 2015).

Iran lies in a region of major zoogeographical interchange (Madjnoonian *et al* 2005, Roselaar & Aliabadian 2007, Coad 2017) and it serves as an important staging and wintering ground for many wetland birds (Nourani *et al* 2015). It is a country with 105 Important Bird Areas (IBAs) in the Middle East (Evans 1994, BirdLife International 2017) and has the highest richness of migratory species in the Middle East (Kirby *et al* 2008). The largest assembly of migratory waterbirds in Iran takes place at the south Caspian sea wetlands (Mansoori 2009), but many waterbirds are also found in suitable waterbodies across the country.

Zarivar wetland (Figure 1, Plates 4, 5) is the only natural wetland in Kurdistan province and supports a significant number of migratory waterbirds, native and rare species: 222 species including 131 terrestrial and 91 waterbirds, of which 11 of the 222 are considered as globally threatened species (3 VU and 8 NT) (Zarei *et al* 2017b). With strengthening of the drought at lake Urmia, in the north of Iran, it seems that the existence of Zarivar lake has significantly increased Zarivar's importance for staging and the wintering of migratory waterbirds of the African–Western Eurasian flyway (Zarei *et al* 2017, 2018).

With society's increasing water demands, numerous artificial waterbodies have been built in Kurdistan province, some for generating electricity, flood management and water storage and some for agriculture and aquaculture, including 34 major dams (nine operational, 11 under construction and 14 in the study stage) (IWPRMC; <http://daminfo.wrm.ir>).

The three artificial waterbodies studied in this research only support one-third (35%) of the total bird species recorded at Zarivar wetland. Zarivar supports a rich fauna and flora (see Zarei *et al* 2017) that is important for maintaining the biological and genetic diversity of the Iranian–Anatolian biogeographic province. Out of 66 breeding birds in the Zarivar wetland (Ahsani *et al* 2015), at least 34 (aquatic and semi-aquatic breeding species) are ecologically dependent on wetlands during the breeding season. The mid-



Plate 5. Land-use change and habitat destruction in the southern and southeastern parts of Zarivar wetland. © Fatah Zarei

winter waterbirds census data of Zarivar lake recorded 1550 Slender-billed Gulls in 1993 and 1500 Ruddy Shelducks in 1994, the number in each case exceeds 1% of the wintering population of their related flyway. Mansoori (1995) stated that Zarivar regularly supports over 1% of the regional population of Tufted Ducks. Zarivar harboured two breeding birds, Ferruginous Duck and Northern Lapwing (Zarei *et al* 2017), which are currently listed as NT in the IUCN Red List. Thus, though these man-made water sources do not have the functionality of natural wetlands (also see Tourenq *et al* 2001), they can reduce the effects of habitat loss and act as alternative habitats for birds (Karakas 2017).

This study and previous research (eg Khaleghizadehi & Sehhatisabet 2007, Nezami 2007, Scott 2007, Barati *et al* 2009, Joolaei *et al* 2011, Behrouzi-Rad & Maktabi 2015, Khani *et al* 2015) showed that artificial structures related to the water industry may be alternative feeding, staging and wintering grounds and can provide suitable habitats for many bird species. Some artificial waterbodies were included in the list of IBAs in Iran as they provide shelter, food and nest sites for significant numbers of bird species (eg Abbas-abad, Dez, Dorudzan, Lashgarak, Latian and Voshmiger dams; BirdLife International 2017). Therefore, beside the protection of natural wetlands, management of these dams is also important for conservation of bird species, especially waterbirds.

However as noted by Bellio *et al* (2009), artificial wetlands may perform some but not all the functions of natural wetlands. The negative ecological consequences of large dams are numerous, including direct impacts on biological, chemical and physical properties of rivers and riparian environments. Dams block fish migration (Liermann *et al* 2012), and in some cases completely separate spawning from rearing grounds or impede the function of these grounds by changing water depths, currents, and deposition patterns, leading to senescence prior to reproduction (Kruk & Penczak 2003, McLaughlin *et al* 2006). Another significant and obvious impact is the transformation upstream of the dam from a free-flowing river ecosystem to an artificial slack-water reservoir habitat (Nilsson *et al* 2005). Changes in temperature, chemical composition, dissolved oxygen levels and the physical properties of a reservoir are often not suitable to the aquatic plants and animals

that evolved with a given river system. Indeed, dams often host non-native and invasive species (eg snails, algae, crayfish and predatory fish) that further undermine the river's natural communities of plants and animals (Johnson *et al* 2008). Large dams have led to the extinction of many fish and other aquatic species, which leads to biotic homogenization (Rahel 2000, Poff *et al* 2007), the disappearance of birds in floodplains (Kingsford 2000), huge losses of forest, wetland and farmland, and many other unmitigable impacts. Therefore, it is better to manage and maintain natural wetlands.

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